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Secretary's Department
Reserve Bank of Australia
GPO Box 3947
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Bulletin enquiries
Media and Communications
Tel: +61 2 9551 8111
Facsimile: +61 2 9551 8033
Email: rbainfo@rba.gov.au

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The Transmission of Monetary Policy: How Does It Work?

Tim Atkin and Gianni La Cava*

The transmission of monetary policy refers to how changes to the cash rate affect economic activity and inflation. This article outlines the stages of transmission and the channels through which it occurs. The effects of monetary policy are hard to quantify, though the housing market seems particularly important to the transmission process in Australia. A lower cash rate stimulates household spending and housing investment, partly through increasing the wealth and cash flow of households. A lower cash rate also tends to result in a depreciation of the exchange rate, leading to higher net exports and imported inflation.

The Reserve Bank conducts monetary policy in Australia to achieve its objectives of price stability, full employment, and the economic prosperity and welfare of the Australian people. In support of this, the Bank has an inflation target that seeks to keep inflation between 2 and 3 per cent, on average, over time. The cash rate is the 'instrument' used to influence inflation in order to achieve this flexible medium-term target.[1] The transmission of monetary policy refers to how a change to the cash rate affects the interest rates that households and businesses face and, in turn, economic activity, employment and inflation. Understanding this transmission process helps the Reserve Bank assess current and future economic developments, and helps the Reserve Bank Board decide on the setting of monetary policy. It is also a helpful framework for describing to a wider audience how changes to monetary policy flow through to economic activity, employment and inflation.

A simple picture of the transmission of monetary policy is shown in Figure 1. When the Reserve Bank lowers the cash rate, this causes other interest rates in the economy to fall. Lower interest rates stimulate spending. Businesses respond to this by increasing how much they produce, leading to an increase in economic activity and employment. If the increase in demand is strong enough it can push up prices, and lead to higher inflation.

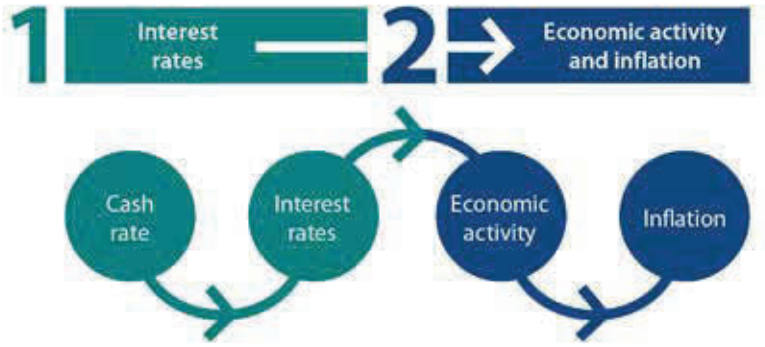
While this is a simple textbook description, the effects of monetary policy can be also seen in practice. Some estimates from work at the Reserve Bank suggest that lowering the cash rate by 100 basis points leads to economic activity, as measured by GDP, being ½ to ¾ percentage point higher than it otherwise would be over the course of two years. Inflation typically rises by a bit less than ¼ percentage point per year over two to three years.[2] More generally, estimates suggest that it takes between one and

* At the time of writing, the authors were in the Public Access & Education section and Economic Analysis Department, respectively. This article has an associated 'Explainer' as part of the Reserve Bank's education resources, which is specifically targeted at senior high school students.

1 The implementation of monetary policy and how the Reserve Bank maintains the cash rate at its target level is discussed in Baker and Jacobs (2010).

2 These estimates come from a macroeconomic model based on Rees, Smith and Hall (2016). Brischetto and Voss (1999), Dungey and Pagan (2009) and Berkelmans (2005) also find that unexpected changes to the cash rate affect output and inflation.

Figure 1: The Transmission of Monetary Policy



Source: RBA

two years for changes in the cash rate to have their maximum effect on economic activity and inflation.

The transmission of monetary policy can be simplified into two stages:

1. Changes to the cash rate affect other interest rates in the economy.
2. Changes in these interest rates affect economic activity and inflation.

This article outlines these two stages and discusses the main channels through which monetary policy affects the Australian economy.[3] It focuses on the basic effects of a reduction in interest rates (an 'easing' of monetary policy).[4] An increase in interest rates (a 'tightening' of monetary policy) has the opposite effect. In reality, these effects are complex, and can vary over time, so it is not possible to know exactly how long they will take to play out, or exactly how large they will be. The size of the effects will depend on factors such as whether financial markets expected the change and where they expect interest rates will be in future.

The transmission of monetary policy is also affected by inflation expectations. Households' and businesses' expectations about future inflation can affect their current behaviour.[5] For example, if workers expect prices to rise in the future, they might ask for larger wage increases to maintain their purchasing power. Similarly, if businesses expect prices in the economy to rise, they might raise their prices now, depending on the outlook for demand and competitive conditions in the industry. In both of these examples, higher expectations for inflation can lead to higher actual inflation.

So that higher expected inflation does not lead to ever-higher actual inflation, it is important for the central bank to have a credible monetary policy framework. This can help anchor inflation expectations, which should increase the confidence of households and businesses in making saving, spending and investment decisions because it reduces uncertainty about the economy.

3 The perspectives on the transmission of monetary policy in this article are similar to those internationally. For more discussion of the transmission of monetary policy, see Mishkin (1996) and George *et al* (1999).

4 The 'stance of monetary policy' (the level of the cash rate relative to a 'neutral' interest rate) is also important. The neutral rate can be thought of as the rate required to bring about full employment and stable inflation over the medium term. When the cash rate is below the neutral rate, then monetary policy is exerting an expansionary influence on the economy, and if the cash rate is above the neutral rate, then monetary policy is exerting a contractionary influence on the economy. While the focus is often on the change in the cash rate, it is also important to understand how far the cash rate is from the neutral rate. However, because the neutral rate cannot be directly observed this is difficult in practice. For more information, see McCririck and Rees (2017).

5 For more information on measures of inflation expectations in Australia, see Moore (2016).

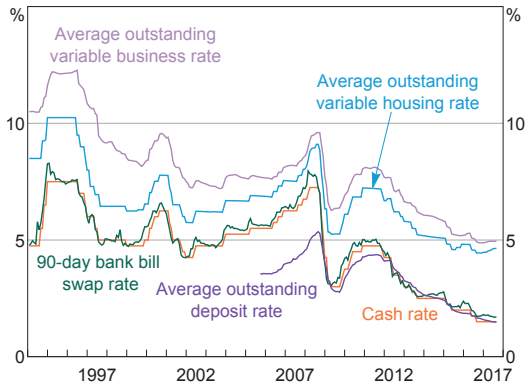
The First Stage of Monetary Policy Transmission

The first stage of monetary policy transmission refers to how changes to the cash rate affect other interest rates in the economy. The cash rate is the market interest rate for overnight loans between financial institutions. It serves as a benchmark for interest rates at which funds can be lent or borrowed in financial markets, including for different sources of bank funding, such as wholesale debt and deposits. Through its effect on the funding costs of financial institutions, the cash rate has a strong influence over the lending and deposit rates that households and businesses face. As a result, the cash rate and other interest rates have moved in broadly similar ways since at least the early 1990s (Graph 1).

The extent to which changes in the cash rate flow through to other interest rates is often referred to as 'interest rate pass-through'. While the cash rate acts as an anchor for other interest rates, it is not the only determinant. Other factors such as conditions in financial markets, changes in competition, and risks associated with different types of loans also influence interest rates. As a result, the degree of interest rate pass-through can vary over time. For instance, since the global financial crisis, banks' funding costs have risen relative to the cash rate because of a reassessment of risk in financial markets and greater competition among banks for different sources of funding (Atkin and Cheung 2017). Over the same period, banks have increased their lending rates relative to the cash rate (Graph 2).[6]

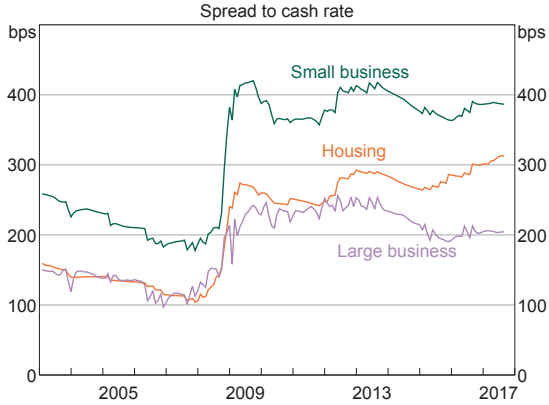
The speed of interest rate pass-through to households and businesses depends on whether loans and deposits have variable or fixed interest rates. Loans and deposits that have variable interest rates typically respond very quickly to changes in the cash rate. In Australia, variable-rate loans account for around four-fifths of housing loans and roughly two-thirds of business loans. As a result, a large share of loans can be influenced by a change in the cash rate relatively quickly. In contrast, interest rates on existing fixed-rate loans are not affected by a change in the cash rate. Interest rates on new fixed-rate loans depend on the expected path of interest rates. As a result, an anticipated change in the cash rate would not typically be passed through to new fixed-rate loans.

Graph 1
Interest Rates



Sources: APRA; Australia Branch; Bloomberg; Financial reports; RBA; UBS AG

Graph 2
Lending Rates
Spread to cash rate



Sources: APRA; Australia Branch; Bloomberg; Financial reports; RBA; UBS AG

6 For more information on developments in banks' funding costs and lending rates, see Cheung (2017).

While interest rate pass-through varies over time, this does not necessarily mean that monetary policy is any more or less effective in influencing the economy. The Reserve Bank Board takes developments in funding costs and lending rates into account when determining the appropriate setting of the cash rate (Lowe 2012). The Board aims to ensure that interest rates faced by households and businesses are consistent with the desired stance of monetary policy. For example, if the Board expects that a given reduction in the cash rate will not be matched by an equivalent reduction in interest rates, then it can opt for a larger reduction in the cash rate as required to achieve the desired monetary policy setting.

The Second Stage of Monetary Policy Transmission

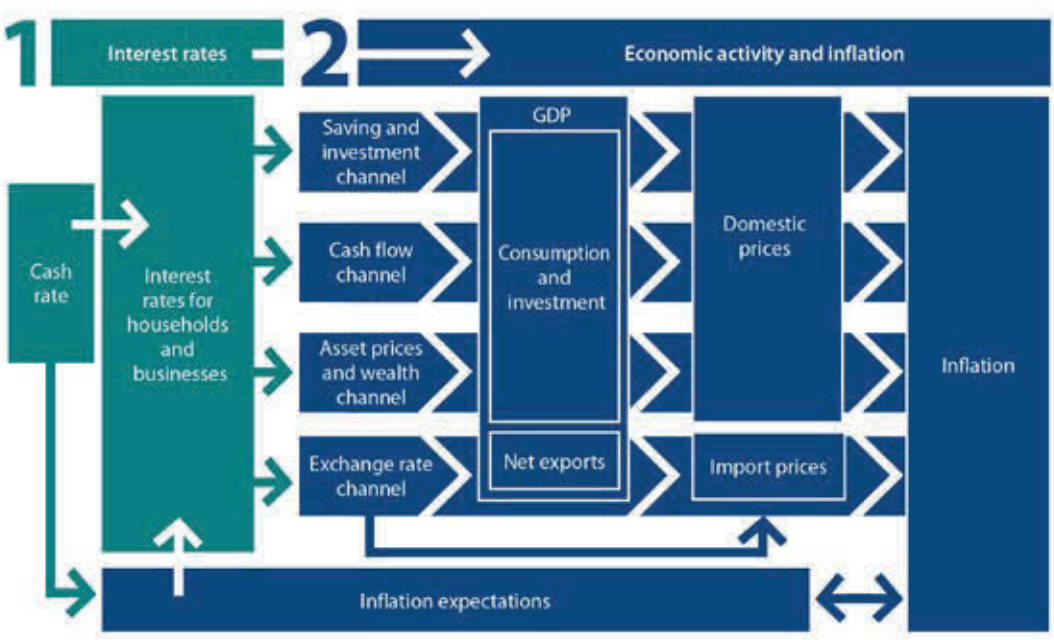
The second stage of transmission refers to how changes to interest rates influence economic activity, employment and inflation. This occurs through a range of different channels (Figure 2). The main differences between the channels are in how interest rates influence economic activity.[7] In contrast, the links between economic activity and inflation are basically the same for all the channels.

The saving and investment channel

Interest rates influence economic activity by changing the incentives for households and businesses to save rather than consume or invest:

- A reduction in interest rates reduces the incentives for households to save and can encourage them to borrow. Because of this, there are greater incentives for households to spend now rather than later. In particular, it can stimulate spending on durable goods, such as cars and household appliances, and housing. As a result, lower interest rates should be associated with higher household consumption and housing investment.

Figure 2: Channels of the Transmission of Monetary Policy



Source: RBA

7 One exception is the exchange rate channel where there is a direct effect on inflation.

- Similarly, lower interest rates encourage businesses to borrow and increase their spending on investment (in capital assets like new equipment or buildings). As interest rates fall, the cost of borrowing declines, leading to higher expected returns on investment projects. This can help to justify going ahead with these projects. Overall, lower interest rates should be associated with an increase in business investment.

In modern macroeconomic textbooks this channel is known as the 'inter-temporal substitution' channel, as households and businesses substitute between spending now and in the future. It is a key channel of monetary transmission in many modern macroeconomic models. Despite this, there is mixed evidence as to whether a strong relationship between lower interest rates and higher consumption growth actually exists. Lawson and Rees (2008) find that housing investment and business investment in machinery and equipment are actually the most sensitive components of GDP expenditure to changes in monetary policy. But this research does not provide specific evidence for any particular channel of monetary transmission.

The cash flow channel

Lower interest rates influence the spending decisions of households and businesses by reducing the amount of interest they pay on debt and the interest they receive on deposits. This affects how much disposable income (or 'cash flow') they have available to spend. This is commonly referred to as the cash flow channel of monetary policy.[8] The importance of this channel is often emphasised by policymakers and the news media.

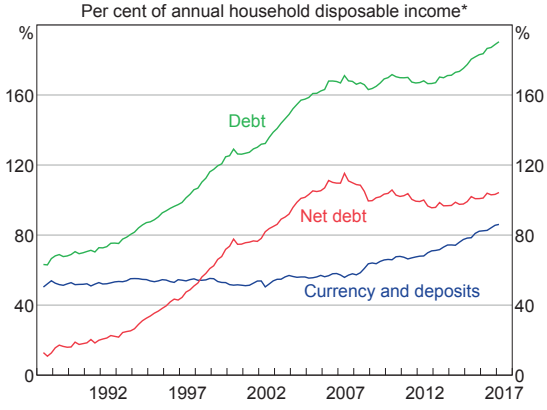
8 The cash flow channel is described here in terms of the direct effect of interest rate changes on income from interest-sensitive assets and debt. There is research indicating that interest rate changes can also have indirect cash flow effects by influencing other sources of income, such as wages. For example, see Auclert (2017).

The cash flow channel works in opposite directions for 'borrowers' (those with more variable-rate debt than deposits) and 'lenders' (those with more variable-rate deposits than debt).

- For *borrowers*, lower lending rates can reduce the repayments they must make, assuming they have variable-rate debt. This can result in higher disposable income, and households may choose to spend more, particularly if income was previously a constraint on their spending.
- For *lenders*, lower rates on deposits (or other interest-earning assets such as bonds) reduce their interest income; facing a reduction in disposable income, they may choose to cut their spending.

Recent research points to evidence of the cash flow channel for both borrowing and lending households (La Cava, Hughson and Kaplan 2016). However, the cash flow channel is stronger for borrowers for two reasons. First, the Australian household sector as a whole is a net debtor. The average borrower holds two to three times as much variable-rate debt as the average lender holds in interest-earning assets (Graph 3). As a result, lower interest rates lead to higher cash flow in the aggregate economy.

Graph 3
Household Debt and Deposits
Per cent of annual household disposable income*



* Household sector includes unincorporated enterprises; disposable income is before the deduction of interest payments
Sources: ABS; RBA

Second, the spending of borrowers is more sensitive to changes in cash flow than the spending of lenders. This is because borrowers are more likely than lenders to be constrained by the amount of cash they have available. Taking the effects on borrowers and lenders together, one set of estimates suggests that lowering the cash rate by 100 basis points increases total household disposable income by around 0.9 per cent, which, in turn, increases aggregate household spending by about 0.2 per cent through the cash flow channel (Hughson *et al* 2016).

The asset prices and wealth channel

This channel recognises that asset prices and wealth are key determinants of household and business spending. Fluctuations in asset prices not only affect households' and businesses' overall wealth (the wealth channel), but also their borrowing capacity (the balance sheet channel).[9]

- The wealth channel: A reduction in interest rates stimulates demand for assets, such as equities and housing, raising the prices of these assets. This occurs because the reduction in interest rates increases the present discounted value of the asset's future income flows. An increase in asset prices increases the wealth of households and businesses. This can lead to more spending for households and businesses as they generally spend some share of any increase in their wealth; this is often referred to as the wealth effect.
- The balance sheet channel: A reduction in interest rates can increase the borrowing capacity of households and businesses. This is because lower interest rates are associated with higher asset prices. In turn, higher asset prices increase the equity (or collateral) of existing assets that a bank can lend against. As a result, borrowers with existing assets may be able to borrow more, which can lead to more spending, particularly if they were previously constrained by how much they could borrow.[10]

A key difference between the wealth channel and balance sheet channel is that changes in wealth potentially affect all households and businesses, while changes in borrowing capacity mainly affect the spending of those that are currently constrained by how much they can borrow. However, this does not imply that the balance sheet channel is weaker than the wealth channel; the spending of constrained borrowers is typically very sensitive to changes in asset prices.

A range of Australian studies have looked at this channel for household spending. There is general consensus that lower interest rates lead to higher asset prices, and that higher wealth is associated with more household spending. In particular, several studies find evidence that higher housing prices are associated with more spending (La Cava, Windsor and Hansen 2015; Windsor, Finlay and Jääskelä 2015). Younger households also seem to be more sensitive than older households to changes in housing wealth, which suggests that being constrained by how much you can borrow matters for spending (Windsor, Finlay and Jääskelä 2015). This result is more consistent with the balance sheet channel than the wealth channel, and highlights how difficult it can be to disentangle the channels in practice.

There is also extensive evidence from overseas that businesses balance sheets matter for the transmission of monetary policy, and there is some Australian evidence too. For example,

9 The balance sheet and cash flow channels of monetary policy are sometimes referred to under a broader 'credit channel' of monetary policy. For example, see Mishkin (1996).

10 This section focuses on the balance sheets of borrowers. But changes in interest rates can also affect the balance sheets of lending institutions, such as banks, affecting the supply of credit and economic activity ('bank lending channel'). There are currently few Australian studies that have explored these bank lending channels. The limited evidence suggests that these channels are not particularly strong (Suzuki 2004).

Jacobs and Rayner (2012) show that an unexpected decrease in the cash rate results in fewer businesses reporting difficulties obtaining bank funding. La Cava (2005) finds that cash flow matters to business investment decisions, suggesting that monetary policy can also affect business investment through this channel.

The exchange rate channel

Interest rates influence the exchange rate, which can have a notable effect on economic activity and inflation in a small open economy such as Australia. Typically this channel is stronger for sectors that are export-oriented or exposed to competition from imported goods and services. The exchange rate also has a direct effect on inflation.

- A reduction in the cash rate lowers interest rates in Australia relative to those in the rest of the world. This reduces the returns on Australian assets (relative to foreign assets), which can result in lower demand for Australian dollars as investors shift their funds into foreign assets. As a result, a reduction in the cash rate should be associated with a depreciation in the exchange rate.
- A depreciation in the exchange rate increases the competitiveness of domestic producers in foreign markets by reducing the prices of their goods and services compared with foreign competitors. This can lead to a rise in export volumes.[11] A depreciation in the exchange rate can also flow through to higher demand for domestically produced goods and services as Australians substitute away from more expensive imports. This can lead to lower import volumes. As a result, lower interest rates should be associated with an increase in export volumes and a reduction in import volumes (or higher net exports).
- A depreciation in the exchange rate has a direct effect on inflation through higher import prices. For example, a depreciation of the Australian dollar typically raises the price of imported consumer goods, such as cars, computers and TVs. It can also indirectly increase inflation as it may allow domestic firms that produce similar items to increase their margins. An increase in import prices also raises the cost of imported inputs, such as imported capital and intermediate goods, used in production. Depending on how much competition there is in different sectors, businesses may pass on these higher costs to retail prices, which can indirectly feed through to higher inflation. As a result, a reduction in the cash rate should be associated with higher imported inflation.

One set of empirical estimates for Australia suggests that the effect of interest rates on the exchange rate is relatively small. An unexpected 25 basis point decrease in the cash rate is estimated to lead to a ¼ to ½ per cent depreciation of the exchange rate.[12]

There is also evidence that changes in the exchange rate affect exports and imports. Estimates suggest that a 10 per cent depreciation lifts export volumes by 3 per cent while reducing import volumes by 4 per cent within two years. The resulting increase in net exports leads to higher economic activity.[13]

With regard to the direct effect of the exchange rate on inflation, estimates suggest that a depreciation of the exchange rate leads to a large and immediate increase in import prices.

11 If domestic producers are unable to fully satisfy the higher demand, they may also increase their prices.

12 These estimates come from a macroeconomic model based on Rees, Smith and Hall (2016).

13 For more information on the sensitivity of trade to the exchange rate, see Cole and Nightingale (2016).

However, the subsequent effect of higher import prices on the final prices that households pay is smaller and occurs more slowly.[14]

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14 The timing and extent of this effect is uncertain. The effect of the exchange rate change on retail prices may depend on the currency in which imports are invoiced, may be absorbed in importers' or retailers' margins in response to competitive pressures, or may be deferred where importers or retailers have contracted prices in advance. Importantly, the currency in which imports are invoiced can affect the transmission process. In particular, Australian dollar invoicing reduces the effect of exchange rate movements on importers' costs, and so the prices charged to consumers are generally less responsive to changes in the exchange rate. For more information on the exchange rate and pass-through to consumer prices, see Chung, Kohler and Lewis (2011) and Gillitzer and Moore (2016).

The Neutral Interest Rate

Rachael McCririck and Daniel Rees*

Central banks monitor the neutral interest rate for a number of reasons, a key one being that it provides a benchmark for assessing the stance of monetary policy. This article describes the determinants of the neutral interest rate and discusses its trends in Australia over recent decades. We estimate that Australia's neutral interest rate has declined by 150 basis points since 2007 and is currently around 1 per cent. However, because we cannot observe the neutral rate directly, there is considerable uncertainty around these estimates. The fall over the past decade is largely attributable to a decline in the economy's potential growth rate and an increase in risk aversion of households and firms.

The Neutral Interest Rate and its Relevance for Monetary Policy

Real policy interest rates in Australia and other developed economies have declined over recent decades. Cyclical factors have clearly played a role, particularly in recent years. But even after accounting for cyclical influences, the real policy rate required to bring about full employment and stable inflation over the medium run – known as the neutral interest rate – appears to be lower now than in the past.[1]

Central banks, including the Reserve Bank of Australia (RBA), monitor the neutral interest rate for a number of reasons. The neutral interest rate provides a benchmark for assessing the current stance of monetary policy.[2] If the real policy rate – that is, the cash rate less expected inflation – is below the neutral rate, then monetary policy is exerting an expansionary influence on the economy. If the real policy rate is above the neutral rate, then monetary policy is exerting a contractionary influence on the economy. Estimates of the neutral interest rate can also be useful for understanding issues such as whether monetary policy has become more or less effective over time.[3]

In this article we describe the determinants of the neutral interest rate, set out alternative methods for inferring the level of the neutral

* The authors are from Economic Analysis Department, and would like to thank Richard Finlay and Jonathan Hambur for their contributions to this article.

1 The term 'neutral interest rate' sometimes refers to the real short-term interest rate that will bring about full employment at any point in time, given the presence of these transitory business cycle influences. On average, over a normal business cycle, this interest rate will coincide with the medium-run concept of the neutral interest rate described above, but it will exhibit greater volatility because it will also adjust in response to transitory economic developments.

2 Strictly speaking, the relevant interest rate for policy decisions is the neutral nominal interest rate, which is equal to the neutral interest rate plus expected inflation. If medium-run inflation expectations are stable – a reasonable assumption for Australia over recent decades – then a change in the neutral interest rate will translate one-for-one into a change in the neutral nominal interest rate, and hence the policy rate over the medium run.

3 If monetary policy has become less effective, then the policy rate will need to be lower during an easing phase and higher in a tightening phase to achieve the goals of monetary policy. By contrast, if the neutral rate has fallen, interest rates will be lower than in the past in both phases.

interest rate in Australia, and discuss factors that may have contributed to changes in the neutral interest rate over time.

Determinants of the Neutral Interest Rate

In a small open economy like Australia, both domestic and international developments influence the neutral interest rate. To understand the determinants of the neutral interest rate, however, it is clearest to consider first the case of a closed economy that has neither trade nor financial dealings with the rest of the world.

In a closed economy, all investment must be funded by domestic saving. The neutral interest rate equates saving and investment at the level of income that is consistent with full employment and stable inflation. Accordingly, most explanations of the neutral interest rate start with factors that influence the amount of saving or investment in the economy. Developments that increase saving will tend to lower the neutral interest rate; developments that increase investment will tend to raise the neutral interest rate.

Many determinants of savings and investment, and therefore the neutral interest rate, tend to evolve quite slowly and hence we should expect the neutral interest rate to change only gradually. One example is the economy's potential growth rate. In an economy with a high potential growth rate, perhaps because of strong productivity or population growth, expectations of increases in future demand create a strong incentive for firms to invest. At the same time, the prospect of future income growth reduces the incentives of households to save. Both of these forces will tend to raise the neutral interest rate.

Besides population growth, another aspect of demography that can influence the neutral interest rate is the age structure of the population. An increase in the share of the population who are of working age – who typically have a higher propensity to save than the young or old – would be expected to lower the neutral interest rate. Similarly, because high-income earners tend to have a greater propensity to save, an increase in income inequality could also lower the neutral interest rate.

Institutional arrangements and regulatory changes can also influence the neutral interest rate. For example, a financial liberalisation that relaxes household borrowing constraints could temporarily reduce saving, and raise the neutral interest rate, as households transition to a higher steady-state level of leverage. A shift from a largely public pension scheme to a model where individuals self-insure against longevity risk may entail a higher saving rate if individuals are unable to take advantage of private risk pooling. This would lower the neutral interest rate.

Another influence on the neutral rate that has attracted attention in recent times is the risk appetite of firms and households and the way risk is priced into market interest rates. This influence can move more rapidly than other determinants. When risk aversion rises, for any given cost of borrowing, firms are less willing to make long-term investments with an uncertain return.[4] At the same time, households are less willing to borrow against future income to fund current consumption. These developments will lower the neutral interest rate. Greater risk aversion is also likely to coincide with an increase in investor preferences for safe assets. One consequence of this is a widening in the spreads between the policy rate and the market

4 It is difficult to distinguish between increases in risk aversion and increases in subjective perceptions of risk. Both are likely to have increased during the global financial crisis (Hoffmann, Post and Pennings 2013). Throughout this article we use the generic term risk aversion to refer to a reduction in risk-taking by households and firms, regardless of whether this reflects true risk aversion or the perception of increased risk.

interest rates that determine the behaviour of households and firms. A given market interest rate will correspond to a lower policy rate if spreads widen. Given that the neutral interest rate is defined in terms of the real policy rate, this will also lower the neutral interest rate.

In an open economy, where capital can move reasonably freely across borders, global interest rates will influence domestic interest rates. This means that, over the medium run, trends in overseas productivity growth, demographics and risk appetite will affect the neutral interest rate in Australia. It also means that changes in the domestic determinants described above will affect Australia's neutral rate by less than they would if Australia were a closed economy. As an example, consider an increase in trend productivity growth in Australia. This would be expected to raise the Australian neutral interest rate and investment returns more broadly. The higher returns on offer will increase the attractiveness of Australia for foreign investors. This, in turn, will lead to greater capital inflow and a wider current account deficit. At the same time, greater capital inflow will cause an appreciation of the exchange rate, reducing the international competitiveness of Australian firms and putting downward pressure on investment returns in Australia. In this way, an increase in productivity growth in an open economy will lead to a smaller increase in the neutral interest rate than in a closed economy, together with movements in the current account and the exchange rate.

Empirical estimates point to similar trends in neutral interest rates across advanced economies. This suggests that for small open economies, international influences play a large, perhaps dominant, role. On the other hand, trends in determinants of the neutral interest rate, such as demographics and productivity growth, tend to be highly correlated across advanced economies. This makes it hard to distinguish between international influences and domestic influences that are common across economies.[5]

Estimating the Neutral Interest Rate for Australia

The neutral interest rate is not directly observable, so we must infer its value from the behaviour of market interest rates and other economic variables. We describe the results from two methods of estimating the neutral interest rate: a model-based approach and one that estimates the neutral interest rate based on financial market prices.

Model-based estimates

Our first measure of the neutral interest rate infers its value from the behaviour of interest rates, economic activity, the unemployment rate and inflation. Other things being equal, when the real policy rate is above its neutral level for a period of time, monetary policy should be exerting a contractionary influence on the economy. That is, the unemployment rate should rise, and the inflation rate should fall. Similarly, when the real interest rate is below its neutral level, monetary policy should be exerting an expansionary influence and the pace of economic activity should pick up.

To move beyond this stylised description of how monetary policy works and derive quantitative estimates of the neutral interest rate, we require a model that describes how real interest rates affect the economy and a method to update our estimates of the neutral rate using observable information from the model.

5 In some cases, the distinction between domestic and overseas influences is unclear. For example, overseas developments are likely to affect productivity growth and borrowing and lending spreads in Australia.

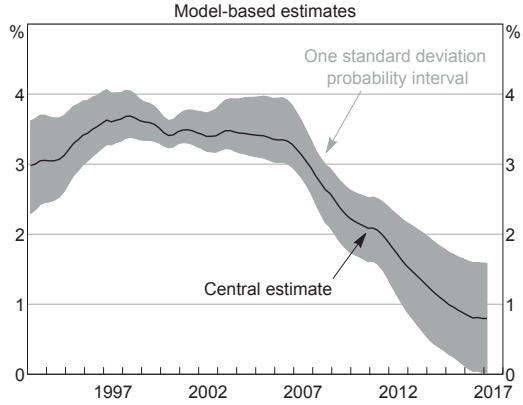
Our model consists of three key equations (for more details, see Appendix A).[6] The first is an investment-savings (IS) curve that relates the output gap – the level of real GDP relative to its potential level – to lagged values of the output gap and the gap between the real policy rate and the neutral interest rate. The second is an Okun's law relationship that maps the output gap to the gap between the unemployment rate and the non-accelerating inflation rate of unemployment (NAIRU). The third is a Philips curve that translates deviations of the unemployment rate from the NAIRU into inflation.

In addition, the model features equations for unobserved variables, including the trend growth rate of potential output, the NAIRU and the neutral interest rate. The equation for the neutral interest rate links its value to the trend growth rate of output plus an unexplained component that accounts for all other factors that influence the neutral interest rate, such as risk aversion or demography. We do not model these additional determinants of the neutral interest rate explicitly. The baseline assumption is that they will stay constant in the next period.

We use a statistical technique known as the Kalman filter to determine how much to revise our estimates of the neutral interest rate in response to surprises in observable variables. For example, if the level of output is lower than the model would have expected, a possible explanation is that the stance of monetary policy is less expansionary than previously thought.[7] In response, we might lower our estimate of the neutral interest rate.

Graph 1 presents the model's estimate of the neutral interest rate, as well as an indication of the degree of uncertainty around these estimates. The solid line shows the central estimate – the model's best guess of the neutral interest rate at each point in time. The shaded area shows the one standard deviation probability interval around the central estimate. The model suggests that there is a 68 per cent probability that the neutral interest rate lies within the shaded area.[8]

Graph 1
Neutral Interest Rate
Model-based estimates



Source: RBA

The estimated neutral interest rate was fairly stable at around 3½ per cent from the early 1990s until 2007. Since then, the estimated neutral interest rate has declined steadily and is currently around 1 per cent. Although there is some uncertainty around the precise level of the neutral interest rate at any point in time, even the upper bounds of the confidence bands are currently below 2 per cent.[9] That is, the model points to a high probability that the neutral interest rate has declined over the past decade.

6 Our model is similar to that used by Holston, Laubach and Williams (2016) and Kiley (2015).

7 Most discrepancies between the model and the data do not reflect shifts in the neutral interest rate. For example, economic activity may be weaker than the model expects because of a transitory dip in consumer expenditure or bad weather that reduces farm production. By using information from multiple data series, the model is able to distinguish between shifts in aggregate demand or supply and movements in the neutral interest rate.

8 The probability interval incorporates uncertainty about both model parameters and shocks.

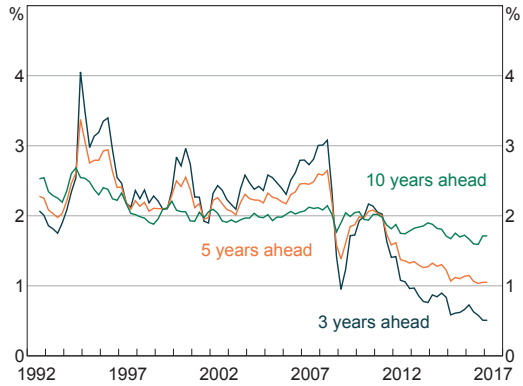
9 This is also true if we consider the two standard deviation probability interval.

A concern with any model-based estimate is that it may be sensitive to the assumptions that went into constructing the model. To gauge the robustness of our results, we also estimated two alternative models. The first eliminates the Okun's law relationship from the model, as is common in models used to estimate the neutral interest rate in other advanced economies. The second includes import prices as an additional observable variable influencing inflation, as is common in other empirical models of inflation in Australia. Reassuringly, the neutral interest rate estimates from these alternative models align closely with the estimates from the baseline model. We use estimates from all three models in the model-combination exercise described below.

An alternative approach to estimate the neutral interest rate is to use expectations of future short-term real interest rates implied by financial market pricing on the assumption that real interest rates should return to their neutral level over time as the economy returns to equilibrium.[10] Graph 2 shows three alternative estimates of the neutral interest rate, which are the expected short-term real interest rates three, five and 10 years in the future as implied by yields on inflation-indexed government bonds. Financial market estimates of the neutral interest rate are generally lower than model-based estimates for the 1990s and 2000s. However, they also point to a large fall in the neutral interest rate since the mid 2000s and estimate it currently to be around ½ to 1½ per cent, which is consistent with the model-based estimates.

All methods of estimating the neutral interest rate have shortcomings and choosing the most appropriate measure is, to a large extent, a matter of judgement.[11] A pragmatic approach is to maintain and monitor a range of indicators. To the extent that alternative measures produce similar estimates of the level and changes in the neutral interest rate, we may have some confidence in the message they provide.

Graph 2
Expected Real Cash Rate



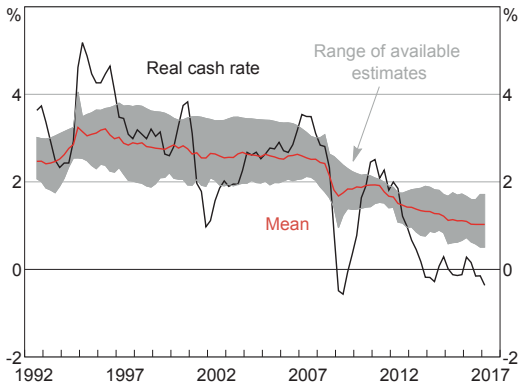
Source: RBA

Graph 3 compares the *ex post* real cash rate – the cash rate deflated by year-ended trimmed mean inflation – to the different estimates of the neutral interest rate described above. The line labelled 'mean' is the average of the available estimates at each point in time. This is our preferred estimate of the neutral interest rate. The shaded area shows the range between the highest and lowest estimates. The average of the estimates declined from 3 per cent in the early 1990s to be around 1 per cent currently. Most of the decline has occurred since 2007. The range of estimates currently spans ½ per cent to 1½ per cent. The highest estimate of the neutral interest rate at present is below the lowest estimate prior to 2007. Although we are uncertain about the level of the neutral interest rate at any point in

10 In theory, financial market measures should incorporate all available information about movements in the neutral interest rates. A problem with these measures is that financial market interest rates may incorporate time-varying term premia, and the estimates may be sensitive to the method used to take account of these term premia.

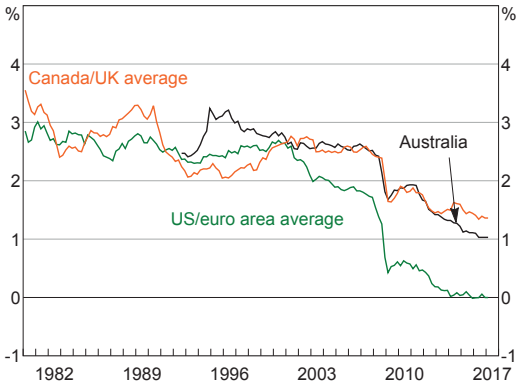
11 For example, model-based estimates may be sensitive to the assumptions underpinning the economic relationships in the model, and financial market-based estimates may be sensitive to the method used to extract term premia and inflation expectations.

Graph 3
Neutral Interest Rate



Source: RBA

Graph 4
Global Neutral Interest Rates



Sources: Holston, Laubach and Williams (2016); Laubach and Williams (2015); Lubik and Matthes (2015); RBA

time, we can be fairly confident that it is lower now than in the past.

The relationship between the *ex post* real policy rate and the neutral interest rate corresponds to standard accounts of the conduct of Australian monetary policy during the inflation-targeting era.[12] During the tightening phases of the mid 1990s and mid 2000s, monetary policy was clearly exerting a contractionary influence on the economy, while in the immediate aftermath of the global financial crisis, monetary policy helped to stimulate economic activity. All of the available estimates suggest that the stance of monetary policy is currently expansionary.

Comparison with international estimates

The fall in the estimated neutral interest rate in Australia mirrors similar declines in other advanced economies. Graph 4 compares the average estimate of Australia's neutral interest rate with a range of international estimates. For most of the economies, estimates of the neutral interest rate were reasonably stable through the 1990s, but have declined since 2007. The size of the estimated fall in Australia's neutral interest rate is similar to that of Canada and the United Kingdom, but smaller than the estimated declines in the United States and the euro area. However, given the uncertainty inherent in these estimates, we would caution against reading too much into this divergence.

What Can Explain the Decline in the Neutral Interest Rate?

Our estimates point to a fall in Australia's neutral interest rate of around 150 basis points since 2007. Most of this decline can be explained by a decline in potential growth and an increase in risk aversion that, in part, has manifested itself in a widening in spreads between the policy rate and market interest rates. To the extent that these developments coincided with related developments overseas, this helps to account for the similar trends in Australian and overseas neutral interest rates over the past decade.

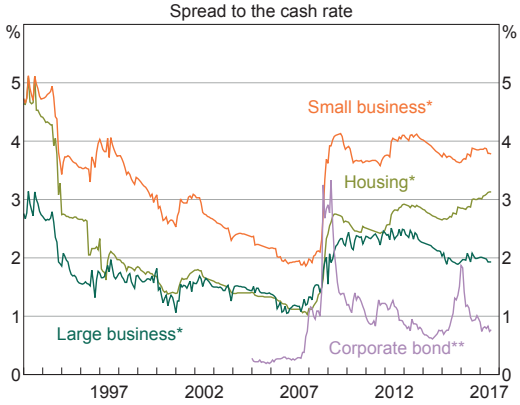
As well as estimates of the neutral interest rate, the neutral interest rate model used here also produces estimates of Australia's long-run potential growth rate. These suggest that potential growth has declined by around

12 For example, Debelle (2009).

½ percentage point since the mid 1990s.[13] Many economic models suggest that a one percentage point decline in the economy's potential growth rate should correspond to a similar decline in the neutral interest rate. This suggests that around 50 basis points of the decrease in the neutral interest rate can be attributed to slower potential output growth.

Across many advanced economies, the risk appetite of firms and households has diminished over the past decade.[14] One indication of this is that firms are investing less than one might expect given the outlook for demand and financing (Kent 2014). Another indication has been through a widening of spreads between market interest rates and the cash rate. Although there is some heterogeneity across measures, most borrowing spreads in Australia have widened by 100 basis points or more (Graph 5).[15] Changes in spreads should have a roughly one-for-one effect on the neutral interest rate. That is, together with trend growth, heightened risk aversion and a widening in spreads seems to account for most of the decline in the neutral interest rate since 2007.[16] Most of the increase in risk aversion and widening in spreads occurred around the time of the global financial crisis. These developments are therefore the most

Graph 5
Interest Rate Spreads
Spread to the cash rate



* Weighted average on credit outstanding; RBA estimate
** 3-year A-rated corporate bond; spread to swap
Source: RBA

plausible explanation for the large fall in the neutral interest rate that occurred at this time.

The contributions of other determinants of the neutral interest rate are harder to quantify. Our assessment is that the contribution of other identifiable influences on the neutral interest rate in Australia has been small. In part, this reflects the fact that these influences tend to evolve only gradually and hence cannot account for the large decline in the neutral interest rate observed around the time of the global financial crisis.

Conclusion

Australia's neutral interest rate has declined over recent decades. This mirrors, and is likely to some extent to have been caused by, a downward trend in neutral interest rates in other advanced economies. Much of the decline in the neutral interest rate since 2007 seems to reflect a reduction in the economy's potential growth rate and an increase in risk aversion by households and firms.

At the same time, uncertainty surrounding estimates of the neutral interest rate should be kept in mind. Alternative estimation methods reach different conclusions about the level of the neutral interest rate, and the individual estimates

13 External estimates point to a similar decline in the economy's potential growth rate. For example, the growth rate at the projection horizon of the Commonwealth Budget has declined by 50 basis points since the mid 1990s. Lancaster and Tulip (2015) also estimate a ½ percentage point fall in potential growth over this period.

14 Aside from trend growth, our model is silent on the other influences on the neutral interest rate. Our inferences regarding the influence of risk aversion therefore rely on off-model information.

15 The widening in spreads over this period is also likely to reflect regulatory changes.

16 The narrowing interest rate spreads during the 1990s, which one might have expected to increase the neutral interest rate, coincided with a period of stability in the neutral interest rate. One explanation for this is that other factors were putting downward pressure on the neutral interest rate over this period. We leave a full decomposition of influences on the neutral interest rate over recent decades to future research.

themselves are somewhat imprecise. As such, it is appropriate to use a suite of indicators, rather than rely on estimates from a single measure. It is entirely plausible that our estimates of the neutral interest rate could increase, or decline further, as the economy evolves. For this reason, the Bank intends to update and monitor these estimates on a regular basis.

Appendix A: Estimating the Model

The model consists of equations linking the output gap, the unemployment rate and inflation. These equations reflect the theoretical relationships between these variables implied by most standard macroeconomic models. Details of the variables used are in Table A1.

IS curve:

$$\tilde{y}_t = a_{y,1}\tilde{y}_{t-1} + a_{y,2}\tilde{y}_{t-2} - \frac{a_r}{2}\sum_{i=1}^{2}\left(r_{t-i} - r^*_{t-i}\right) + \varepsilon_{\tilde{y},t} \tag{A1}$$

Okun's law:

$$u_t = u^*_t + \beta\left(0.4\tilde{y}_t + 0.3\tilde{y}_{t-1} + 0.2\tilde{y}_{t-2} + 0.1\tilde{y}_{t-3}\right) + \varepsilon_{u,t} \tag{A2}$$

Phillips curve:

$$\pi_t = (1-\beta_1)\pi^e_t + \frac{\beta_1}{3}\sum_{i=1}^{3}\pi_{t-i} + \beta_2\left(u_{t-1} - u^*_{t-1}\right) + \varepsilon^{\pi}_t \tag{A3}$$

where $\tilde{y}_t = 100 * \left(y_t - y^*_t\right)$ is the output gap. The model also includes equations for the unobserved state variables, potential output (y^*_t), trend growth (g_t) and the non-accelerating inflation rate of unemployment or NAIRU (u^*_t). In contrast to the equations for the output gap, unemployment rate and inflation, the state equations are atheoretical:

$$y^*_t = y^*_{t-1} + g_t + \varepsilon^{y^*}_t \tag{A4}$$

$$g_t = g_{t-1} + \varepsilon^{g}_t \tag{A5}$$

$$u^*_t = u^*_{t-1} + \varepsilon^{u^*}_t \tag{A6}$$

The neutral rate is described as a function of trend growth and a latent factor z_t, which accounts for all other factors that can affect the neutral interest rate:

$$r^*_t = 4 \times g_t + z_t \tag{A7}$$

$$z_t = z_{t-1} + \varepsilon^{z}_t \tag{A8}$$

We estimate the model using Bayesian methods. This allows us to combine prior information about the values of the estimated parameters from economic theory and other studies with information from the data. Intuitively, the estimation procedure searches for the combination of parameter estimates that best explains the observed behaviour of output growth, inflation and the unemployment rate, but penalises parameter estimates that are far from our expectations. The size of the penalty depends on the strength of our 'priors'. If we have strong reasons to believe that a parameter falls in a particular range, the penalty for deviating from that range will be large. For other parameters, where our beliefs are not as strong, the penalty will be small. For example, economic theory and empirical evidence strongly suggests that a higher real policy rate will lower the pace of economic activity. Therefore, our priors rule out parameter estimates that imply a positive relationship between the real policy rate and economic activity.

For a given set of parameter estimates, we use a statistical technique known as the Kalman filter to generate estimates of the neutral interest rate. At each observation in the sample, given an estimate of the neutral interest rate and Equations A(1)–A(8), the model will produce a prediction for the output gap, the unemployment rate and inflation. Any differences between the predictions and actual data will cause some revision in the estimate of the neutral interest rate for that quarter. Using the revised estimate

of the neutral interest rate, the process is then repeated for the next quarter. Once we reach the end of the sample, we use the Kalman smoother to construct estimates of the neutral interest rate based on the full history of the data.

Table A2 describes the prior distributions and estimation results.

Table A1: Variable Descriptions and Data Sources

Variable	Description	Source
y_t	Chain-volume real GDP	ABS
y_t^*	Current estimate of potential real GDP	
π_t	Quarterly trimmed mean inflation	ABS
π_t^e	Inflation expectations	Cusbert (2017)
r_t	Nominal cash rate deflated by trimmed mean inflation	ABS; RBA
r_t^*	Current estimate of the neutral interest rate	
u_t	Unemployment rate	ABS
u_t^*	NAIRU	

Source: RBA

Table A2: Parameter Estimates

Parameter	Posterior		Prior		
	Mode	Mean	Distribution	Mean	Standard deviation
Structural parameters					
IS curve – $\tilde{y}_{t-1}$	1.53	1.48	Normal	1.10	1.50
IS curve – $\tilde{y}_{t-2}$	−0.54	−0.53	Normal	−0.20	1.50
IS curve – $r_t(L)-r_t^*(L)$	0.05	0.06	Inverse gamma	0.15	1.00
Phillips curve – $\pi_t(L)$	0.39	0.41	Beta	0.50	0.25
Phillips curve – $u_{t-1}-u_{t-1}^*$	−0.32	−0.33	Normal	−0.50	0.30
Okun's law – $\tilde{y}_t(L)$	0.62	0.64	Normal	0.50	0.30
Shock processes					
IS curve	0.38	0.37	Inverse gamma	1.00	1.00
Phillips curve	0.79	0.80	Inverse gamma	1.00	1.00
Unemployment	0.07	0.07	Inverse gamma	0.25	0.25
Trend output	0.54	0.55	Inverse gamma	1.00	1.00
NAIRU	0.15	0.15	Inverse gamma	0.40	0.25
Trend growth	0.05	0.05	Inverse gamma	0.25	0.50
Unexplained r*	0.22	0.34	Inverse gamma	0.40	0.25

Source: RBA

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The Rising Share of Part-time Employment

Natasha Cassidy and Stephanie Parsons*

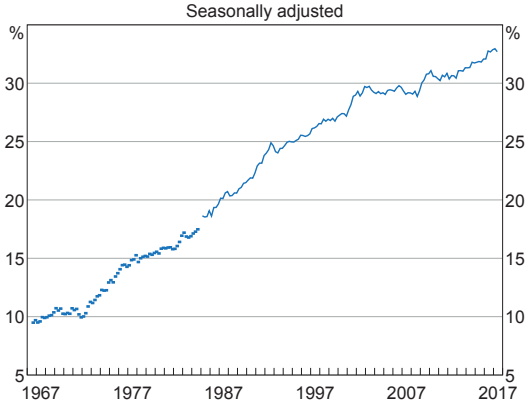
One of the most significant changes to the Australian labour market in recent decades has been the rise in the share of part-time employment to account for nearly one-third of total employment. This article details the various supply and demand factors that have underpinned the increase in part-time employment, as well as some of the characteristics of part-time workers. Because there are some part-time workers who want to work additional hours, it is useful to consider underemployment as well as unemployment in measuring labour market spare capacity.

Introduction

The structure of the Australian labour market has gradually changed over recent decades, reflecting developments in both labour supply and demand. One of the most significant changes has been the large increase in part-time employment, classified by the Australian Bureau of Statistics (ABS) as working less than 35 hours across all jobs in a usual working week. The part-time employment share has risen steadily to now account for nearly one-third of total employment (Graph 1). On the supply side, this has allowed employees to combine paid work with other activities such as education, caring for family members and leisure. On the demand side, firms are using more flexibility in the workforce to respond to fluctuations in demand for their output and to manage labour costs more effectively.

Many advanced economies have also experienced a trend increase in the share of part-time employment over recent decades. However, Australia has one of the highest shares of part-time employment across OECD countries, even when using a more restrictive definition of part-time employment for international comparability (Graph 2).

Graph 1
Part-time Employment Share*
Seasonally adjusted



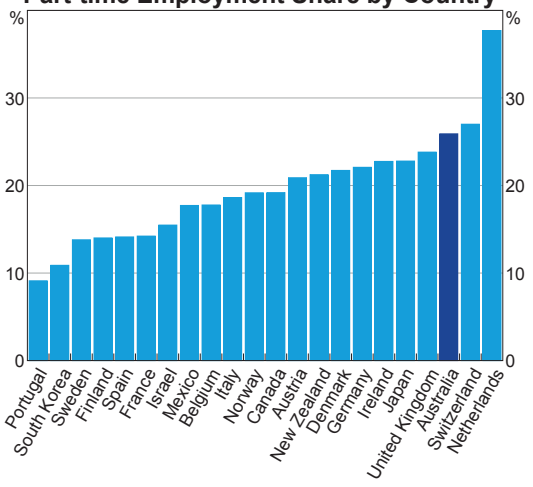
* Series break in 1984 due to change in Labour Force Survey; post 1984 series excludes agriculture, forestry & fishing, and public administration & safety

Sources: ABS; RBA

While part-time employment encompasses a range of actual hours worked, part-time employees work an average of 17 hours per week. More than half of Australia's part-time workers are casually employed, compared with 10 per cent of

* Natasha Cassidy is from Economic Analysis Department and Stephanie Parsons completed this work in Economic Research Department.

Graph 2
Part-time Employment Share by Country*



* Average over 2016; part-time employment defined as people who usually work less than 30 hours per week in their main job

Source: OECD

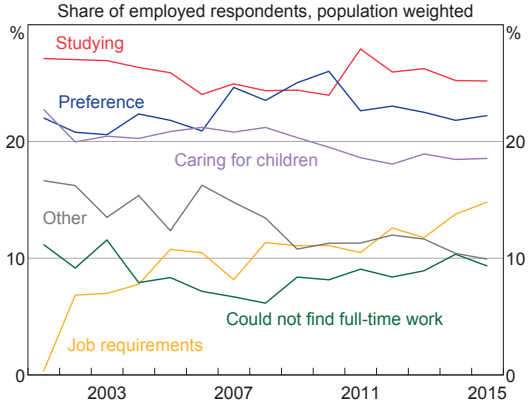
full-time workers. Casual employment is defined here as employment with no paid holiday or sick leave. Perhaps somewhat surprisingly given the continued upward trend in the part-time employment share, the share of casual employees in the workforce has been relatively stable since the 1990s at around 20 per cent. The share of independent contractors working part time is around 40 per cent. Independent contractors own their own business and are contracted to perform services by a client; they represent close to 10 per cent of employment.

Drivers of the Rising Part-time Employment Share

Labour supply factors

Many people choose to work part time. Data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey suggest that the three most common reasons for working part time are to accommodate study, a preference for part-time hours and caring for children.[1] Collectively, these account for around two-thirds of part-time employees and this has been broadly the case since the survey began in 2001 (Graph 3).

Graph 3
Reasons Why People Work Part Time
Share of employed respondents, population weighted

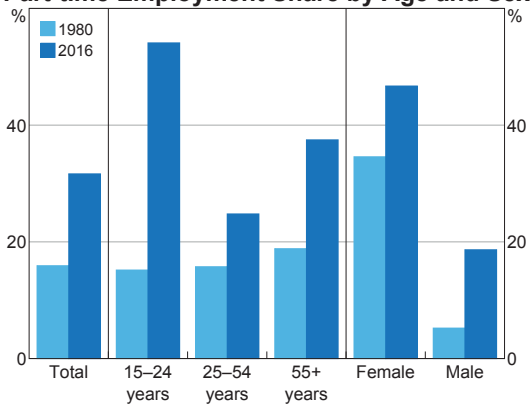


Sources: HILDA Release 15.0; RBA

These three reasons for working part time are consistent with the share of part-time employment being highest for two groups: those aged under 25 years and females (Graph 4). For younger workers, the part-time share has increased from 15 per cent of employment in 1980 to over 50 per cent, with these workers tending to cite study as their main reason for working part time (Graph 5). Just over half of 15–24 year olds are now enrolled in full-time education, which is an increase from 30 per cent in the mid 1980s. While government reforms in the late 1980s increased access to higher education, notable increases in participation in post-secondary education (in particular for younger males) occurred after the decline in full-time employment opportunities in the 1980s and 1990s recessions (Department of Education and Training 2015). The participation rate of younger Australians in the labour force is one of the highest in the OECD; the relatively high share of young people in Australia combining study and work can help explain the high share of part-time employment relative to the OECD average.

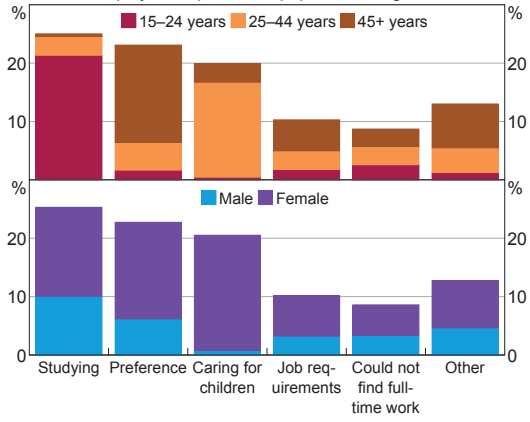
1 See Abhayaratna *et al* (2008) for a comprehensive review of the extent and nature of part-time work in Australia.

Graph 4
Part-time Employment Share by Age and Sex



Sources: ABS; RBA

Graph 5
Reasons Why People Work Part Time by Age and Sex
Share of employed respondents, population weighted, 2001–15



Sources: HILDA Release 15.0; RBA

The participation rate of women in the labour force has increased from 40 per cent in 1970 to 60 per cent in 2017. Close to half of employed females currently work part time. Prime-aged (25–44 year old) females indicate caring for children as the dominant reason for working part time, although this has become a little less pervasive over the past decade. In contrast, the share of males working part time to care for children is relatively small.

The relationship between child care responsibilities and part-time work is complex; some parents may choose to work part-time hours to spend more time caring for children, whereas other parents may prefer additional or full-time hours but are unable to find or afford adequate child care arrangements. Parental leave options are also a significant consideration. According to the HILDA Survey, around 75 per cent of couples with children under 15 years had some difficulty with the cost of child care in 2015, compared with about 60 per cent in 2001. Around 60 per cent of couples with children under 15 years also reported having difficulty finding good quality child care. In Australia, the most common employment arrangement for couples with dependent children is having one partner work full time and the other part time. In contrast, the most prevalent work arrangement across OECD countries is for both partners to work full time.

Relative to other age groups, older workers (particularly those aged 55 years and over) have the strongest preference for working part-time hours. It may be that older workers take on a part-time job (and, increasingly, casual arrangements) as a transition between the role they had for most of their working life and retirement. Older workers also cite caring for relatives and illnesses or disabilities as reasons for working part time. In addition, an older worker's decision to work part-time hours can be influenced by access to, and the level of, pensions and superannuation.

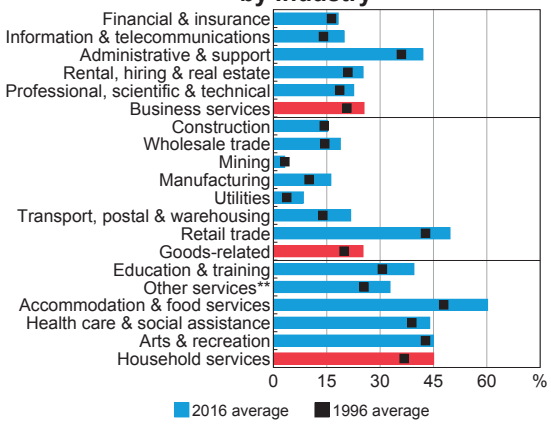
Labour demand factors

A number of long-run labour demand factors have contributed to the changing employment structure of the economy. Firstly, the economy has become more services-oriented as households have become older and wealthier. This has resulted in a large

increase in employment in service areas of the economy, such as health, education, tourism and hospitality. The nature of these jobs can involve irregular hours and this has meant that part-time and casual work are more common in these industries. For example, around 60 per cent of employment in the accommodation and food services industry is in part-time work (Graph 6). As these industries have become more important in the economy, this has contributed to the overall rising share of part-time work. At the same time, there has been a secular decline in traditionally full-time jobs in industries that have been dominated by routine manual jobs, such as manufacturing (Heath 2016).

There is also evidence to suggest that firms are increasingly using part-time employment to respond to cyclical fluctuations in demand for their output. Bishop, Gustafsson and Plumb (2016) found that, since the 1990s, businesses have increasingly responded to changes in labour demand by changing the hours worked by their employees rather than the number of employees. This may be due to a range of factors: the severity of the downturns has been less pronounced since the 1990s; the cost of hiring and training new employees has increased; and labour market reforms in the late 1980s and early 1990s have made it easier for firms to bargain directly with employees on wages and working arrangements. The authors suggest that the process of adjusting the hours of employees may have tempered the rise in unemployment during recent downturns.

Graph 6
Part-time Employment Share by Industry*



* Seasonally adjusted by RBA; does not remove the effects of changes in the timing of ABS supplementary surveys

** Includes personal services; religious, civic, professional and other interest group services; repair and maintenance activities; and private households employing staff

Sources: ABS; RBA

Another driver of demand for part-time employment is that firms have increasingly relied on part-time and casual employment to improve the flexibility of their business models. This has often been enabled by market reforms in recent decades. For example, the liberalisation of retail shopping hours increased the number of workers employed on non-standard hours and working on a part-time basis. Improved technological systems have also allowed firms to manage staff hours more efficiently and facilitated the automation of certain processes. Consistent with these developments, the share of part-time employment has risen in all industries, including industries traditionally dominated by full-time employment. In addition, information from the Bank's liaison program suggests that businesses make use of employees of labour hire firms or employ staff on fixed-term contracts as ways to adjust to changes in labour demand, or to differentiate the wages between existing and new staff.

From a firm's perspective, less idle labour during off-peak periods may enable a business to run more efficiently. However, there are also costs to firms from employing part-time workers. A firm will encounter the same hiring and overhead costs as employing a full-time worker, though part-time workers on average have shorter job tenures than full-time workers (driven by casual part-time employees). There may also be differences in the relative productivity of

part-time and full-time workers (Abhayaratna *et al* 2008).

While data from the HILDA Survey suggest that many people choose to work part time, the survey also found that around one-quarter of part-time workers were employed in a part-time capacity in 2015 because they could not find a full-time job or because part-time hours were a requirement of their job (Graph 3). The latter reason has increased from around 10 per cent of part-time workers in 2011 to 15 per cent in 2015; the change has been most pronounced for males and for those aged 45 years and over. Consistent with this, ABS data suggest that around one-quarter of part-time workers (about 8 per cent of the labour force) want to, and are available to, work more hours than they currently do. On average, these underemployed part-time workers would like to work an additional 14 hours per week; around 15 per cent of all part-time workers desire enough additional hours to become full-time workers. In 2014, around 40 per cent of all underemployed part-time workers were actively seeking additional hours, for example by responding to job advertisements and asking their employer for additional hours.[2]

Implications for Spare Capacity

Underlying the changes in aggregate labour market outcomes, there are much larger flows of individuals moving into and out of part-time employment, full-time employment, unemployment and the labour force. The flows between all of these labour market 'states' depend on longer-run structural changes as well as cyclical developments.

Data from the HILDA Survey suggest that, on average, a little less than 20 per cent of part-time workers switch to full-time employment each year. In contrast, less than 10 per cent of full-time workers switch to part-time work on average each year. As previously mentioned, many young people combine part-time work and study, while unemployed workers more commonly transition to part-time (particularly casual) jobs rather than full-time work. This provides some evidence that part-time work can be used as a stepping stone into full-time employment.

Gross flows data from the ABS Labour Force Survey show that there were fewer people than usual transitioning from part-time work to full-time work over 2016. This tends to happen during periods of slower labour demand; indeed, during the slowdowns in 2001 and 2009, there was a small net outflow from full-time employment to part-time employment as firms adjusted hours due to weaker demand. As discussed earlier, this tendency to adjust hours rather than heads may have slowed the rise in unemployment, particularly during the 2009 slowdown.

The increasing flexibility of hours worked has a number of implications. The rise in part-time employment over the past few decades has contributed to an increase in labour market participation, but also means there are more part-time workers who are willing and able to work additional hours. This warrants monitoring a broader range of measures of labour market spare capacity alongside the more conventional unemployment rate or unemployment gap.[3]

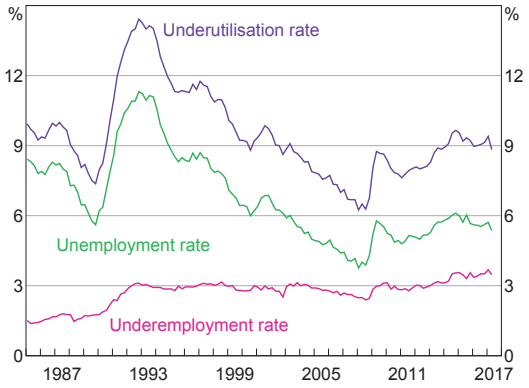
There are a number of ways to include part-time workers who want to work more hours in an underutilisation measure. One measure that has conceptual appeal is an hours-based underutilisation rate. This measures the additional hours sought by workers (including those

2 These data are no longer available from the ABS.

3 The unemployment gap is the difference between the unemployment rate and the unemployment rate that is associated with a stable rate of inflation (known as the non-accelerating inflationary rate of unemployment or NAIRU). See Cusbert (2017) for more detail.

currently unemployed) relative to the total number of hours that workers would like to work. The steady rise in part-time employment over recent decades has been accompanied by a rise in this underutilisation rate (Graph 7). It shows the same general pattern as the unemployment rate, although the gap has tended to widen since 2011.

Graph 7
Labour Market Underutilisation
Hours-based measures



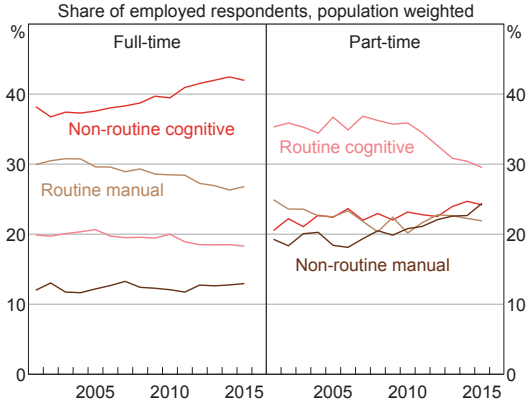
Sources: ABS; RBA

Implications for Wages

The characteristics of part-time workers can influence both the level of employees' wages and their bargaining power. As is the case in many other countries, Australian part-time workers earn an average hourly wage that is lower than full-time workers. However, unlike some other countries, there is no evidence that part-time workers in Australia face a wage penalty once other factors (such as industry, job tenure and education) are controlled for (Booth and Wood 2008; Day and Rodgers 2013).

Part-time workers have a tendency to work in industries and occupations with below-average levels of pay. For example, part-time workers are more commonly employed in routine cognitive occupations (such as sales and clerical roles) than full-time workers (Graph 8). In contrast, over 40 per cent of full-time workers are employed in

Graph 8
Occupation by Employment Status
Share of employed respondents, population weighted



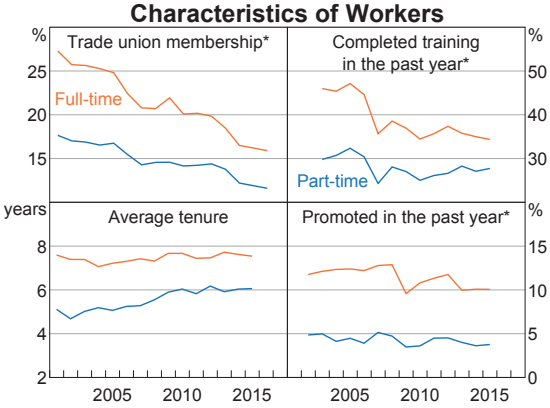
Sources: HILDA Release 15.0; RBA

non-routine cognitive occupations, which tend to earn the most per hour on average. There has also been an increase in the share of part-time workers employed in non-routine manual occupations over the past decade, which include occupations related to assisting or caring for others.[4]

A smaller share of part-time workers aged over 24 years have post-school qualifications (around 60 per cent) compared with full-time workers (around 70 per cent). On average, part-time workers have spent a shorter amount of time with their current employer than full-time workers, though, as previously mentioned, this is entirely attributable to casual workers (Graph 9). On average, permanent part-time employees have had the same job for around eight years, one year longer than the average full-time employee. Compared with full-time workers, part-time workers less commonly belong to unions; casual workers have a particularly low union membership rate. In addition, the average part-time worker is less likely to have been

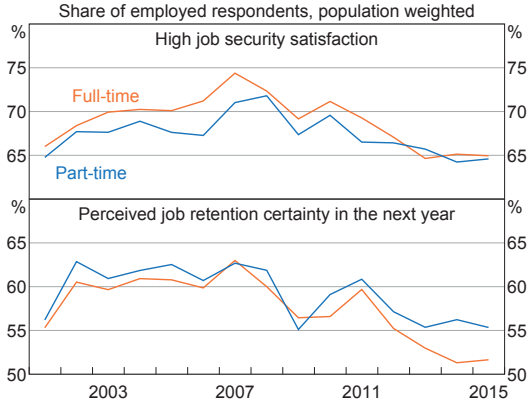
4 This grouping of occupations was first used by Autor, Levy and Murnane (2003). Routine manual occupations include labourers and machinery operators in manufacturing and construction; routine cognitive occupations include salespeople and administrators; non-routine manual occupations include service occupations related to assisting others; and non-routine cognitive occupations include management and professional occupations.

Graph 9
Characteristics of Workers



* Share of employed persons by employment status
Sources: ABS; HILDA Release 15.0; RBA

Graph 10
Job Security by Employment Status
Share of employed respondents, population weighted



Sources: HILDA Release 15.0; RBA

promoted or completed work-related training in the past year than the average full-time worker.

Data from the HILDA Survey suggest that full-time workers have more commonly reported high satisfaction with job security than part-time workers, though in recent years there has been little difference (Graph 10).[5] An alternative measure of job security – workers' perceptions that they will retain their job in the next year – has typically been higher for part-time workers than full-time workers. This is because permanent part-time workers have much more certainty that they will retain their job in the next year compared to both casual part-time workers and full-time workers, and is consistent with permanent part-time workers reporting the highest overall job satisfaction.[6]

It may also be the case that part-time workers have less bargaining power in wage negotiations given that they have lower union membership rates and some part-time workers have lower perceptions of job security. Haldane (2017) argues that shifts in working patterns in the UK, such as lower union membership and the increasing incidence of self-employment, flexible work, part-time work and zero-hours contracts have contributed in some way to weak wage growth in the UK.[7] For Australia, apart from the rise in the part-time employment share, it is difficult to find much evidence that there has been an increase in the share of workers employed on temporary contracts or working for a labour hire firm over the past decade. Data from the HILDA Survey suggest that less than 10 per cent of employees were on a fixed-term contract in 2015 and this share has been little changed over the last 15 years, while ABS data suggest that around 1 per cent of workers were paid directly by a labour hire firm in August 2016, down from 2 per cent in 2001.

The Bank has previously noted that subdued growth in wages over recent years can largely be explained by the unemployment gap, the decline in the terms of trade and lower inflation outcomes (Bishop and Cassidy 2017). However, these determinants cannot fully

5 In aggregate, perceptions of job security have tended to track labour market conditions fairly closely (Bishop and Cassidy 2017).

6 Borland (2017) uses ABS data to suggest part-time workers have a higher expectation of leaving their job over the year ahead than full-time workers. A reconciliation between the ABS data and the HILDA data shown in this article is that the latter only measures a worker's subjective probability of losing their job rather than the subjective probability of voluntarily leaving their job.

7 Under zero-hours contracts, employers are not obliged to provide workers with a minimum number of hours and workers are not obliged to accept a minimum number of hours.

explain the decline in wage growth over this period. One plausible reason is that there is more spare capacity in the labour market than suggested by the unemployment gap. In recent years, the broadest measure of hours-based underemployment has increased while the unemployment rate has declined a little. The relationship between labour underemployment and wage growth is somewhat complex. The presence of underemployed workers could dampen wage growth given they offer additional labour supply to the pool of unemployed workers.[8] From a modelling perspective, the addition of a measure of part-time underutilisation has some explanatory power in a wages Phillips curve, and, at the margin, may have contributed to the decline in wage growth in recent years.

Conclusion

There has been a trend increase in the share of part-time employment for several decades as a result of supply and demand factors. While the majority of part-time workers appear to be working part-time hours voluntarily, there is a pool of part-time workers who want to, and can, work additional hours. These workers represent additional spare capacity in the labour market that should be considered when assessing wage and price pressures in the economy.

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8 Alternatively, it may be the case that lower wage growth could lead to higher underemployment in that workers may desire more hours than otherwise to boost income growth.

The Resources Economy and the Terms of Trade Boom

Sean Langcake and Emily Poole*

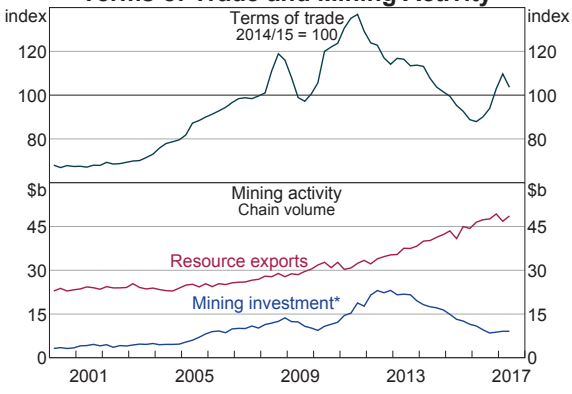
The transition from the investment to the production phase of the resources boom is nearly complete. The adjustment has affected industries beyond the resources sector, which has amplified the impact of the resource investment boom on the Australian economy. The value added and employment shares of this broader 'resources economy' have retreated from their 2011/12 peaks, but remain above their pre-boom averages.

Introduction

After a decade of adjustment following the unprecedented boom in commodity prices from the mid 2000s to late 2011, conditions facing the resources sector appear to be stabilising (Graph 1).[1] Almost all of the resource investment projects committed to during the boom are now complete; just a few liquefied natural gas (LNG) projects remain under construction. Aside from these LNG projects, resource companies have shifted their focus to increasing export volumes by boosting productivity rather than investing in additional capacity. In short, the transition from the investment to the production phase of the mining boom is nearly complete.

The adjustment to this transition has affected industries beyond the resources sector. Industries that provide inputs to resource extraction and investment activities have also had to adjust, which has amplified the effects of the boom on the Australian economy. This article uses the input-output tables produced by the Australian Bureau of Statistics (ABS) to examine the impact of the transition on activity and prices in the resources and resources-exposed sectors. Information from the Bank's business liaison program is used to provide insights on the outlook for activity and employment in these sectors.[2]

Graph 1
Terms of Trade and Mining Activity



* Net of imports
Sources: ABS; RBA

* Sean Langcake completed this work in Economic Analysis Department and Emily Poole is from Economic Analysis Department.

1 This article focuses on developments within the resources and resources-exposed sectors. For analysis of the impact of the mining investment boom on the non-resources sector, see Bishop *et al* (2013), Tulip (2014), Gorajek and Rees (2015) and Kent (2016).

2 See RBA (2014) and Heath (2015) for information on the Bank's business liaison program.

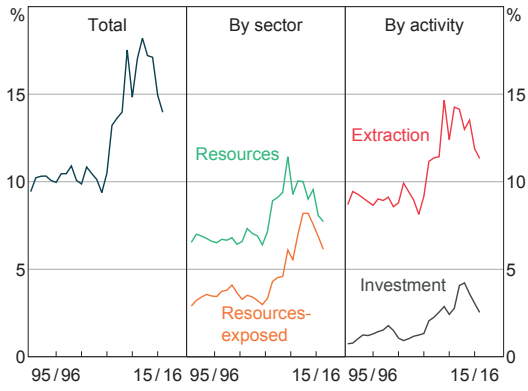
The Resources Economy

The extraction, processing and export of resources requires inputs from a wide range of industries outside the mining industry. For example, iron ore operations require inputs ranging from explosives produced by the manufacturing sector, replacement parts for mining vehicles from equipment suppliers, and external auditors from the business services sector. The resources sector, which is defined in this article as the mining and resource-specific manufacturing industries, is combined with these resources-exposed industries to make up the broader 'resources economy'.[3]

The size of the resources economy is estimated using the input-output tables released by the ABS, which capture inter-industry linkages throughout the economy. Using the approach taken by Rayner and Bishop (2013), the nominal gross value added (GVA) of the resources-exposed sector is estimated from the spillovers from extraction and investment activity by the resources sector to other sectors (see Appendix A for a brief summary of the methodology and key assumptions).[4] The GVA of a sector is the value of goods and services it produces less the value of intermediate inputs it consumes; since the focus here is on the contribution to the domestic economy, imported inputs are netted out.[5] Nominal GVA estimates will capture changes in both the price and volume of activity.

Based on these estimates, the resources economy as a share of the total economy peaked at just over 18 per cent in 2011/12; almost double its pre-boom share (Graph 2). The increase in nominal GVA up to that time was driven by both higher commodity prices associated with strong demand for commodities from China, and the resulting increase in resource extraction and investment activity. Activity in both the resources and resources-exposed sectors increased as a result, with the increase in nominal GVA from the resources-exposed sectors larger than the increase from the resources sector. As resource companies typically contract out investment-related activity, almost all of the investment activity is assumed to be done by firms in the resources-exposed sector, such as civil and heavy engineering companies, rather than the resources sector.[6] In contrast, extraction activity is assumed to be primarily undertaken by the resources sector.

Graph 2
Resources Economy*
Share of nominal GVA



* Net of capital imports
Sources: ABS; RBA

3 The resources sector is defined throughout as mining industries (coal mining, oil & gas extraction, iron ore mining, non-ferrous metal ore mining, non-metallic mineral mining, exploration & other mining support services) and some manufacturing industries closely linked to mining industries (iron & steel manufacturing, petroleum & coal product manufacturing, and basic non-ferrous metal manufacturing). The ABS definition of the mining industry does not include resource-specific manufacturing.

4 The data are available up to 2014/15 and are used to estimate the nominal GVA of the resources economy up to 2015/16. Nominal GVA estimates are presented, rather than real GVA estimates, as the required price indices are not available.

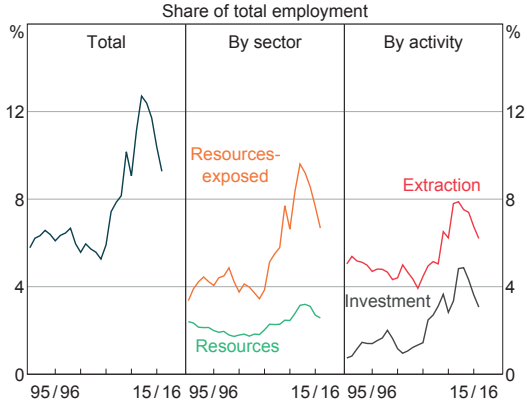
5 The difference between GVA and GDP is net taxes and subsidies.

6 The methodology attributes different types of investment to different industries: mining non-residential construction gross fixed capital formation (GFCF) is attributed to engineering; mining machinery & equipment GFCF is attributed to machinery & equipment manufacturing; a distribution margin (calculated from the input-output tables) on mining machinery & equipment GFCF is attributed to the wholesale, retail & transport industries; and mining intellectual property (research & development, exploration) is attributed to the mining industry.

The share of the resources economy fell back to 14 per cent of nominal GVA in 2015/16 and is expected to have fallen further in 2016/17. The nominal share generated by resource extraction activity fell between 2011/12 and 2015/16, reflecting the large decline in commodity prices between late 2011 and early 2016, and despite the continued ramp-up in export volumes. This share will probably increase in the future; LNG extraction volumes are expected to increase as projects are completed and Australia's bulk commodity prices are forecast to remain above the late 2015/early 2016 troughs. In contrast, the share of nominal GVA generated by resource investment has a little further to fall, as the remaining LNG projects are completed; it should stabilise around the second half of next year. In real terms, the direction is relatively clear: the share of output coming from the resources economy should increase as the drag from the fall in mining investment dissipates and export production continues to increase; but what this means for the share of nominal GVA will depend on the evolution of commodity prices, which is harder to predict.

Employment in the resources economy increased alongside the increase in extraction and investment activity, peaking at 13 per cent of total employment in 2011/12.[7] As with GVA, most of the increase in employment was in the resources-exposed sectors, rather than the resources sector (Graph 3).[8] The

Graph 3
Resources Economy
Share of total employment



Sources: ABS; RBA

extraction of resources is very capital intensive, requiring few workers relative to the value of its output compared with most other sectors. Since 2012/13, productivity gains achieved as commodity prices fell have seen employment in resource extraction shrink despite the doubling in export volumes. The resources economy's share of employment will continue to fall over the next year or so as the more labour-intensive investment activity is completed, but extraction-related employment is expected to stabilise as further productivity gains become more difficult to achieve.

Resource Investment Activity

A distinctive feature of the recent resource investment boom compared with previous mining investment cycles in Australia was the scale of investment in LNG projects. Compared with the coal and iron ore projects committed to during the boom, individual LNG projects were generally much larger, had longer lead times, took longer to construct and had higher imported content (Table 1). The long lead and construction times of these projects meant that oil and gas companies were less able than iron ore and coal companies to respond to the large

7 See Doyle (2014) and Davis, McCarthy and Bridges (2016) for detailed discussions of developments in the Australian labour market over the course of the resource investment boom.

8 These estimates are calculated by multiplying the final demand from the resources sector for a given industry's output by the number of employees in that sector. The underlying assumption is that an industry employs the same number of workers to meet a given amount of additional demand, irrespective of whether this demand comes from the resources sector, or any other part of the economy. As Rayner and Bishop (2013) point out, this seems like a reasonable assumption, with the possible exception of the construction industry, where labour productivity would be expected to be higher on resource projects than residential construction.

Table 1: Key Characteristics of Resource Projects by Commodity[(a)]

	Iron ore	Coal	LNG
Timing of the peak in investment	Investment peaked in 2012/13, with most projects completed by 2016	Investment peaked in 2012/13, with most projects completed by 2015	Investment peaked in 2013/14, with most projects expected to be completed by 2019
Number of projects	~35	~75	12
Median duration of projects	2 years	1¾ years	5¼ years
Median project size[(b)]	Around $1½bn	Around $¼bn	Around $20bn

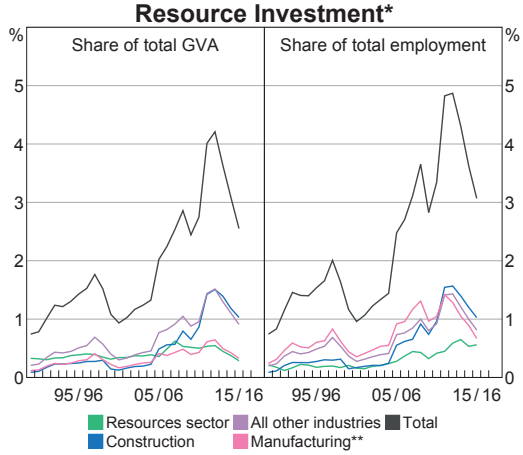
(a) Infrastructure, expansion and sustaining projects recorded in the RBA's major resource project database that reached a final investment decision after 2006; some projects may be missing from this database
(b) 'Around' is used to reflect uncertainty about the exchange rate assumptions used in company reports. Includes spending on imported components
Sources: company reports; RBA

declines in commodity prices by downgrading the capital intensity of committed projects.[9] Several of the LNG projects also experienced significant delays and cost over-runs, resulting in higher investment expenditure than initially anticipated (largely spent on domestic labour) to complete the projects. The prolonged construction time of these LNG projects has supported resource investment-related GVA and employment for longer than initially expected, extending the duration of the investment phase of the boom.

The resources-exposed construction industry, which includes civil and heavy engineering firms, experienced the largest increase in nominal GVA and employment as a result of the resource investment boom (Graph 4). Both the machinery & equipment manufacturing and business services sectors also experienced higher employment, activity and prices through to 2012/13. At the time, firms in these sectors commonly reported having record order books and strong margins. Labour costs escalated rapidly as the number of employees increased and large wage increases were granted due to competition for skilled labour. Yet the prices being paid by resource companies to resources-exposed firms for work were generally reported to be increasing at the same pace as labour costs or faster. High turnover of employees was common due to competition for skills; several firms noted that productivity of their workforce was declining because they had to hire less-experienced workers.

As the pipeline of new mining investment-related work shrank after 2012/13, labour demand eased significantly. Another factor

Graph 4
Resource Investment*



* Net of capital imports
** Excludes resource-specific manufacturing industries
Sources: ABS; RBA

9 An exception is the drilling plans of the three coal seam gas LNG projects in Queensland, which have been curtailed relative to initial expectations.

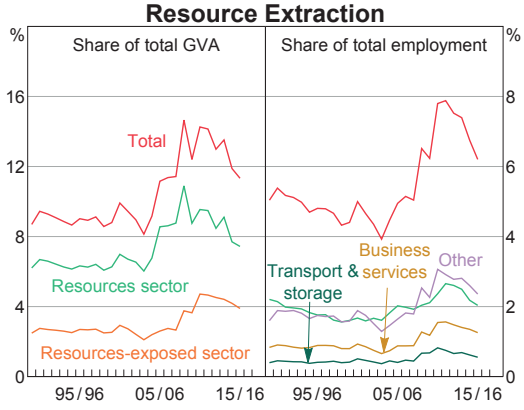
influencing resource investment-related employment over this period was cost-cutting pressure from resource companies as commodity prices fell. Resource companies put pressure on contractors in the resources-exposed sectors to reduce their rates, which in turn led to reductions in headcount, wage growth and other costs to relieve pressure on margins. Some firms affected by this trend tried to diversify into non-resources areas of the economy, such as infrastructure and commercial construction, or enter overseas markets. However, strong competition and the time taken establishing credibility in new markets made this challenging.

With the exception of firms involved in completing the remaining LNG projects, conditions facing firms in sectors exposed to resource investment have stabilised since late 2016. There are several small new projects in train for commodities such as gold and lithium, and constraints on spending on the maintenance and replacement of existing mining machinery and equipment appear to have eased. Preliminary work has commenced on some projects required to replace depleted resources and maintain production at the elevated rates achieved as a result of the resource investment boom. This sustaining investment is expected to be sizeable, particularly for iron ore and LNG projects, totalling tens of billions of dollars over the next decade.

Resource Extraction Activity

Not surprisingly, the resources sector experienced the largest increase in nominal GVA and employment as a result of the increases in commodity prices and extraction activity through to 2011/12, but the increases for the business services sector were also sizeable (Graph 5). Increased extraction activity also supported the manufacturing and transport & storage sectors, in line with energy, chemicals,

Graph 5
Resource Extraction



Sources: ABS; RBA

maintenance, and transport being the key intermediate inputs in resource extraction. The construction sector plays a relatively small role in resource extraction.

All else being equal, the increase in resource volumes seen since 2011/12 would have been expected to result in employment related to resource extraction continuing to increase. However, firms in these sectors responded to the pressure on margins resulting from lower commodity prices by improving productivity and lowering labour costs. For the resources sector, information from the Bank's liaison program suggests that these productivity gains were largely achieved by increasing capacity utilisation rates and improving the efficiency of processes and systems, rather than automating them.

Looking to the future, liaison suggests that employment in the resources and resources-exposed sectors is stabilising, and that further gains in productivity are difficult to achieve in the short term. However, there is likely to be downward pressure on employment in the resources sector over the longer term from the automation of mining machinery and equipment. Mining operations involving large open-cut mines (such as iron ore) are taking the lead on this front.

The completion of the remaining LNG projects is not expected to add much to employment because they require significantly fewer operational employees than iron ore and coal projects. Estimates based on company reports and liaison suggest that combined operational employment at the LNG projects will stabilise at a few thousand people, compared with tens of thousands involved in iron ore and coal operations. Over the long term, the experience of the mature LNG projects suggests that the new LNG projects are likely to be able to expand production through process improvements without increasing employment. LNG projects are already highly automated.

Assessment and Outlook for the Resources Economy

The resources economy's share of nominal GVA and employment has retreated from its resource investment boom highs, but remains above its pre-boom averages. The investment phase of the boom generated significant employment in the construction, manufacturing and business services sectors. It is drawing to a close with only a few LNG projects remaining under construction. Looking to the future, liaison suggests that resource companies are focusing on 'incremental' capacity expansions achieved through small-scale investments aimed at boosting productivity, rather than projects aimed at expanding capacity of the type seen during the investment boom. The automation of mining processes is one example of this type of investment. Some investment will also occur as a result of the need to invest in replacement mines and gas wells as existing resources are depleted to maintain production volumes.

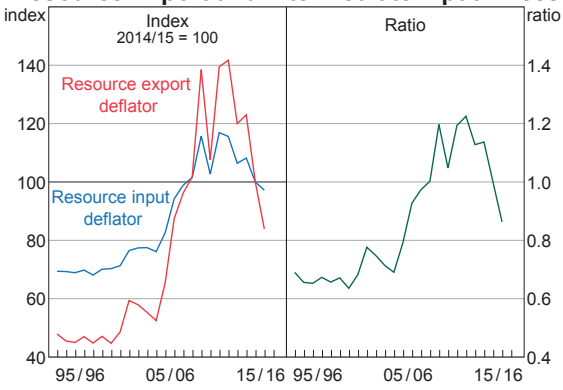
Appendix A: Estimating the resources economy

The estimates of the size and industry composition of the resources economy in this article are based on the methodology outlined in Rayner and Bishop (2013). In summary, the methodology consists of three main steps:

1. Estimating all of the final demand (or expenditure) in the economy that is related to resource extraction and investment, and then identifying the industries that produce these final goods and services. Industries that produce a final good (or service) are those that are responsible for the final steps in the production chain for a given product. For example, the resource extraction sector produces resource exports, and the heavy and civil engineering construction industry undertakes resource-related construction investment (net of capital imports).
2. Using input-output (I-O) tables to calculate the value and industry composition of intermediate inputs required to meet this final demand. For example, I-O tables are used to calculate the value and industry composition of intermediate inputs required by the resource extraction sector to produce each dollar of resource exports, and the value and industry composition of intermediate inputs required by the heavy and civil engineering construction industry to undertake each dollar of resource-related construction investment.
3. After making some simplifying assumptions, this information from I-O tables is used to transform the final demand related to resource extraction and investment into a measure of resources economy GVA that can be decomposed by industry. The GVA of an industry is the gross output of that industry less the intermediate inputs it uses to produce that output.

For financial years where I-O table data are not yet published, information from the closest I-O table(s) is used. For example, the latest vintage of published I-O table data is 2014/15, meaning that detailed data on industry linkages for 2015/16 is not available. For this year, the structure of the economy is assumed to be the same as in 2014/15. As a result, the analysis does not account for relative price changes that may have affected industry structure in 2015/16. Of particular importance is the relative price of resources sector output to its inputs. This price is proxied for by the ratio of the export price deflator and a weighted average input price deflator for the resources sector (Graph A1).

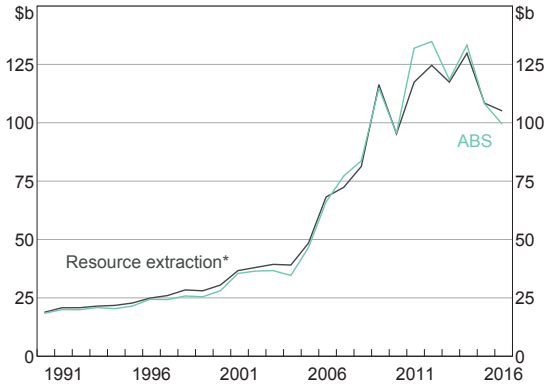
Graph A1
Resource Export and Intermediate Input Prices



Sources: ABS; RBA

Mapping estimates of the resource extraction sector calculated using this methodology to the ABS' measure of the mining industry provides a cross-check to the analysis as, conceptually, subtracting resource-specific manufacturing output from our measure of resource extraction should reconcile these measures. The two series track each other closely (Graph A2).

Graph A2
Mining GVA
Nominal



* Excluding resource-specific manufacturing

Sources: ABS; RBA

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Structural Liquidity and Domestic Market Operations

Benn Robertson*

The Reserve Bank is a net supplier of liquidity to the Australian financial system. This reflects demand for the Reserve Bank's liabilities from its customers, as well as the asset allocation decisions of the Reserve Bank. The key drivers of variations in the amount of liquidity supplied by the Reserve Bank have been fluctuations in government deposits and the demand for banknotes. The Reserve Bank meets the demand for liquidity through its domestic market operations.

Introduction

The role of the Reserve Bank's domestic market operations is to manage the availability of liquidity in the financial system. In this context, 'system liquidity' refers to the end-of-day balances held by financial institutions in their Exchange Settlement (ES) accounts. System liquidity is managed to ensure that the cash rate trades at the target set by the Reserve Bank Board and to facilitate the settlement of financial institutions' payment obligations.

Every transaction carried out between the Reserve Bank or its clients (mainly the Australian Government and foreign central banks) and the financial system directly affects the size and/or composition of the Reserve Bank's balance sheet, as well as the availability of system liquidity.[1] These transactions can be classified as arising from two sources.

- *Exogenous transactions* are typically initiated at the request of the Reserve Bank's customers, such as the lodgement of a deposit (by the government at the Reserve Bank) or the issuance of banknotes (by the Reserve Bank to a bank). They may also be initiated by the Reserve Bank for policy purposes related to the management of foreign exchange reserves (see below for further details).
- *Domestic market operations* refer to those transactions initiated by the Reserve Bank in order to adjust liquidity within the financial system. They are conducted in response to exogenous transactions and realign system liquidity with the demand by financial institutions at the cash rate target. These transactions include repurchase agreements (repos), foreign exchange swaps and/or transactions in outright securities.[2]

At any point in time, the 'structural liquidity' position of the financial system vis-à-vis the Reserve Bank is defined as the excess liquidity that would exist in the absence of the Reserve Bank's domestic market operations (for further details on the mechanics

* The author is from Domestic Markets.

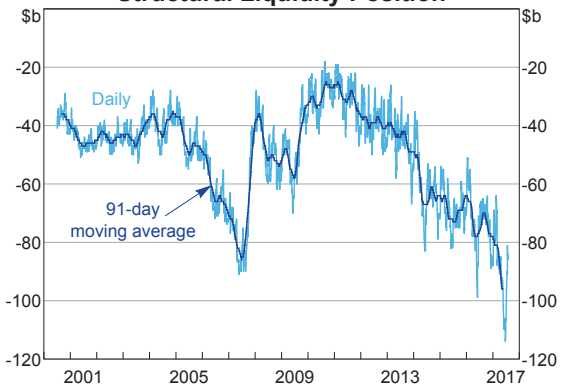
1 For an introduction to the structure of central bank balance sheets, see Rule (2015).

2 For further information on domestic market operations, see <https://www.rba.gov.au/mkt-operations/dom-mkt-oper.html>.

see Appendix A).[3] In other words, the structural liquidity position of the system can be identified as the net value of all exogenous transactions. When the net value of those transactions withdraws liquidity from the system, this implies a structural shortage, or deficit, of liquidity. That would require the Reserve Bank to add liquidity using domestic market operations. The opposite would be true when the net value of exogenous transactions adds liquidity into the system.

The Australian financial system has operated with a persistent structural liquidity deficit since 2000, although it has fluctuated within quite a wide range of between $18 billion and $115 billion during this time (Graph 1). Hence, the Reserve Bank has been a net supplier of liquidity through its domestic market operations. Changes in the structural liquidity position over time can be seen to have arisen from four key areas of the balance sheet: banknotes on issue; government deposits; gold and foreign exchange reserves; and the demand for ES balances by financial institutions.

Graph 1
Structural Liquidity Position



Source: RBA

3 Excess liquidity refers to the amount of liquidity available in the system above and beyond the level of demand for ES balances by financial institutions that is consistent with the monetary policy objective. This accounts for circumstances where the central bank supplies liquidity in excess of the demand by market participants, such as through unsterilised monetary purchases or providing monetary financing of government budget deficits. In such cases, the excess supply of liquidity on the central bank's balance sheet would need to be subtracted from the balance sheet calculation. However, this is not the case for the Reserve Bank. Similar definitions of structural liquidity can be found in Aamodt and Tafjord (2013) and Nessén, Sellin and Åsberg Sommar (2011).

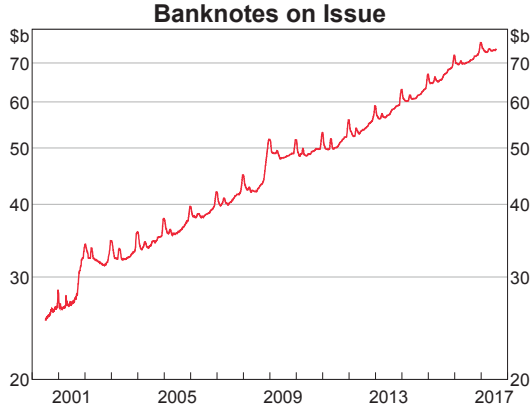
The Exogenous Drivers of the Structural Liquidity Position

Banknotes on issue

The stock of banknotes in circulation is the largest balance sheet item that affects the structural liquidity position of the financial system. A commercial bank may request to purchase banknotes from the Reserve Bank on behalf of the public (its customers). Because the settlement of these purchases occurs in ES balances, liquidity is reduced when the commercial bank's ES account is debited (to pay for the banknotes), and this contributes to a structural liquidity deficit.

As the Reserve Bank supplies banknotes to meet the public demand for cash on a daily basis, seasonal changes in demand can generate considerable short-term variation in the structural liquidity position, such as around Christmas and Easter. On top of this short-term volatility, the long-run growth in the demand for banknotes has acted to increase the structural liquidity deficit over time (Graph 2).[4]

Graph 2
Banknotes on Issue



Source: RBA

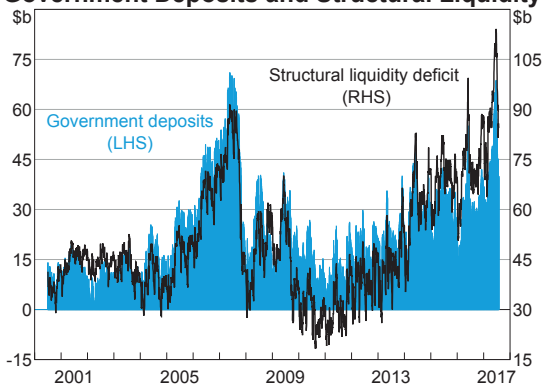
4 Further information on the long-run demand for banknotes can be found in Cusbert and Rohling (2013).

Government deposits

Transactions involving government accounts held at the Reserve Bank and the rest of the economy affect the structural liquidity position of the financial system. For example, when the government receives taxes into its account, liquidity is withdrawn from the system as ES balances of the banks are used to make payments to the government's account at the Reserve Bank. This process increases the structural liquidity deficit of the financial system. Conversely, the government paying out funds, such as when a government bond matures, contributes to a structural liquidity surplus (as government deposits at the Reserve Bank are transferred to ES balances of the banks). Changes in government deposits are responsible for most of the day-to-day variation in the structural liquidity position (Graph 3). These changes occur because of the mismatch in timing between government expenditure and receipts.

The increase in government deposits between 2004 and 2007 drove a significant increase in the structural liquidity deficit. These deposits arose from budget surpluses that were generally held on deposit at the Reserve Bank. The rapid decline in deposits in late 2007 was associated with the creation of the Future Fund and the subsequent withdrawal of these deposits from accounts held at the Reserve Bank. As a result of these withdrawals, there was a commensurate decrease in the structural liquidity deficit. Since 2012, the government has increased the balances it has placed on deposit at the Reserve Bank. Some of the increase in deposits reflects the prefunding of nominal expenditure, which has increased. The build-up and subsequent run-down in the government's account for these purposes has contributed to an increase in both the variability and level of the structural liquidity deficit.

Graph 3
Government Deposits and Structural Liquidity



Source: RBA

Gold and foreign exchange reserves

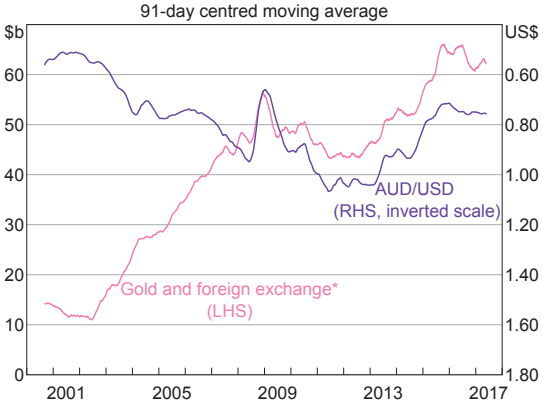
Gold and foreign exchange reserves are held by the Reserve Bank for a variety of reasons, including for potential exchange rate intervention and other policy purposes.[5] When the Reserve Bank acquires foreign exchange reserves, it pays for the foreign currency by selling Australian dollars to a bank. As the settlement of the Australian dollars occurs in the bank's ES account, a purchase of foreign currency will lead to an increase in liquidity as its ES account is credited. Although these transactions affect domestic liquidity, they are classified as exogenous transactions as they are typically initiated by the Reserve Bank for policy reasons other than managing domestic liquidity.

The increase in foreign exchange reserves between 2002 and 2006 largely reflected the process of replenishing reserves following the preceding period of intervention ending in 2001 (Graph 4).[6] In more recent years, however, valuation effects have been the main driver of the increase in gold and foreign exchange reserves; these valuation effects only affect structural liquidity if they are realised as part of a transaction with the Reserve Bank.

5 For further details, see Vallence (2012).

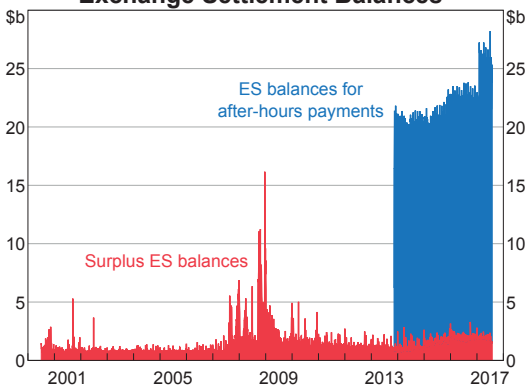
6 For further details, refer to the Reserve Bank's annual reports over this period. In particular, RBA (2006) provides a summary of reserves replenishment operations.

Graph 4
Gold and Foreign Exchange Reserves
91-day centred moving average



* Excludes USD swap facility
Source: RBA

Graph 5
Exchange Settlement Balances*



* Total ES balances are as at midnight, after late direct entry (DE) payments; Surplus ES balances refer to the portion of total ES balances in excess of contracted open repo positions and adjusted for late DE payments.
Source: RBA

Exogenous changes in the demand for ES balances

Banks and a range of other financial institutions hold ES accounts at the Reserve Bank to facilitate the settlement of payments, both with each other and the Reserve Bank. Through its domestic market operations, the Reserve Bank seeks to ensure that the supply of ES balances is sufficient to meet the prevailing demand by financial institutions and ensure that the cash rate trades at its target.[7]

Prior to the global financial crisis, financial institutions typically sought to maintain their aggregate ES balances at around $750 million (red columns in Graph 5). The onset of the financial crisis, however, led to an increase in banks' demand for ES balances, resulting in a commensurate increase in the structural liquidity deficit in 2007–09. To accommodate this additional demand, the Reserve Bank increased the supply of ES balances though its domestic market operations. As conditions in financial markets normalised, the structural liquidity deficit declined as the precautionary demand for ES balances subsided.

The introduction of the same-day settlement of direct entry (DE) payments in November 2013 saw financial institutions increase their holding of ES balances. This was to ensure that they would have sufficient liquidity buffers to meet their payment obligations outside of normal banking hours. This increase in the structural liquidity deficit could have been accommodated through domestic market operations. However, a new standing facility, known as 'open repos', was set up to supply liquidity for after-hours payments purposes independently of domestic liquidity operations.[8] As a result, there was no net change in the structural liquidity position arising from the introduction of the same-day settlement of DE payments.

From January 2015, there has been a slight increase in the size and volatility of demand for ES balances from banks seeking to comply with the Liquidity Coverage Ratio (LCR) by holding

7 If the Reserve Bank supplies ES balances in excess of market demand, then the excess supply of balances should make institutions more eager to lend funds, and therefore places downward pressure on the cash rate. Conversely, if the Reserve Bank were to supply too few balances, then the cash rate would come under upward pressure as institutions compete for the available balances. For further details, see RBA (2003) and Debelle (2008a).

8 The introduction of same-day settlement of DE is described in more detail in RBA (2014) and Fraser and Gatty (2014).

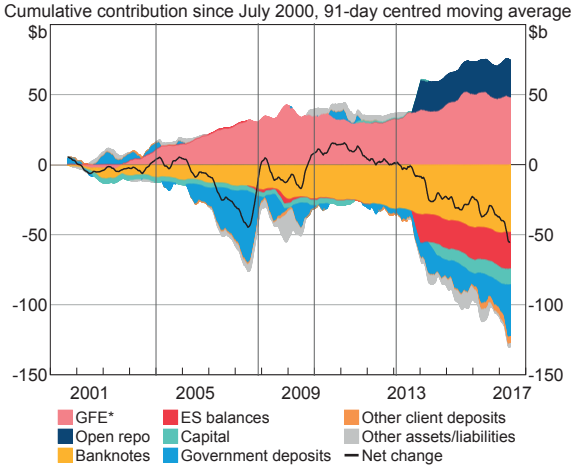
additional ES balances.[9] In response to this change in demand, the Reserve Bank regularly adjusts the quantity of ES balances available. Due to the relatively small magnitude of these changes, the impact on the day-to-day structural liquidity position is typically not appreciable.

Long-run Trends in the Structural Liquidity Position

Since 2000, structural liquidity has behaved in somewhat different ways across five different episodes (Graph 6):

- **Stability (2000–03)** – the structural liquidity position fluctuated in a relatively small range. This reflected increases in the stock of banknotes on issue that were coincidentally offset by other exogenous transactions. In the first half of the period, this was largely due to decreases in government deposits. In the second half, this reflected increases in gold and foreign exchange reserves as a result of reserves replenishment activity.
- **Budget surpluses and the Future Fund (2004–07)** – the structural liquidity deficit increased largely in response to increases in government deposits, although the ongoing issuance of banknotes also contributed. Partially offsetting this was a further replenishment of foreign exchange reserves. At the end of the period, the withdrawal of deposits by the Future Fund (from the Reserve Bank's accounts) led to a sharp increase in structural liquidity as these balances were transferred to the financial system.
- **Global financial crisis (2008–09)** – the financial crisis saw an increase in the precautionary demand for banknotes and ES balances, which drove a small increase in the structural liquidity deficit. The increase in gold and foreign exchange reserves during this period predominantly reflected valuation effects that were offset by a commensurate increase in other liabilities on the balance sheet.
- **Stability (2010–12)** – the issuance of banknotes was more subdued as the demand for precautionary cash holdings normalised, offsetting some of the trend growth. There was no material change in structural liquidity arising from transactions in gold and foreign exchange reserves, and government deposits were relatively stable throughout this period.
- **Government deposits and the issuance of banknotes (2013–17)** – the increase in the structural liquidity deficit largely reflected an increase in government deposits. The ongoing issuance of banknotes drove much of the remaining increase in the structural liquidity deficit. The introduction of same-day settlement of DE payments had no net impact on the structural liquidity position as the increase in payments demand for ES balances was offset by the supply of liquidity through open repos.

Graph 6
Change in Structural Liquidity
Cumulative contribution since July 2000, 91-day centred moving average



* Gold and foreign exchange; excludes the USD swap facility
Source: RBA

9 Further information on the demand for ES balances arising from the LCR can be found in RBA (2015).

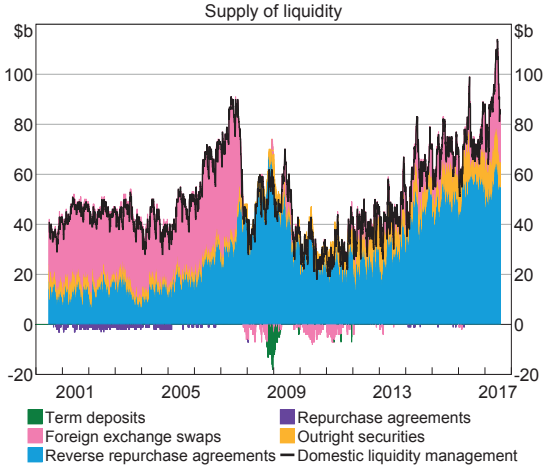
Sterilising the Structural Liquidity Deficit

The Reserve Bank prepares daily forecasts of changes in structural liquidity in order to assess the appropriate size of its open market operations each morning.[10] Further operations can be conducted later in the day if needed to ensure that the liquidity available at the end of the day meets the system's demand. Due to the persistent structural liquidity deficit, domestic market operations have generally sought to inject liquidity into the system. This has been supplied through a combination of repos, foreign exchange swaps and outright purchases of government securities (Graph 7).[11,12]

When conducting domestic market operations, the Reserve Bank takes a number of factors into consideration. These include conditions in domestic markets, interactions with market participants, the expected returns on its investments and projections of future changes in the structural liquidity position. Reflecting these factors, the Reserve Bank's use of different types of transactions to manage the structural liquidity position has varied over time:

- **The early 2000s** – domestic market operations were influenced heavily by the increase in the Reserve Bank's balance sheet and the consolidation of the Australian Government Securities (AGS) market. The decline in the amount of AGS on issue limited the availability of collateral to secure lending under repos. At the same time, government budget surpluses resulted in additional funds being placed on deposit, increasing the structural liquidity deficit, which needed to be offset through domestic market operations. If the Reserve Bank had conducted most of its transactions in the repo market, this combination of factors would have led the Reserve Bank to hold an increasingly large proportion of AGS outstanding.[13] Some of these limitations were overcome through the progressive widening of the range of collateral eligible to secure reverse repo transactions. However, the persistent structural liquidity deficit meant that foreign exchange swaps (which do not involve the use of AGS collateral) were an important part of domestic market operations.[14,15] Repo

Graph 7
Domestic Liquidity Management
Supply of liquidity



Source: RBA

10 For further details on liquidity forecasting, see Baker and Jacobs (2010).

11 For information on domestic market operations and the instruments used, see <https://www.rba.gov.au/mkt-operations/dom-mkt-oper.html>.

12 On occasion, the Reserve Bank has withdrawn liquidity from the system using repos, foreign exchange swaps, term deposits and sales of outright securities. Such transactions have been conducted relatively infrequently, typically on days where there has been a significant increase in structural liquidity or to fine-tune system liquidity.

13 In 2001, it was estimated that, if the structural liquidity deficit was offset using only reverse repos, then the Reserve Bank would hold about 40 per cent of all securities issued by the Australian and state governments (RBA 2001). By comparison, if the current structural liquidity deficit was sterilised entirely through reverse repos secured by Australian and state government securities, the Reserve Bank would hold around 10 per cent of the combined total of securities.

14 The decision to widen access to domestic securities rather than rely even more on foreign exchange swaps also reflected a desire on the part of the Reserve Bank to maintain flexibility in managing the composition of the assets on its balance sheet. For further details, see RBA (2003) and RBA (2004). For a summary of the timeline of the expansion of eligible collateral, see Debelle (2008b).

15 Further details on the role of foreign exchange swaps during this period can be found in RBA (2008a).

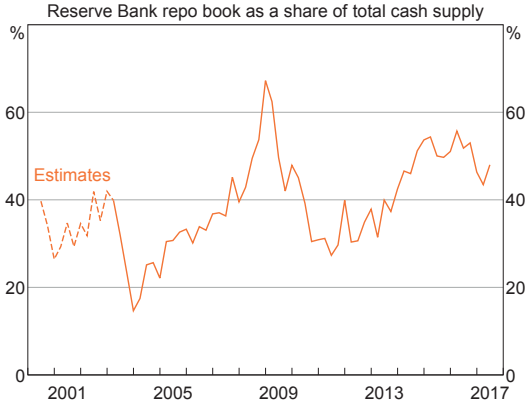
transactions were also conducted on a small number of days each month to assist in withdrawing liquidity when there was a large increase in structural liquidity.[16]

- **The global financial crisis** – in late 2007, following the withdrawal of deposits by the Future Fund, the structural liquidity deficit of the system declined. To offset the corresponding increase in structural liquidity, the Reserve Bank allowed its use of foreign exchange swaps to wind down. At the same time, the onset of the global financial crisis saw the Reserve Bank alter the composition of its assets towards domestic securities markets by supplying additional liquidity through repos (secured by a wider range of eligible domestic collateral) in response to the impact of the crisis.[17]

  To facilitate the provision of liquidity to term domestic securities markets, the Reserve Bank regularly offered to transact at longer terms in its repo operations. One implication of this was that the liquidity provided through these operations did not need to be rolled over (or resupplied) as frequently. In order to continue supplying liquidity to these markets without increasing the overall amount of liquidity available in the system, the Reserve Bank offered to withdraw the excess (short-term) liquidity. This was achieved through a combination of foreign exchange swaps and the introduction of a term deposit facility. This process had the effect of ensuring that the net liquidity supplied through domestic market operations was consistent with the system's demand for liquidity.

- **The post-crisis period** – since the financial crisis, liquidity has been provided mainly using repos. Growth in the repo book over this period has been supported by an increase in the stock of eligible securities, particularly as the issuance of AGS and semi-government securities has increased. The expansion of collateral eligibility and changes in financial markets makes it difficult to compare market shares over time. Nonetheless, it is clear that the Reserve Bank has become a more important supplier of funds into the repo market over recent years (Graph 8).

Graph 8
Repurchase Agreements
Reserve Bank repo book as a share of total cash supply



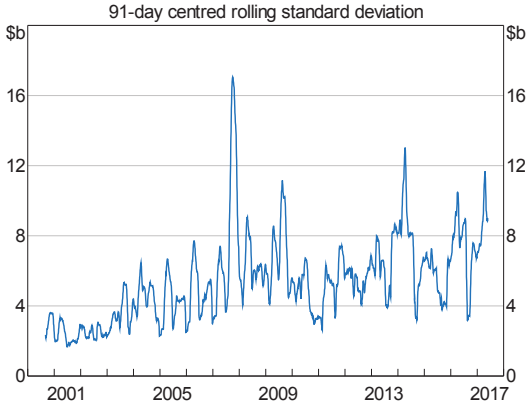
Sources: APRA; RBA

The repo market has only limited ability to absorb rapid changes in the Reserve Bank's positions. The Reserve Bank has therefore increasingly used foreign exchange swaps and outright securities transactions in response to larger fluctuations in the structural liquidity position (Graph 9). Outright securities have been mainly used to manage the liquidity impact of AGS bond maturities, with the associated structural liquidity injections on some days now regularly exceeding $15 billion. Foreign exchange swaps have also been utilised more over recent years to assist in the management of some of the more regular large fluctuations in structural liquidity.

16 The domestic liquidity management implications of these structural liquidity events, typically public sector pay days and transfers of GST receipts to the states, are described in RBA (2003).

17 For further details, see RBA (2008b).

Graph 9
Volatility in the Structural Liquidity Position
91-day centred rolling standard deviation



Source: RBA

Summary

Domestic market operations seek to ensure that there is an appropriate amount of liquidity in the financial system. Since July 2000, the Australian financial system has operated with a structural liquidity deficit. This has reflected the structure of the Reserve Bank's balance sheet, which is determined by exogenous transactions. As a result, this has meant that domestic market operations have, in net terms, been required to inject liquidity into the system.

Over time, the size of the structural liquidity deficit (and therefore domestic market operations) has varied depending on demand for Reserve Bank liabilities. It has also been affected by reserves replenishment activities in the early 2000s. Notably, the steady growth in the demand for banknotes consistently added to the deficit. At the same time, changes in government deposit balances have helped to drive changes in the structural liquidity position. In accommodating the liquidity needs of the financial system, the Reserve Bank has supplied liquidity through reverse repos, foreign exchange swaps and the outright purchase of securities.

Appendix A: The Impact of Transactions on Liquidity and the Balance Sheet

A stylised central bank balance sheet is constructed to analyse the effects of different types of transactions on the structural liquidity position. By appropriately classifying the stocks on the balance sheet into two categories, reflecting whether they arise from the Reserve Bank's domestic market operations or as a result of exogenous transactions, it is possible to examine how exogenous transactions have influenced the domestic market operations conducted by the Reserve Bank.

The purchase of banknotes by a commercial bank, such as to restock its ATMs, is an example of an exogenous transaction that withdraws liquidity from the system. This is because purchases of banknotes from the Reserve Bank must be paid for using ES balances. The effect of this is to transform ES balances into another form of liability (banknotes on issue) on the balance sheet (Table A1). For example, a $2 billion purchase of banknotes increases the stock of banknotes on issue by $2 billion while simultaneously reducing system liquidity (the availability of ES balances) by the same amount.

In order to ensure that total system liquidity remains consistent with demand, the Reserve Bank conducts domestic liquidity management operations to offset (sterilise) this withdrawal of liquidity. The Reserve Bank could re-inject the $2 billion of liquidity by contracting a reverse repo transaction with a financial institution. Such a transaction would restore the availability of ES balances to be in line with demand again, at $25 billion. However, it also leads to a $2 billion increase in the balance sheet as the stock of reverse repos (an asset) and ES balances (a liability) both increase by $2 billion. Regardless of the mechanism used to inject liquidity, there is

Table A1: Balance Sheet Effects of a Purchase of Banknotes
Stylised balance sheet, $ billions

Assets	Initial	Transaction	Sterilisation	Final
Domestic market operations	***85***	**–**	**+2**	***87***
Reverse repos	55		+2	57
Outrights	10			10
Foreign exchange swaps	20			20
Exogenous items	***85***	**–**		***85***
Gold and foreign exchange	60			60
Open repo	25			25
Other assets	–			–
Total assets	**170**	**–**	**+2**	**172**

Liabilities	Initial	Transaction	Sterilisation	Final
Domestic market operations	**–**			**–**
Repos	–			–
Term deposits	–			–
Exogenous items	***170***	**–**	**+2**	***172***
Deposits	45			45
Banknotes on issue	75	+2		77
ES balances	25	–2	+2	25
Capital	15			15
Other liabilities	10			10
Total assets	**170**	**–**	**+2**	**172**

Source: RBA

a net increase in the supply of liquidity provided through the Reserve Bank's domestic market operations.

Exogenous transactions initiated by parties other than the Reserve Bank that result in the withdrawal of liquidity from the system are associated with an increase in demand for other central bank liabilities on the balance sheet. Such transactions include purchases of banknotes or the deposit of funds into client accounts. The Reserve Bank may also carry out transactions on its own behalf that act to reduce system liquidity. These transactions act on the asset side of the balance sheet, such as the sale of gold and/or foreign exchange reserves. Conversely, exogenous transactions that result in the creation of additional liquidity are either initiated by third parties and reflect a reduction in demand for central bank liabilities or are initiated by the Reserve Bank to purchase additional assets.

In both cases, domestic market operations seek to realign the availability of liquidity within the system to be in line with demand and will, therefore, only be conducted in response to exogenous transactions that impact upon the availability of liquidity.[18]

18 Changes in the demand for liquidity by participants translate into a change in the demand for ES balances. While there is no explicit exogenous transaction directly affecting the central bank balance sheet in this case, domestic liquidity management operations must nevertheless accommodate the exogenous change in demand for this liability.

Deriving the Structural Liquidity Position

As exogenous transactions have an impact on the availability of liquidity, the net sum of these exogenous transactions on the central bank's balance sheet provides an indicator as to the structural liquidity position of the system. When the sum of these exogenous items is a net liability, the system would operate with a shortage of liquidity in the absence of domestic market operations. In the stylised balance sheet, the central bank has a structural liquidity deficit of $85 billion (Table A2). Over time, there will be fluctuations in the structural liquidity position as the composition of the balance sheet is influenced by exogenous transactions.

Table A2: Structural Liquidity Position
Stylised balance sheet, $ billions

	Balance sheet	Structural liquidity position
Assets	**170**	**85**
Reverse repos	55	
Outrights	10	
Foreign exchange swaps	20	
Gold and foreign exchange	60	60
Open repo	25	25
Liabilities	**170**	**170**
Repos	–	
Term deposits	–	
Deposits	45	45
Bankotes on issue	75	75
ES balances	25	25
Capital	15	15
Other liabilities	10	10
Structural liquidity position		**–85**

Source: RBA

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Shadow Bank Lending to the Residential Property Market

Michael Gishkariany, David Norman and Tom Rosewall*

Shadow bank lending can play an important role in the economy, but on a large enough scale it could damage financial system resilience. Domestic banks have tightened standards for lending to the residential property market over recent years, creating an opportunity for other lenders to expand. However, shadow banks appear to account for only a small share of total property loans in Australia. Their share of lending for property development has increased more than for housing lending.

Shadow Banking

Shadow bank financing is similar to bank lending, but typically more risky. The Financial Stability Board (FSB) defines shadow bank lending as credit intermediated outside of the regulated banking sector. Shadow bank lending can play an important role in supporting economic activity by broadening access to credit for parts of the economy that have difficulties accessing bank loans. It can also foster competition between lenders and distribute risk away from systemically important parts of the financial system. Like traditional banking, shadow bank activities typically involve maturity or liquidity transformation and the use of leverage.[1] However, a fundamental difference is that shadow banks operate with less prudential oversight. This can lead shadow banks to adopt much riskier business models. Shadow bank lending can also pose threats to the stability of the financial system if the additional credit amplifies or propagates pre-existing financial system vulnerabilities. This is especially problematic if competitive pressures from the shadow bank sector encourage banks to loosen lending criteria, or if shadow banks create an avenue for borrowing that circumvents prudential regulation.

Many of these attributes of shadow bank lending were present in the lead-up to the financial crisis in the United States in 2008. Securitisation of poor quality assets, maturity transformation by entities without access to central bank liquidity and excessive leverage by non-prudentially regulated broker-dealers all exacerbated underlying vulnerabilities in the US housing market and financial system.[2] In response, an important element of the international regulatory agenda since the global financial crisis has been to steer shadow banks towards more resilient market-based structures (FSB 2014).

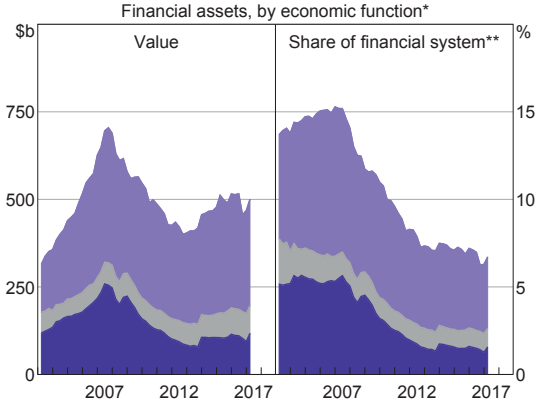
Shadow bank activity in Australia has followed a similar pattern to that in other countries, expanding rapidly until 2008 and then falling sharply over subsequent years (Graph 1). As a share of the financial system, shadow bank

* Michael Gishkariany and David Norman are from Financial Stability Department and Tom Rosewall is from Economic Analysis Department.

1 See Manalo, McLoughlin and Schwartz (2015) for a broader discussion on the nature of shadow banking, both domestically and internationally.

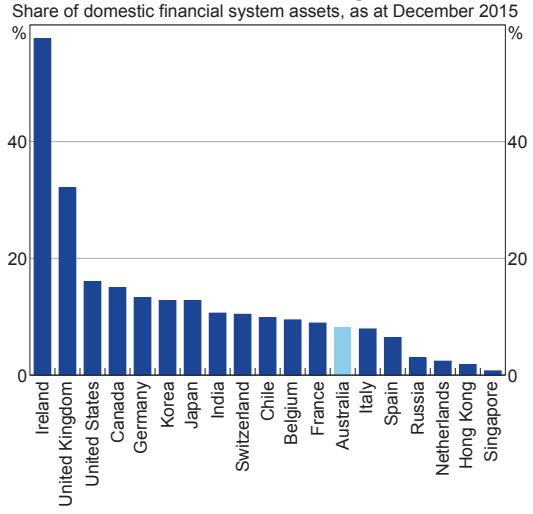
2 For a fuller discussion, see, for example, Edey (2009).

Graph 1
Shadow Banking in Australia
Financial assets, by economic function*



* Total assets for some entity types where financial assets data are unavailable
** Financial system excludes the RBA
*** Including hedge funds and other funds investing in credit products
Sources: ABS; APRA; RBA

Graph 2
Shadow Banking
Share of domestic financial system assets, as at December 2015



Source: FSB

lending is estimated to have declined from 15 per cent in 2007 to around 7 per cent currently. The shadow banking sector in Australia is (and always was) small by international standards (Graph 2).[3] It also has only limited interconnections with the prudentially regulated sector (RBA 2017).

The Australian shadow banking sector can be separated into three main types of entities:

- Managed funds (including hedge funds and other funds investing in credit products): these tend to be equity financed by wealthy individuals, syndicates, trusts and superannuation funds. They account for about two-thirds of Australia's shadow banking sector. Their share has increased a little over the past decade as financial assets have expanded.
- Registered Financial Corporations (RFCs): these entities' principal business is to intermediate debt finance, in the same manner as a bank but without access to deposit funding. They account for around one-sixth of the domestic shadow banking system.[4]
- Wholesale funders: these are securitisation vehicles that are not consolidated within a banking group. They primarily originate residential mortgages and rely heavily on securitisation to fund their activities. They account for one-fifth of the shadow banking system, down from one-third prior to the crisis.

A tightening in regulation of the banking sector has historically contributed to growth of shadow banking. Cizel *et al* (2016) show that macroprudential policies aimed at slowing bank credit growth have typically resulted in lending by banks contracting but lending by non-banks growing. This substitution effect has

3 The measure of shadow banking presented in this article is consistent with the FSB's *narrow* measure, which limits other financial intermediaries' (OFI) assets to those relating to lending activities. Focusing on this measure allows for a more targeted assessment of shadow banking risks to financial stability compared with a broader OFI measure, which includes all assets of non-prudentially regulated entities, including those not related to credit intermediation.

4 Registered finance companies that are consolidated into broader domestic or international banking groups are excluded from this measure.

been found to be stronger in countries where there is a greater reliance on lending from the largest banks (Morris-Levenson, Sarama and Ungerer 2017). Indeed, more onerous capital requirements for banks compared with non-banks were one factor underpinning the rapid growth in global securitisation markets in the mid 2000s. More recently, Kim, Plosser and Santos (2016) show that the US Federal Reserve's guidance to banks to curtail leveraged lending to businesses saw non-banks increase their market share. And in some European countries, most notably the Netherlands, stricter capital requirements for banks have contributed to the notable rise over the past six years in the share of outstanding mortgage credit originated by pension funds and insurers (ECB 2017).[5]

This international experience is instructive given the recent tightening in lending conditions for property in Australia. Most notably, the ability of authorised deposit-taking institutions (ADIs) to originate some types of residential mortgages has been constrained by the Australian Prudential Regulation Authority's (APRA) guidance since the end of 2014 promoting sound lending practices. This has included a benchmark for growth in investor lending, tighter lending standards and recently announced limits on interest-only lending (APRA 2014; APRA 2017). In addition, ADIs have chosen to reduce their lending to borrowers relying on foreign income, prompted by some cases of fraud. Banks have also reduced their appetite for property development lending following a reassessment of the associated risk, in part prompted by supervisory attention.

5 It is debateable whether this strengthens or weakens financial stability. Pension funds and insurers are regulated entities and in the Netherlands are subject to the same macroprudential rules as banks, but these investors may be less familiar with the risks involved in mortgage lending, are not subject to the same degree of regulation as banks, and may impair the profitability of the banking system (see DNB (2016) and ECB (2017) for a fuller discussion of these issues).

Shadow Bank Property Lending

Shadow banking seemingly only accounts for a small share of property lending in Australia, but it is still important to monitor given the potential for it to grow rapidly and influence banks' lending standards. The following sections examine whether shadow banks have increased their share of mortgage origination and lending for property development.

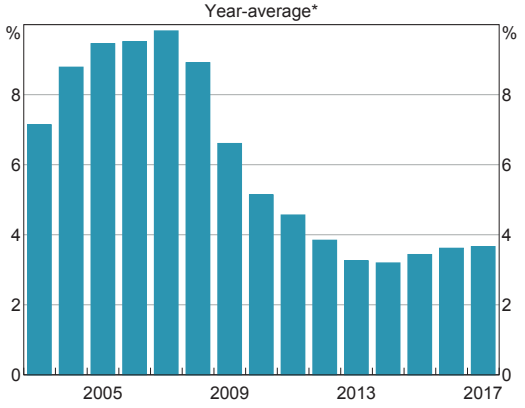
Accurately assessing the scale of shadow bank property lending is difficult because non-prudentially regulated entities are subject to less extensive reporting requirements than ADIs are. RFCs are required to supply only a very small subset of the information APRA collects from banks, and APRA specifies only voluntary reporting arrangements on wholesale funders and no requirements on managed funds. There are various reasons why these requirements are more limited. First, reporting RFCs must be a corporation, meaning that alternative structures (most notably, trusts) that intermediate credit in much the same way are not captured. Second, RFCs are only required to report their activities to APRA if lending accounts for at least 50 per cent of their total assets in Australia and they are predominantly financed by debt; some corporations with a sufficiently large non-lending asset base or that are equity financed are therefore exempt, despite their lending activities being material. Finally, RFCs must self-identify to APRA; some entities might choose not to identify themselves to avoid the reporting burden, while others might be unaware of their reporting obligations. In recognition of this (and other) limitations, this years' Federal Budget proposed to expand the scope of the *Financial Sector (Collection of Data) 2001 Act*.

Lending to the residential mortgage market

Estimates suggest that shadow banks' share of housing credit is small, having fallen in the years after the crisis.

One set of estimates are based on RFC and wholesale funds data collected by APRA and periodic surveys conducted by the Reserve Bank of Australia for the purpose of calculating the monthly financial aggregates (Graph 3).[6] The decline in these estimates was driven by the sharp contraction in residential mortgage-backed securities (RMBS) markets following the global financial crisis; RMBS were used to fund shadow banks' residential mortgage lending. Shadow banks' share of housing credit increased a little over 2015 and 2016 as APRA communicated tighter expectations for ADIs' lending standards and there was some improvement in the RMBS market. However, shadow banks' share of the market has not grown much over the past year, despite further tightening in constraints on banks' lending.

Graph 3
Estimated Non-ADI Share of Housing Credit
Year-average*



* 2017 is year-to-date average
Sources: APRA; RBA

Alternative data sources confirm the slight pick-up in shadow bank housing credit in recent years. RMBS are the main liability used by shadow banks to fund housing credit. Adding the stock of RMBS issued by shadow banks to an estimate of shadow banks' warehouse loans from large banks indicates that shadow banks account for around 2 per cent of total housing credit.[7] This estimate may understate the true figure as it only captures those securities that are eligible for repurchase with the Reserve Bank and does not measure any warehouse finance that could be provided by other financial institutions. Public issuance of RMBS by shadow banks fell sharply after the financial crisis and has remained at a low level, as has been the case in other advanced economies where little or no direct government support is offered to the RMBS market (Graph 4).[8] However, issuance has been stronger in the past year than any other 12-month period since the crisis, with only some portion of this increase reflecting entities reducing their stock of warehoused loans as conditions in the domestic RMBS market have improved (RBA 2017).

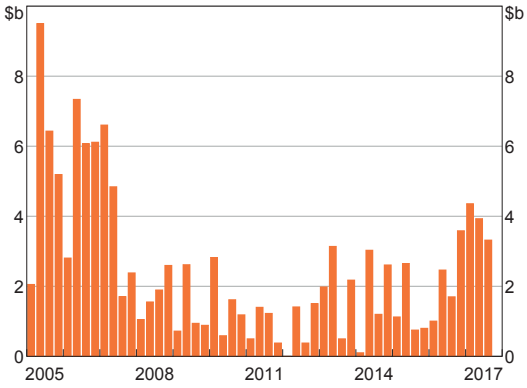
Another potential trigger for shadow banks to expand residential mortgage lending has been the major banks' withdrawal from lending to borrowers who rely on non-resident income. Foreign banks with close ties to the borrowers' home country (enabling them to more readily verify the supporting documentation) appear to be the main entities expanding in response, rather than shadow banks. However, there have been reports of managed funds and RFCs

6 Residential mortgage lending by managed funds (which includes superannuation funds) is estimated to be less than 0.1 per cent of the stock of housing credit, and is excluded.

7 Securitised housing credit from the Reserve Bank's securitisation database is about $22 billion and warehouse facilities with large banks as estimated by APRA total about $11 billion. Warehouse facilities are temporary lines of credit provided to special purpose vehicles, including shadow banks, as they accumulate enough loans to securitise.

8 Government assistance in the form of a purchase program from the Australian Office of Financial Management (AOFM) helped support market activity for a period during the crisis. See Debelle (2009) for more information.

Graph 4
Non-ADI RMBS Issuance



Source: RBA

providing finance to these borrowers, sometimes funded by international private equity and at times facilitated by property sales agents. Some property developers with larger balance sheets have also been offering a form of bridging (or 'vendor') finance to customers unable to obtain bank finance in order to ensure settlement occurs. This shadow bank activity has increased of late, but appears to still be a tiny portion of total housing credit. More generally, it is unlikely that the scale of shadow bank lending to non-residents is large, since such lending has never been a significant part of banks' businesses.

Lending for property development

Assessing shadow bank lending for property development, rather than mortgages, is even more challenging. Entities lending to this sector do not require the visibility needed to sell residential mortgages to households. Australian law also provides less protection for commercial borrowers compared with consumers because they are thought to be more informed and financially sophisticated borrowers.[9] It therefore attracts less regulatory oversight compared with residential mortgage lending. The nature of such lending – large loans to a small number of developers – also means that lending is typically arranged bilaterally rather than through a centralised distribution network of brokers that exists for housing lending.

The way that property development is typically financed also complicates the assessment of credit provision by shadow banks. Historically, developers have commonly funded a moderate-to-large portion of a project with bank loans, while some have supplemented this with additional finance from shadow banks, such as mezzanine debt or equity.[10] Many of the shadow bank financiers have a long association with property development in Australia. These financiers can be funded by (or invest on behalf of) a single wealthy individual or a pool of investors, typically comprised of family trusts, individuals, superannuation funds, other property developers and construction firms.

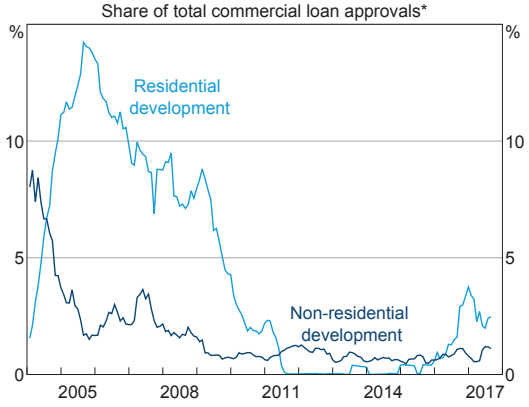
Available data, although incomplete, suggests there has been a pick-up in shadow bank lending to property developers. One partial source is RFC data collected by APRA, which indicate that RFCs' share of residential property development loan approvals fell from a pre-crisis level of 14 per cent to zero in 2011, before increasing to a little under 4 per cent in the second half of 2016 (Graph 5). However, RFCs account for only a portion of shadow bank lending to the property development sector and so these data are incomplete. A broader measure comes from Australian Bureau of Statistics data on managed funds' lending to non-financial corporations.[11] This amounts to $28 billion (compared with $225 billion in

9 Key legislative protection for non-consumer borrowers is in the *Australian Securities and Investments Commission Act 2001*. This specifies some basic protections for commercial borrowers, such as prohibiting unconscionable, misleading or deceptive conduct.

10 In a capital structure, mezzanine debt is between senior debt and equity.

11 These data include superannuation funds and other trust structures. Recent media reports an increase in their lending to property development.

Graph 5
RFC Commercial Loan Approvals
Share of total commercial loan approvals*



* Six-month rolling average
Sources: APRA; RBA

bank loans to commercial property), and has been little changed since 2014. However, this figure is likely to significantly overstate lending to property development as it includes loans made to corporations for any purpose (that is, both non-property related and to purchase established property).[12]

Given the paucity of reliable data, the Reserve Bank's business liaison program provides a useful complement in assessing the growth and nature of shadow bank lending for commercial property. This information suggests that the recent expansion of shadow bank lending for property development is likely greater than suggested by RFC data, but still only partially offsets the pull-back by the major banks. Liaison identifies that some shadow bank lenders that have typically provided higher-risk finance have expanded into offering senior debt that would have historically been provided by a bank. Industry participants have also observed a range of new firms funding property developments, including foreign funds. In addition, some shadow banks have increased the share of project funding they provide as banks have lowered the maximum loan-to-valuation ratio they are willing to offer. The structure of project funding is important as projects in which a bank provides senior debt and a shadow bank provides mezzanine debt will be subject to a level of prudential oversight (as banks approve the credit extension with visibility of the mezzanine debt), unlike deals in which there is no bank involved.

Information on the structure of shadow bank lending arrangements is limited, but deal characteristics appear to vary widely. Shadow bank lenders charge higher interest rates for senior debt than banks, although some lending conditions, such as minimum apartment pre-sale requirements or caps on pre-sales to foreign buyers, can be somewhat more relaxed than those currently imposed by banks. For mezzanine debt, interest rates are reported to be around 15 per cent or higher, and have increased alongside demand from developers as banks have sought to limit their exposure to property development. Property developers in the Bank's liaison program report that there has been an overall tightening in financing conditions despite the expansion of shadow bank lenders, with a higher average cost of funds and reduced availability for developers. Project feasibility has become more difficult to achieve, and higher equity contributions are generally needed.

Constraints to Growth

While shadow bank lending to the domestic property market is estimated to be small, it is important to understand whether these activities can grow rapidly and how they could feed back to bank lending for property.

For residential mortgage lending, a key constraint is the cost and availability of warehouse financing, which is generally provided by a

12 Private equity is another possible source of funding. Available data indicate that total assets for this sector are around $10 billion, but are mostly security investments.

major bank. Data collected by APRA reveals that shadow banks currently have access to about $16 billion in warehouse facilities from large banks, of which $11 billion was drawn as at June 2017. Both estimates are lower than last year, perhaps partly reflecting the decline in shadow banks' inventory of warehoused loans as conditions in securitisation markets have improved. Revisions to APRA securitisation regulations, which come into effect from January 2018, will increase the cost to banks of providing warehouse financing. Banks' willingness to provide warehouse facilities will also be limited by APRA's March 2017 announcement that it would be concerned if 'warehouse facilities were growing at a materially faster rate than an ADI's own housing loan portfolio, or if lending standards for loans held within warehouses are of a materially lower quality than would be consistent with industry-wide sound practices'.

A second constraint to shadow bank activity is their more limited funding options. Shadow banks have only limited access to short-term wholesale markets and no access to deposit funding. Securitisation contributed to a build-up of shadow banking risks prior to the crisis but has since become a more expensive source of funding compared to options available to ADIs, such as deposits. This means that shadow banks will only be competitive when lending to borrowers with lower credit quality that typically pay higher interest rates.

Despite these constraints, it is still possible that other sources of capital could emerge to fund shadow banks' activities. Arguably, this is more likely to occur with the global search for yield in the current low interest rate environment. Alternative sources could include the managed funds industry, either locally or internationally. Innovation in financing arrangements, like that in the Netherlands (see above), could be a way to attract more funding from these sources.

Conclusion

Shadow banks' share of lending to the domestic property market has increased as banks' underwriting standards have tightened since the end of 2014. Nonetheless, the available evidence suggests that shadow banks' residential mortgage lending accounts for only a small share of this market and this share is currently not growing by much. In addition, there are several constraints to this lending being quickly scaled up. Shadow banks' lending to property development – while more difficult to measure – appears to have increased relatively strongly over the past year or so, though from a low base and not likely enough to replace the pull-back by large banks. In many cases, this lending still occurs with some regulatory oversight because banks continue to provide senior debt to these developments (though perhaps less than in the past). Moreover, shadow banks providing mezzanine debt tend to demand a premium for this type of lending, in recognition of the greater risks involved.

Data constraints are a challenge in monitoring the size and growth of shadow bank lending to property. Additional data on shadow bank activities are expected to be collected if proposed legislative changes announced in this year's Federal Budget are passed. This would be an important step to enhance the ability to monitor these activities and assess their impact on financial stability.

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Covered Bonds in Australia

Benjamin Watson*

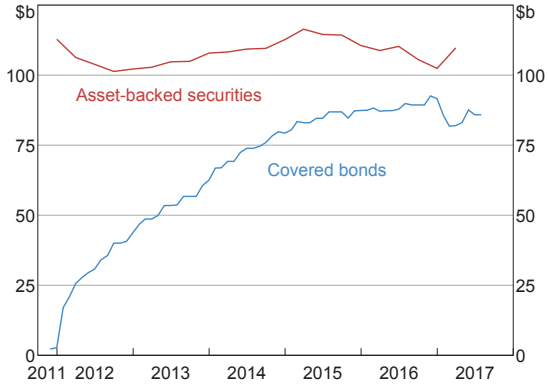
Since their introduction in Australia in 2011, the stock of covered bonds has grown to around $80 billion, or around 15 per cent of Australian financial institutions' long-term debt. Covered bonds are a form of secured funding backed by both the issuer and a specific pool of assets. In practice, covered bonds are typically issued by banks and secured against pools of residential mortgages. Since they are secured against assets, covered bonds provide increased protection for lenders. As a result, they can be issued at lower yields and longer tenors than unsecured bonds and can be easier to issue during periods of market stress. However, covered bonds can reduce the protection of other unsecured creditors who then may require extra return.

Introduction

The Australian covered bond market first came into existence in 2011 when the Australian Government introduced legislation allowing covered bonds to be issued.[1] Since then, the amount of covered bonds on issue has grown significantly and represents around 15 per cent of Australian financial institutions' total long-term debt. With around $80 billion on issue, the Australian covered bond market has become almost as large as the asset-backed securities market (Graph 1).

Issuance of covered bonds by financial institutions varies significantly across countries. For example, the covered bond market in the euro area is well established and accounts for around half of European banks' long-term debt. In contrast, the United States has no specific covered bond legislation and therefore almost no covered bonds are issued by US banks.[2] Globally, the covered bond market grew strongly up to 2013, but has contracted in recent years (Graph 2).[3] Issuance of covered bonds

Graph 1
Asset-backed Securities and Covered Bonds
Total on issue from Australian financial institutions



Sources: ABS; RBA

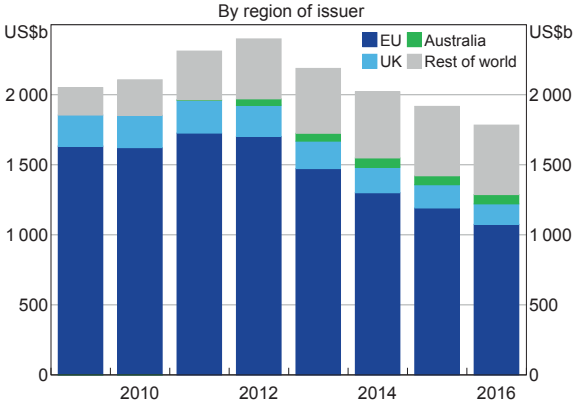
* The author is from Domestic Markets Department.

1 For this article, 'Australian covered bonds' refers to covered bonds issued by Australian financial institutions. *The Banking Amendment (Covered Bonds) Act 2011* was introduced to provide an alternative source of finance that could be useful during times of market stress.

2 See Batchvarov and Caris (2016).

3 Issuance in Germany slowed from 2003, see Packer, Stever and Upper (2007) for more information.

Graph 2
Covered Bonds Outstanding
By region of issuer



Sources: Dealogic; RBA

by European banks has slowed following a reduction in credit growth, a declining amount of eligible collateral in Germany after the withdrawal of public guarantees to public banks and increased issuance of other types of bonds.[4]

This article explains how covered bonds work and looks at the evolution of the Australian covered bond market, including the tenor, pricing and currency of issuance. Even though the market has grown rapidly, there are limits to how much further it can expand.

What is a Covered Bond?

Covered bonds are a form of secured funding for financial institutions. They are secured by a pool of high-quality assets – the 'cover pool' – typically mortgages. Covered bonds have the following essential features:

- The bond is issued by – or bondholders otherwise have full recourse to – a financial institution that is subject to public supervision and regulation.
- Bondholders have a claim against a cover pool of financial assets in priority to the unsecured creditors of the financial institution.
- The financial institution has an ongoing obligation to maintain sufficient assets in the cover pool to satisfy the claims of covered bondholders at all times.
- The obligations of the financial institution in respect of the cover pool are supervised by public or other independent bodies.[5]

The history of covered bonds

The origin of covered bonds can be traced back to the late 18th century, when they were an important source of public funding for Prussia after the Seven Years' War. The concept spread throughout Europe and by the late 19th century many European countries had a covered bond market.

The covered bond market declined in importance in the mid 20th century as capital markets developed and retail deposits grew strongly, which provided the banking system with a stable source of funding for mortgage lending. The covered bond market was revived towards the end of the 20th century amid regulatory changes. An important change was a 1988 European Union (EU) Directive, which established common characteristics of covered bonds and led to greater harmonisation of legal frameworks in the region.[6] The creation of 'jumbo' covered bonds in 1995 was also important to the market's development as it boosted liquidity and attracted more investors.[7]

4 For example, European banks have increased the issuance of bonds that can be counted towards their total loss-absorbing capacity.

5 See ECBC (2017) for more information about the essential features of covered bonds.

6 This refers to the 1988 amendment of the undertakings of collective investment in transferable securities (UCITS) Directive; see *Council Directive 88/220/EEC*.

7 The current definition for jumbo covered bonds includes issuance of a single bond line of greater than €500 million.

Australian covered bond structure

Until the introduction of enabling legislation in 2011, authorised deposit-taking institutions (ADIs) had previously been prohibited from issuing covered bonds, because doing so would have been in conflict with Australia's depositor preference regime.[8] Under the *Banking Act 1959*, depositors are given priority (above that of other unsecured creditors) over the Australian assets of an ADI in the event that an ADI defaults. But in foreign jurisdictions, covered bond holders typically have a higher claim than depositors on a bank's assets in default. The Australian legislation therefore specifies that if the cover pool is insufficient to pay the full claims of the covered bond holders, their residual claims rank below deposit holders but at the same level as holders of senior debt. It also contains a limit on the total volume of covered bonds an ADI may issue, to 8 per cent of its total Australian assets. This limits the extent to which assets can be made unavailable to depositors in the event of default.

Covered bonds were first introduced in Australia with the intention of providing ADIs with an alternative source of finance that could be useful during future times of market stress.[9] This followed the experience of the global financial crisis, when market stress caused some credit markets internationally to seize up.[10] That experience had required the Australian Government to introduce the Guarantee Scheme for Large Deposits and Wholesale Funding to address funding pressures.[11] To ensure covered bonds could address this need without a government guarantee, the legislation included provisions to ensure the quality of the cover pools:

- allowing only limited types of assets to be used in the cover pool
- limiting loan-to-valuation ratios for mortgages in the cover pool
- requiring that the value of the cover pool assets must be at least 103 per cent of the face value of outstanding covered bonds (see Appendix A for further details on the legislative features).

By having recourse to a pool of assets, covered bonds share similarities with asset-backed securities such as residential mortgage-backed securities (RMBS). However, the main difference between the two is that RMBS depend only on the underlying pool of mortgages to pay the security holders, while covered bonds depend on the issuer to pay the security holders, and the assets in the cover pool are used only in the event of default.[12] Another difference in the Australian market is that ADIs do not have an explicit limit for the share of funding they can source from securitisation, while cover pool assets are capped at 8 per cent of an ADI's Australian assets.[13]

The assets inside a cover pool are held by a special purpose vehicle (SPV). This enables the assets to be separately identified and monitored by the 'cover pool monitor', a registered auditor that ensures the accuracy of cover pool information. In the event of an issuer default, the SPV is required to meet the covered bond obligations using the cash flows generated from the cover pool assets. Despite this ring-fencing of

8 Before 2011, ADIs were not permitted by the Australian Prudential Regulation Authority (APRA) to issue covered bonds; see *Banking Amendment (Covered Bonds) Act 2011* for the details of the enabling legislation.

9 Reducing 'the risks associated with dislocation in one or more credit markets' was highlighted as a benefit of introducing covered bonds, see Lonsdale (2011) for a discussion of the covered bond legislation.

10 Covered bond issuers' access to debt markets was also disrupted during the crisis, see RBA (2011).

11 See Schwartz and Tan (2016) for more information on the Australian Government Guarantee Scheme.

12 For more information about the structural features of RMBS, see Arsov, Kim and Stacey (2015).

13 APRA recognises that if an ADI has a large share of securitised funding, this may conflict with depositor preference and that ADIs 'must prudently diversify their funding sources', but is not currently proposing to limit securitisation; see Littrell (2013).

the assets for bankruptcy purposes, the covered bonds are direct, unconditional obligations of the issuing bank and the assets remain on the issuer's balance sheet for the purposes of accounting, tax and capital adequacy.

The Australian Prudential Regulation Authority (APRA) requires issuers to maintain clear rules for how assets are moved between the issuer's balance sheet and the SPV, covering things such as how assets are valued and what entity is responsible for administering the mortgages. In most circumstances, assets can be freely moved back from the SPV to the ADI's balance sheet. Instances where the assets cannot be moved back to the ADI's balance sheet include an event of default of the issuer or if the assets are required to meet the legislated 103 per cent minimum level of collateral in the cover pool.

There are legislative restrictions on the types of assets allowed in cover pools, and issuers of covered bonds can also set their own guidelines for what assets are eligible. For example, most issuers do not allow mortgages past 30 days in arrears to be entered into the cover pool. Additionally, while the legislation allows for commercial mortgages, Australian banks have only issued covered bonds backed by residential mortgages.

Risks and protections for investors

Covered bonds typically receive AAA credit ratings from the major rating agencies, mainly because:

- the issuer's credit rating is sufficiently high. The more highly rated an issuer, the easier it is to obtain a AAA rating on a covered bond
- the quality of the collateral included in the cover pool is sufficiently high. Higher-quality loans (such as loans with lower loan-to-valuation ratios (LVRs) or a longer history of repaying the mortgage on time) enhance the credit quality of the covered bonds
- the issuer commits to provide extra collateral in the cover pool.

The issuer's credit rating has a significant impact on the credit rating of covered bonds. This is because covered bonds usually function like other unsecured debt instruments, with the issuer responsible for meeting coupon and principal payments. In Australia, the issuers of covered bonds are relatively highly rated, with credit ratings of around AA or A; it is easier for these issuers to achieve AAA ratings on their covered bonds, compared with lower-rated issuers.

In the event that the issuer defaults, a key risk faced by covered bond investors is that the assets in the cover pool are insufficient to cover the interest and principal payments on time. This is a particular concern given the mismatch between a covered bond's interest rate and maturity date and those of the assets in the cover pool. For example, covered bonds are usually fixed-rate securities with an average maturity of less than seven years, while the residential mortgages in the cover pool are typically floating-rate with generally longer legal maturity dates (20 to 30 years) and uncertain actual repayment dates. That means, in the event of default of the issuer, the cover pool assets may need to be sold to meet the payments of the covered bonds. Given the generally illiquid nature of pools of residential mortgages, the timely sale of the cover pool assets is a potential concern for covered bond investors.

Some of these risks can be lessened by using hedging instruments, such as interest rate swaps, or by adding certain structural features to the covered bonds. Two common structural features that address these concerns are 'committed over-collateralisation' and 'soft bullet' securities.

'Committed over-collateralisation' is a commitment by the issuer to provide assets in

the cover pool significantly above the value of covered bonds on issue. For example, the major banks generally agree to provide cover pool assets worth around 110 per cent of the value of covered bonds on issue. If the assets in the cover pool were to fall below the committed level, the major credit rating agencies may change their credit rating for the respective covered bond.[14]

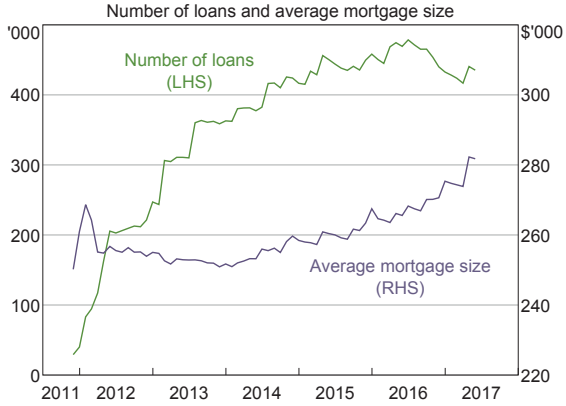
Issuing 'soft bullet' securities is another way that covered bond issuers can reduce repayment risk for investors. A 'hard bullet' security repays its entire principal on a specified date. A soft bullet security also has a set maturity date where the entire principal is due to be repaid, but comes with the option to extend the maturity of the security by a set time (usually 12 months). Triggers for the maturity extension can be the default of the issuer or the consent of the bondholders. The maturity extension provides time to find a buyer for the pool of assets and reduces the risk of a 'fire sale' during a period of market stress. Interest still accrues on the covered bond during the extension period.

Recently, one Australian bank announced that it would issue covered bonds with a conditional pass-through structure, the first covered bond of this type in Australia.[15] Under this structure, covered bonds have a set maturity date where the entire principal is due to be repaid. However, if the issuer defaults, the maturity date is extended significantly and interest and principal payments from the cover pool mortgages are passed through to the bondholders, similar to an RMBS structure. This removes the risk of a forced sale of the cover pool assets in the event of issuer default. In addition, the pass-through structure makes it easier for institutions to obtain AAA ratings on their covered bonds, since the rating will depend more on the quality of the cover pool assets and less on the issuer's rating.

Assets backing covered bonds

In Australia, there are over 400 000 mortgages (with an average size of $280 000) backing covered bonds (Graph 3). Each month, covered bond issuers produce publicly available snapshots of these mortgages. The quality of the loans affects the credit rating of covered bonds. Similar to RMBS, ratings agencies take into account individual mortgage characteristics such as seasoning (the time since the mortgage was originated or refinanced), the LVRs of each mortgage, arrears rates, geographic concentration, and the split between investor and owner-occupier loans.

Graph 3
Australian Cover Pool Mortgages
Number of loans and average mortgage size



Source: Issuer websites

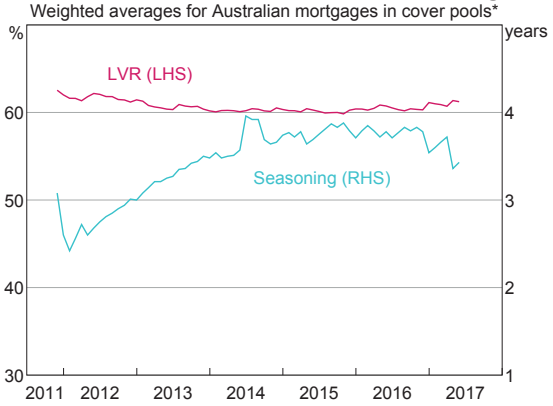
The mortgages backing covered bonds in Australia have weighted-average LVRs of around 60 per cent and this has been little changed since 2012 (Graph 4).[16] The average seasoning of mortgages has been between 3½ and 4 years since 2014. These characteristics are similar to mortgages that underlie RMBS when they are first issued. Other characteristics of mortgages

14 Moody's (2016) defines the commitment as a 'commitment [that] cannot be reversed or reduced at the discretion of the issuer without the issuer (or its directors) facing material negative consequences'.

15 See Bank of Queensland (2017).

16 Here LVR is calculated using the current loan balance of the mortgage and the most recent valuation of the property.

Graph 4
Loan-to-Valuation Ratios and Seasoning
Weighted averages for Australian mortgages in cover pools*



* Weighted by mortgage size
Source: Issuer websites

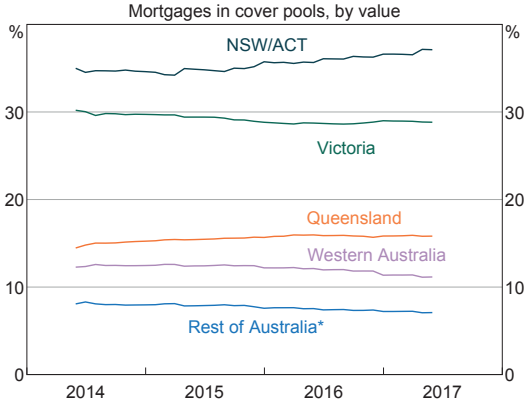
in cover pools, such as average size and average mortgage rate, appear similar to data for all Australian mortgages.

Ratings agencies assign lower credit ratings to pools of mortgages that are geographically concentrated. In practice, the geographic distribution of mortgages in cover pools appears to follow Australia's population shares by state (Graph 5). The largest difference is for Queensland, which has around 20 per cent of Australia's population but only around 16 per cent of mortgages in cover pools, by value. NSW/ACT has the largest over-representation, with 37 per cent of mortgages in cover pools compared with around 33½ per cent of Australia's population. There has been a slight increase in NSW's share of mortgages in recent years. More generally, state shares are also likely to be affected by differences in household income levels and average mortgage sizes. For example, states with higher household income levels may have larger average mortgage sizes and therefore a larger share of mortgages, given those households' greater ability to service larger mortgages.

Recent Developments in the Covered Bond Market

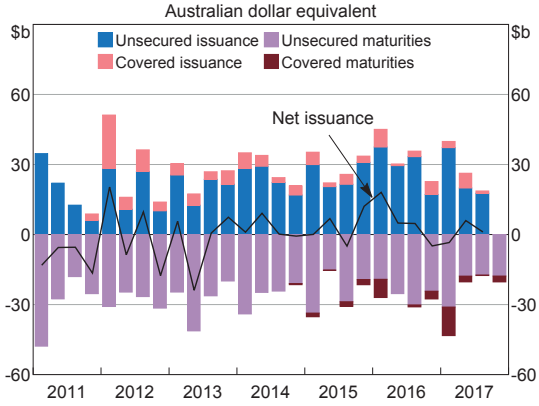
Since their introduction in Australia in October 2011, covered bonds have grown to around $80 billion on issue, with most issuance coming from the major banks. After a large volume of issuance initially, covered bonds have remained a small but stable share of bank's total bond issuance (Graph 6). Recent issuance has mainly been used to refinance maturities. As noted above, the legislation limits the assets that ADIs can provide into the cover pool to 8 per cent of their resident assets. In practice, the major banks issue far less than this limit (Graph 7). This

Graph 5
Geographic Concentration
Mortgages in cover pools, by value



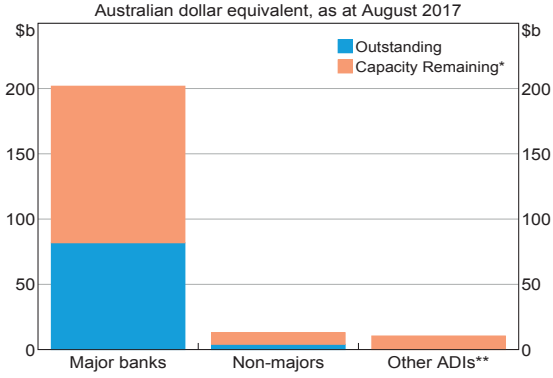
* Northern Territory, South Australia and Tasmania
Source: Issuer websites

Graph 6
Australian Banks' Bond Issuance*
Australian dollar equivalent



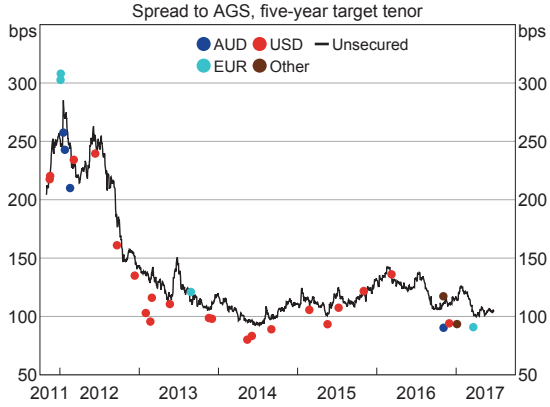
* Latest quarter issuance to date
Source: RBA

Graph 7
Covered Bonds on Issue
Australian dollar equivalent, as at August 2017



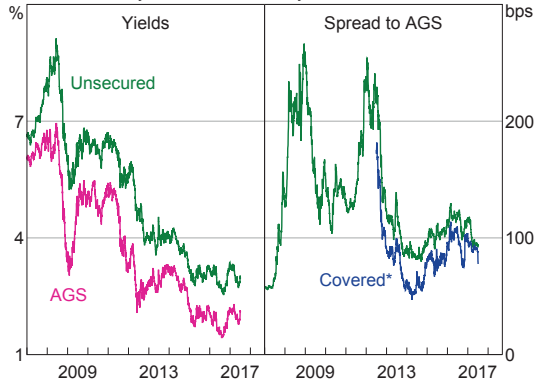
* Issuance capacity based on resident assets and over-collateralisation levels
** Five largest ADIs, by volume of housing loans, without covered bonds
Sources: APRA; RBA

Graph 8
Major Banks' Bond Pricing*
Spread to AGS, five-year target tenor



* Dots are covered bonds spreads at primary issuance, line is secondary market spread for Australian dollar unsecured bonds
Sources: RBA; UBS AG, Australia Branch

Graph 9
Major Banks' Bond Pricing
Three to five-year residual maturity, Australian dollar bonds



* Covered bond pricing interpolated to a target tenor of four years using bonds with a residual maturity between two and 10 years
Sources: Bloomberg; UBS AG, Australia Branch

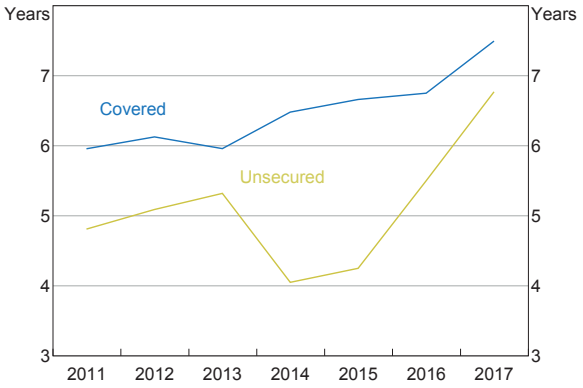
provides a buffer for any future period of market stress, where issuing covered bonds may be easier than issuing unsecured bonds.

Pricing of covered bonds for Australian banks at primary issuance was initially similar to secondary market pricing on unsecured bonds, suggesting that there was little pricing advantage compared with unsecured bonds (Graph 8). This could have reflected the possibility that investors were initially unfamiliar with the new instrument, along with generally stressed market conditions in 2011/12 amid concerns about the European sovereign debt market. Since then, spreads of covered bonds to Australian Government Securities (AGS) at primary issuance have generally been tighter than for unsecured bonds. Secondary market spreads of covered bonds have been around 20 basis points below similar spreads for unsecured bonds over recent years (Graph 9).

However, it should be noted that while covered bonds have lower yields than similar unsecured bonds, they may not necessarily reduce an institution's overall borrowing cost. Investors in unsecured debt could theoretically demand a higher return if their investment is subordinated to a substantial volume of covered bonds. So overall, the lower cost of covered bonds could be offset by higher costs of unsecured bonds.

Covered bonds have other potential advantages for issuers such as diversifying the types of investors to include those that may not invest in unsecured debt. They may also allow the issuer to borrow for longer tenors than in the case of other debt instruments. For instance, tenors at primary issuance for covered bonds are, on average, one to two years longer than unsecured bonds (Graph 10). Most covered bonds issued by

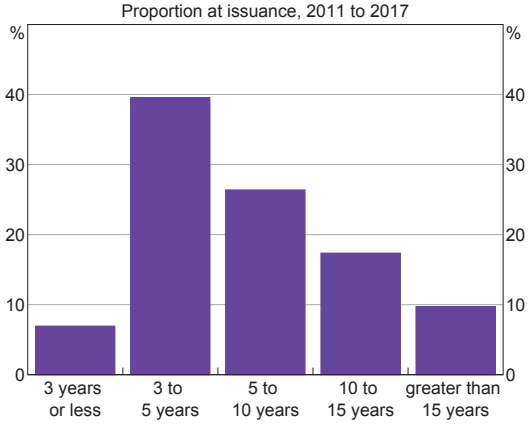
Graph 10
Weighted Average Tenor of Bank Bonds
At issuance



Source: RBA

Australian banks are around the 5- and 10-year tenor, with around one-quarter of issuance for tenors longer than 10 years (Graph 11). Issuing for longer tenors may also help banks extend the average maturity of their liabilities to meet regulatory requirements, such as the net stable funding ratio.

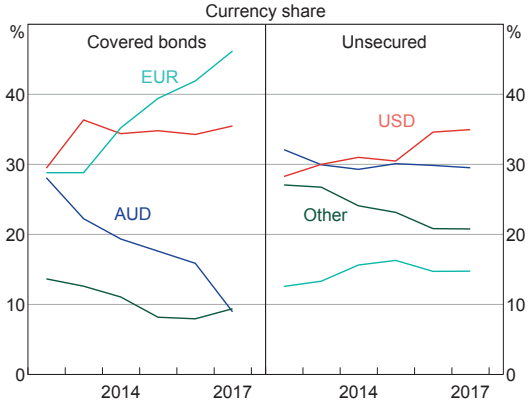
Graph 11
Australian Covered Bond Tenor
Proportion at issuance, 2011 to 2017



Source: RBA

Given Europe's well-established covered bond market, many Australian institutions undertake a large share of covered bond issuance in the euro area.[17] Currently just under half of Australian banks' covered bonds are denominated in euros, compared with around 15 per cent of unsecured bank bonds (Graph 12). The US dollar is an important funding currency for both covered and unsecured bonds, with around one-third of issuance for both types of bonds denominated in US dollars. Covered bond issuance in Australian dollars has declined markedly in recent years, offset by an increase in euro-denominated issuance.

Graph 12
Australian Bank Bonds
Currency share



Source: RBA

Conclusion

The market for Australian covered bonds has grown significantly since enabling legislation was enacted in 2011. The stock outstanding of covered bonds is around $80 billion and covered bond issuance has become a small but stable share of Australian banks' total bond issuance. By having recourse to a pool of assets, covered bonds provide investors increased protection against default. Covered bonds also allow for issuance at longer tenors than unsecured bonds and provide issuers access to a different group of

17 For Australian covered bonds, the location of issuance and the currency of issuance are usually related. For example, nearly all Australian covered bonds denominated in US dollars have been issued in the US market.

investors. Pricing of covered bonds has generally been 20 basis points tighter than similar unsecured bonds and issuance has been mainly in the European market.

Appendix A: Key Legislative Features of Covered Bonds in Australia

The Banking Amendment (Covered Bonds) Act 2011 specifies that the following assets are allowed in cover pools in Australia:

- residential mortgage
- commercial mortgage
- at-call deposit with an ADI
- bank-accepted bill or certificate of deposit with less than 100 days to maturity that is Reserve Bank repo-eligible
- Australian Government Security or semi-government security
- derivatives that hedge risks related to the assets in the cover pool or liabilities secured by the cover pool.

The legislation also discourages loans above certain LVRs; residential mortgages with an LVR greater than 80% are permitted in the cover pool but the value of the mortgage exceeding 80 per cent is not counted as an asset. Similarly, the portion of a commercial mortgage that exceeds 60 per cent LVR is not counted as an asset in a cover pool.

Cover pool assets also have three important legislative requirements:

- The cover pool must be monitored by a registered auditor.
- An ADI cannot issue a covered bond if the total cover pool assets would exceed 8 per cent of the ADI's resident assets.
- Cover pool assets must be at least 103 per cent of the face value of covered bonds.

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The Growing Demand for Cash

Gordon Flannigan and Andrew Staib*

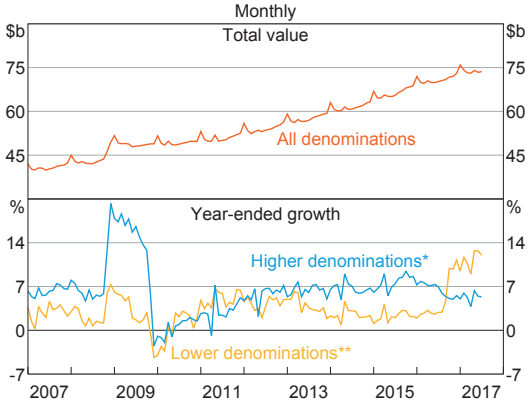
While survey data indicate that the share of Australian consumers' payments made with cash continues to fall, the number (and value) of banknotes in circulation continues to grow at around its trend pace of 6 per cent per year. This article discusses the reasons for these diverging trends, including: population, inflation and real income growth; a slower decline in total (rather than relative) cash payments; high cash users not captured by survey data; and the increasing stock of banknotes held for non-transactional purposes.

Introduction

Cash is an important element of the Australian payments system. Growth in the value of banknotes in circulation has been broadly steady at around 6 per cent per annum for more than a decade.[1] Currently, the total value of banknotes in circulation is around $74 billion (Graph 1). Growth is evident in all denominations, although growth in demand for the higher denominations has generally outpaced that of the lower denominations over the past 10 years.[2]

At the same time, evidence from the Reserve Bank's triennial Consumer Payments Survey (CPS) indicates that the share of payments (by number) made with cash has fallen substantially over the same period.[3] In 2007, around 70 per cent of consumer payments were made with cash. This fell to around 37 per cent in 2016 (Graph 2). In 2016, cards (debit and credit combined) overtook cash as the most common payment method.

Graph 1
Value of Banknotes in Circulation



* $50 and $100 denominations
** $5, $10 and $20 denominations
Source: RBA

Investigating the share of consumer payments made with cash is important for understanding consumer payment preferences. In isolation, however, it is difficult to draw inferences from these data regarding the value of banknotes required to meet the overall demand for cash, which also includes demand for cash from other transactional users (e.g. tourists and businesses) and as a store of value.

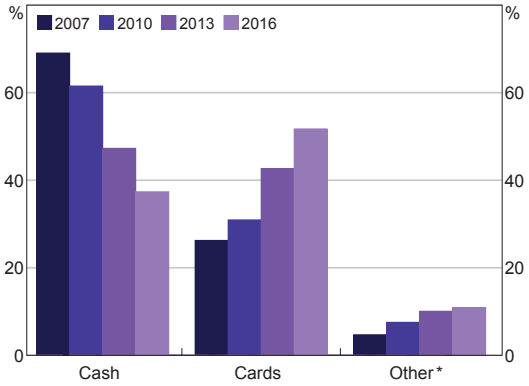
* The authors are from the Note Issue Department.

1 The exception was during the global financial crisis when the growth in banknotes in circulation, particularly high-denomination banknotes, was considerably higher than the long-term trend.

2 The pick-up in growth in the lower denominations over the past year largely reflects the introduction of the new $5 banknote in September 2016, with the previous series $5 banknote also remaining in circulation.

3 The Reserve Bank has conducted a survey of consumer payments every three years since 2007. See Emery, West and Massey (2007); Bagnall, Chong and Smith (2011); Ossolinski, Lam and Emery (2014); Doyle *et al* (2017a); and Doyle *et al* (2017b).

Graph 2
Consumer Payment Methods
Share of the total number of payments



* Includes prepaid, gift and welfare cards, cheques, money orders, Cabcharge, internet/phone banking, BPAY, PayPal and other online payment methods (e.g. POLi)
Sources: Colmar Brunton; Ipsos; RBA; Roy Morgan Research

This article first discusses the factors influencing banknote demand over the long term, and then explores the reasons for the divergence between the continued growth of banknotes in circulation and the CPS results.

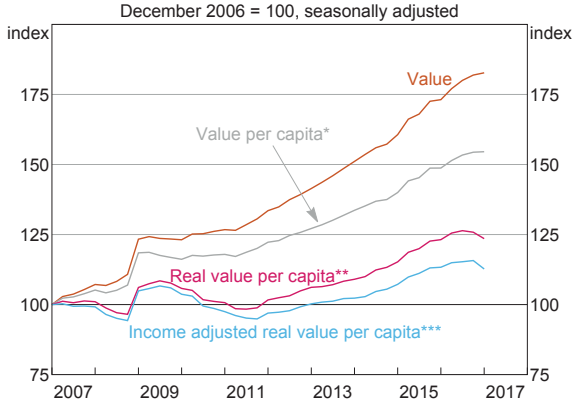
Long-term Drivers of Banknote Demand

Previous research by the Reserve Bank has found that the long-term determinants of banknote demand included the size of the Australian economy (nominal GDP), the interest rate and access to the payments system (the number of ATMs, EFTPOS machines and bank branches in Australia).[4] Updating this work using the latest data finds similar results (see Appendix A: Model 1).

The size of the economy is the most important driver of banknote demand, with a 1 per cent increase in nominal GDP associated with a 1 per cent increase in cash demand over the long term. While an increase in nominal GDP raises demand for all denominations, its impact is greatest on the higher denominations. Nominal GDP simultaneously captures the effect of population growth, inflation and real income growth, which suggests that these factors are important drivers of cash demand.

In fact, these three factors can explain much of the growth in circulation over the past 10 years. To see this, the value of banknotes in circulation can be adjusted to account for each factor (Graph 3). To begin with, the top line shows how the total value of banknotes in circulation has increased since 2007. The line immediately below adjusts this to account for Australia's increasing population. The next line incorporates the rate of inflation, and the final line accounts for the increase in real income per capita.

Graph 3
Banknotes in Circulation
December 2006 = 100, seasonally adjusted



* Adjusted by population
** Adjusted by population and inflation (GDP deflator)
*** Adjusted by population, inflation (GDP deflator) and real GDP per capita
Sources: ABS; RBA

Compared with the total value of banknotes in circulation, the income adjusted real value of banknotes per capita in circulation has increased quite slowly over the past 10 years: around 1 per cent per annum, on average. This suggests that the value of banknotes in circulation has grown broadly in line with the Australian economy. Nevertheless, even this may seem surprising given the extent of the shift away from cash as a payment method indicated by the CPS.

4 See Cusbert and Rohling (2013). The method outlined by Cusbert and Rohling was also replicated by the Bank of England, who found similar results (Miller 2017).

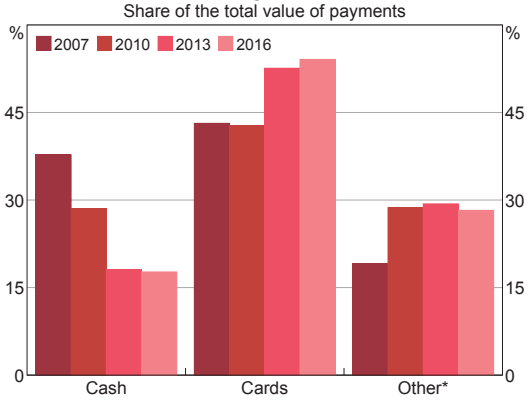
Part of this is because we are comparing a variable in nominal terms (the dollar value of banknotes in circulation) with a variable expressed as a percentage share (the share of payments made with cash). This issue is addressed in the next section. The following section then expands upon the CPS results by exploring the transactional use of cash by groups other than Australian consumers. The final section considers the relationship between the stock of banknotes in circulation and the flow of payments made with cash.

The Total Value of Cash Payments

To make the CPS results comparable with the total value of banknotes in circulation, they need to be expressed in similar terms. While the CPS measures the percentage share of payments made with cash, circulation is a measure of the nominal (dollar) value of banknotes on issue. As such, circulation should be compared with the total value of cash payments rather than the share of payments made with cash.

The CPS data can be used to calculate each payment method's share of total payments by value (Graph 4). Cash payments comprise a smaller share of total payments when measured by value than by number. This is because cash is more commonly used in low-value payments. The share of cash payments by value has fallen since 2007, but was stable between 2013 and 2016 at around 18 per cent.

Graph 4
Consumer Payment Methods
Share of the total value of payments



* Includes prepaid, gift and welfare cards, cheques, money orders, Cabcharge, internet/phone banking, BPAY, PayPal and other online payment methods (e.g. POLi)

Sources: Colmar Brunton; Ipsos; RBA; Roy Morgan Research

The total value of consumer cash payments can be estimated using the ratio of cash payments to card payments (from the CPS) and the value of consumer card payments in the economy (from the RBA's Retail Payment Statistics). Using this approach, total cash payments made by Australian consumers is estimated to have fallen by around one-quarter between 2007 and 2016 (Table 1).[5] Importantly, because total payments have increased – due to factors such as population, inflation and income growth – the fall in the total value of cash payments has not been as large as what is suggested by the changing share of cash payments, which declined by more than half.

Table 1: Estimated Value of Cash Payments Made by Australian Consumers
By year

	2007	2010	2013	2016
Value of card payments ($ billion)[(a)]	250	321	403	496
Ratio of cash payments to card payments	*0.87*	*0.67*	*0.34*	*0.33*
Estimated value of cash payments ($ billion)	218	214	139	162

(a) Excludes payments made using credit cards issued to businesses, but includes payments made using debits cards issued to businesses

Sources: Colmar Brunton; Ipsos; RBA; Roy Morgan Research

5 Precisely estimating the total value of consumer cash payments is difficult. While the method applied here is useful for gauging the direction and magnitude of the change in the value of cash payments, the exact values shown in Table 1 should be treated with caution.

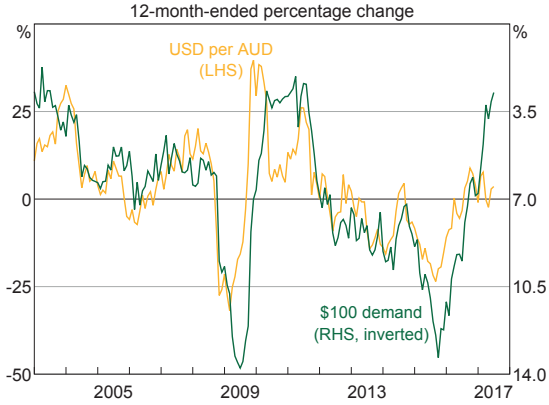
Other Transactional Users of Cash

While the CPS measures the changing payment preferences of Australian consumers, it does not cover all users of Australian currency. Because of this, it might overstate the size of the decline in the total value of cash payments, particularly if other groups tend to use cash more often than the average Australian consumer. For example, the CPS does not cover cash use by businesses, nor is it likely to fully capture the use of cash in the shadow economy (e.g. to avoid reporting income to the authorities or to finance illicit activities).[6] Another important source of cash demand not captured by the CPS comes from overseas.

Foreign citizens and institutions may hold Australian banknotes for both transactional and non-transactional purposes. This is highlighted by the close relationship between the exchange rate and demand for the $100 banknote (Graph 5). This suggests that foreign citizens and institutions have a strong preference for the $100 banknote, most likely due to the lower transport and storage costs associated with holding higher-denomination banknotes.

The relationship between $100 banknote demand and the exchange rate can more formally be assessed using a regression framework (see Appendix A: Model 2). The full-sample model suggests that a 10 per cent depreciation in the value of the Australian dollar (relative to the US dollar) is associated with a cumulative increase in $100 banknote demand of around 1 per cent over a three-month period. Furthermore, the relationship appears to have strengthened since the global financial crisis, with a 10 per cent depreciation of the Australian dollar more recently associated with a 1.5 per cent rise in $100 banknote demand. Additionally, more of the variation in $100 banknote demand is explained by the exchange rate in the post-crisis period than the pre-crisis period.

Graph 5
Exchange Rate and $100 Demand
12-month-ended percentage change



Sources: RBA; Thomson Reuters

Foreign citizens who travel to Australia contribute to the transactional demand for Australian banknotes. Survey data on the spending patterns of overseas visitors, from Tourism Research Australia (TRA), can be used to estimate overseas visitors' payment preferences. Total expenditure has increased by around three-fifths since 2008 (Graph 6, left panel). The share of this that is attributable to card payments can be approximated using data on payments made with cards that were issued overseas.[7] Estimating cash expenditure as the residual (i.e. non-card payments) shows that the total value of cash payments by visitors has risen by more than two-fifths since 2008, with cash payments declining only slightly as a share of total expenditure.[8]

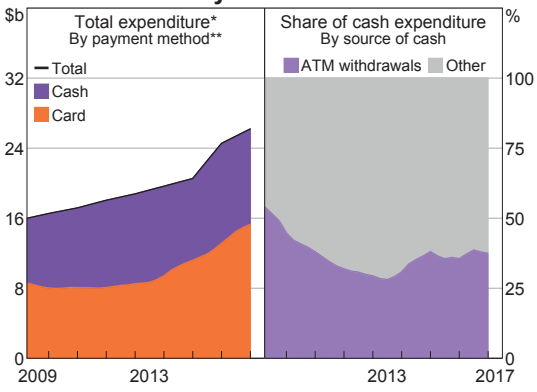
The TRA data can also be used to estimate where overseas arrivals obtain Australian banknotes.

6 Cash use by businesses and those who operate in the shadow economy are not discussed in detail in this article.

7 This may overstate card payments as it will include some card-not-present transactions (e.g. online payments where card details were supplied) made from overseas. Such payments would not be included in the TRA expenditure data.

8 This may overstate cash expenditure because: i) international visitors may use payment methods other than card or cash; and ii) overseas visitors who are in Australia for a prolonged period of time, such as those here for education or employment, may open an Australian bank account from which non-cash payments can be made.

Graph 6
Annual Expenditure in Australia by Overseas Visitors



* Quarterly estimates of total expenditure have been linearly interpolated from annual data

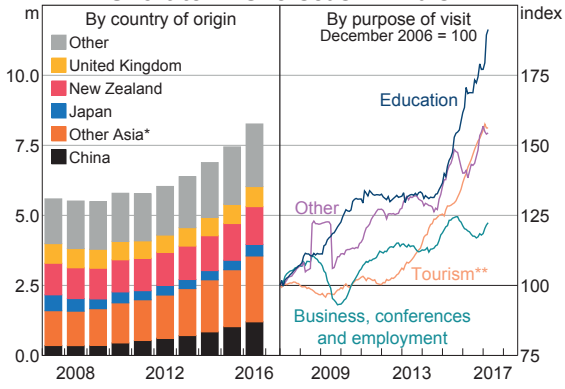
** Card expenditure is estimated using data on payments made with cards issued overseas; cash expenditure is assumed to be equal to total expenditure less card expenditure

Sources: RBA; Tourism Research Australia

While cash expenditure by overseas visitors in 2016 is estimated to be around $11 billion, less than two-fifths of this was sourced through domestic ATMs using cards issued overseas (Graph 6, right panel). This is down from a share of around one-half in 2008. While some of the remaining cash could have come from other domestic sources (e.g. over-the-counter withdrawals, domestic foreign exchange retailers etc), it is likely that a large share of it is obtained prior to arrival in Australia. Liaison with foreign exchange companies suggests that cash is indeed often purchased before arrival in Australia.

These data suggest that overseas visitors are more likely to use cash than Australian consumers. This preference may be for a number of reasons including: the type of spending (e.g. a greater share of spending at restaurants and bars); the costs associated with overseas card use (e.g. international transaction fees); and the convenience of using cash when travelling (e.g. near universal acceptance). The changing composition of overseas visitors may also be a factor. The share of overseas arrivals from developing economies, which generally have higher cash use than advanced economies, has increased (Graph 7, left panel). Additionally, overseas student and tourist arrivals have also increased significantly (Graph 7, right panel). Liaison suggests that overseas students and tourists are relatively high cash users compared with the average Australian consumer.

Graph 7
Short-term Overseas Arrivals



* Asia excluding China and Japan

** Includes arrivals for the purpose of a holiday or to visit friends/relatives

Sources: ABS; RBA

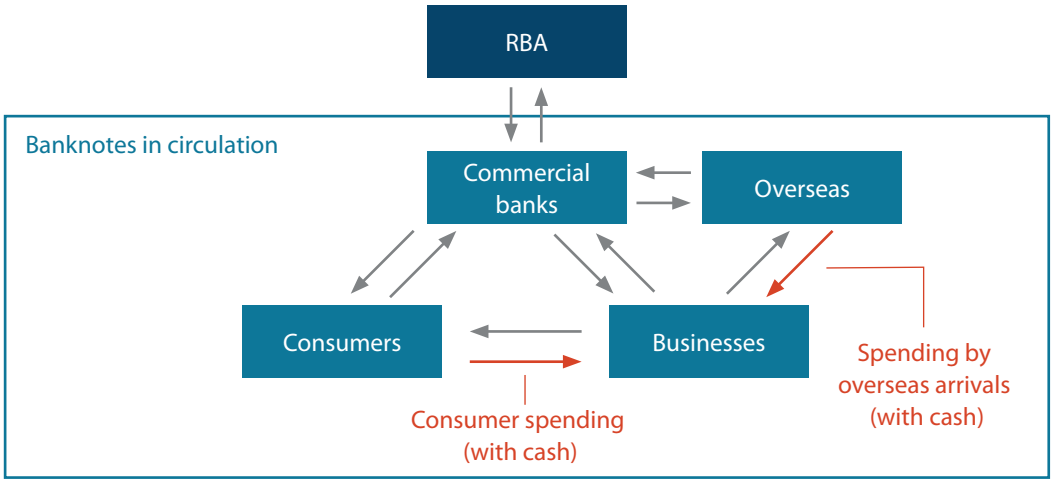
The Stock of Banknotes versus the Flow of Payments

While the value of banknotes in circulation and the value of cash payments are both measured in nominal (dollar) terms, they differ on another key aspect. This difference is illustrated using a stylised diagram of the banknote distribution system (Figure 1).[9] The value of banknotes in circulation is a stock. It measures the value of all banknotes held by the public – consumers, businesses, banks and overseas residents – at a particular point in time. In contrast, the value of cash payments is a flow. It measures the value of all payments made by consumers and overseas arrivals to businesses over a period of time.[10]

9 For further information on banknote distribution arrangements, see Cowling and Howlett (2012).

10 Other payment types also occur (e.g. consumer-to-consumer, business-to-business), though we do not discuss these here for brevity.

Figure 1: The Banknote Distribution System



Source: RBA

While the stock of banknotes in circulation and the flow of cash payments are related, there are important differences. A single banknote can be used in multiple cash payments. The average number of times that each banknote is used to make a payment in a given period of time is called the velocity of cash (*Velocity*). It relates the value of cash payments (*Payments*) to the value of banknotes in circulation (*Circulation*) via a simple equation:

Payments = Velocity x Circulation

The velocity of cash is not constant. It evolves with changes in technology, changes to the operation of the banknote distribution system, the stage of the business cycle, and consumer and business preferences. The rising stock of banknotes in circulation alongside declining cash payments suggests that the velocity of cash has fallen over the past 10 years. That is, each banknote in circulation is being used in fewer transactions now than in the past. Several factors have contributed to this, related to both the stock of banknotes held for transactional purposes and the stock held for store-of-value purposes.

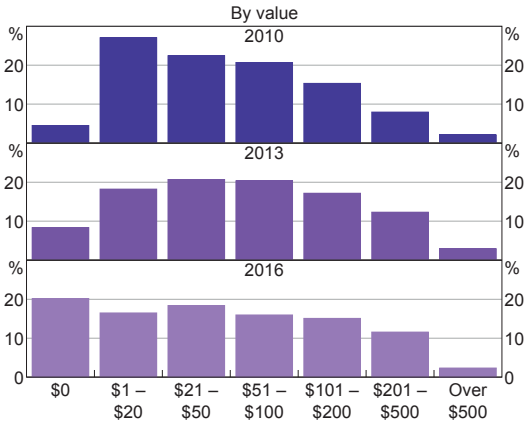
Transactional stock

The transactional stock of banknotes – the stock of banknotes in the economy required to facilitate the flow of cash payments – is held in many different locations. These include wallets, cash registers, ATMs and other banknote-accepting and dispensing machines (e.g. self-service checkouts and ticketing machines). The velocity of cash will have slowed if the stock of cash held in such locations has increased (or remained constant) alongside falling cash transactions. This appears to have been the case given changes in the way consumers and businesses manage their holdings of cash.

Wallets

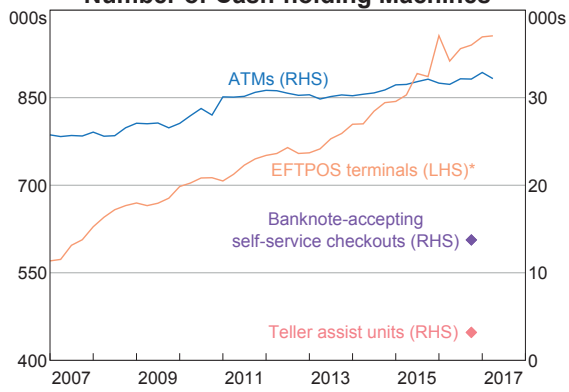
Consumers hold a stock of banknotes in their wallets to facilitate day-to-day payments. The CPS asked participants to record the value of banknotes held in their wallet at the start of the survey. While most respondents reported holding $100 or less in the 2016 wave of the survey, around 29 per cent reported that they held more than $100 (Graph 8). In fact, the average value of banknotes held in wallets has increased from

Graph 8
Distribution of Cash Held in Wallets



Sources: Colmar Brunton; Ipsos; RBA; Roy Morgan Research

Graph 9
Number of Cash-holding Machines



* The number of EFTPOS terminals is used to approximate the number of cash registers

Sources: Australian Payments Network; RBA

$93 in 2010 to $101 in 2016.[11,12] This has occurred despite cash being used in transactions less frequently.

Cash registers

Cash registers hold a stock (a float) of banknotes in order to provide change. There are practical considerations that suggest there is a minimum level for this stock. Specifically, businesses must ensure that they are able to provide change to their cash-paying customers. This suggests that an increase in the number of cash registers in Australia since 2007 is likely to have led to an increase in the total value of cash held in cash registers. Alongside a decline in cash payments, this would have slowed the velocity of cash. Detailed data on the number of cash registers in Australia is not available but, assuming that most cash registers accept both cash and card payments, the number of EFTPOS terminals can be used as a proxy. The number of EFTPOS terminals has increased substantially since 2007 (Graph 9).

ATMs

ATMs hold a stock of banknotes to meet future withdrawals. While the expected value of future withdrawals is a factor which contributes to the decision on how to stock ATMs, practical considerations are also relevant. It is logistically challenging and costly to restock ATMs frequently, so they typically hold several days' worth of withdrawals. Further, some ATM operators have indicated that low interest rates have reduced the opportunity cost of holding banknotes. These factors have likely led to a rise in the value of banknotes held in ATMs, even as ATM withdrawals are falling.[13,14] According to the Australian Payments Network, the number of ATMs in Australia has increased by around 26 per cent since 2007.[15]

11 The number and value of banknotes held in participants' wallets was not asked in 2007. In 2013, the average value of banknotes held in consumers' wallets was $112.

12 This excludes survey participants who reported holding more than $10 000 in their wallets. If included, the 2010 and 2013 averages are unchanged, but the 2016 average increases to $118.

13 In 2007, $145 billion was withdrawn from ATMs in Australia. This fell to $135 billion in 2016.

14 The results of Model 1 (Appendix A) provide some support for this, suggesting that a 1 per cent increase in the number of ATMs per capita leads to a 0.2 per cent increase in the number of $20 banknotes in circulation and a 0.1 per cent increase in the number of $50 banknotes in circulation. The result is not statistically significant for the $50, though this is sensitive to the choice of income measure in the regression. The economic and statistical significance increases for both denominations when gross national income or household disposable income is used in place of GDP.

15 The Australian Payments Network was formerly known as the Australian Payments Clearing Association.

Self-service checkouts

Self-service checkouts and other automated payment machines hold a stock of banknotes to provide change as well as banknotes that have been received as payment. Staff-operated cash registers recycle banknotes (i.e. use a banknote received in payment as change for the next customer). This is not generally the case for self-service checkouts, which typically hold cash received as payment separately from cash able to be dispensed as change. Recent advances in payment technology and consequent cost reductions have resulted in self-service checkouts and other automated payment machines becoming more prevalent. These have either replaced existing cash registers or increased the number of point-of-sale locations within those stores that use self-service checkouts. This has likely increased the number of banknotes used to facilitate the same number of payments. Based on surveys of the major banknote equipment manufacturers, it is estimated that at least 17 000 banknote-accepting self-service checkouts and teller assist units are in use in Australia.[16] Many other machines – such as ticketing machines, vending machines and smart safes – also hold a stock of cash.

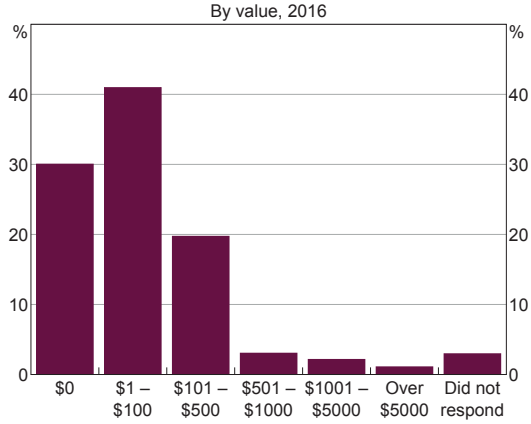
Domestic store of value

In addition to its function as a means of payment, cash can also be held as a store of value. An increase in the value of banknotes held for store-of-value purposes necessarily reduces the velocity of cash because it has no effect on the value of cash payments. While accurately measuring cash held as a store of value is difficult, the available evidence suggests it is an important component of cash demand.

Around 70 per cent of participants in the 2016 CPS reported holding some cash outside of their wallet. The most common reason was for emergency transactions. Other reasons include ATM fees and withdrawal times, cash gifts and saving for large purchases.

The value of banknotes held outside of wallets varies greatly across consumers (Graph 10). Participants in the CPS were not asked to specify their exact cash holdings. Instead, they select which range of cash holdings they fall into from a set of pre-specified ranges. While most tend to hold less than $100, around 3 per cent of respondents reported holding amounts greater than $1 000, and 1 per cent hold more than $5 000 (the highest category).

Graph 10
Distribution of Cash Held Outside of Wallets
By value, 2016



Sources: Ipsos; RBA

These results suggest that a large amount of wealth held in banknotes is concentrated in a relatively small number of households, which is broadly consistent with the distribution of wealth more generally. In fact, households with far greater stores of cash have been identified from damaged banknote claims received by the

16 Teller assist units are increasingly used by staff in bank branches to dispense banknotes rather than cash drawers.

Reserve Bank over the past five years.[17] A number of claims where 'house fire' was cited as the cause of damage were in excess of $20 000. While the total value of banknotes being held as a domestic store of value is difficult to extrapolate from these data, it is clearly an important source of domestic cash demand. The data from these claims also provide some evidence that high-denomination banknotes are preferred for store-of-value holdings.

Macroeconomic factors since the financial crisis may have contributed to an increase in demand for banknotes held as a store of value. Firstly, heightened uncertainty may have increased demand for cash held for precautionary purposes. Secondly, low global and domestic interest rates have reduced the opportunity cost of holding cash over other assets. Model 1 (Appendix A) suggests that, over the long term, there is an inverse relationship between interest rates and cash demand. Finally, as with the transactional demand for cash, population growth, inflation and real income growth will increase underlying demand for cash held as a store of value.

Overseas store of value

Similar to domestic residents, foreign citizens and institutions may also hold Australian banknotes as a store of value. The reasons for doing so, however, are less clear. Overseas residents who frequently travel to Australia may hold a store of Australian currency instead of purchasing it each time they visit. Policy settings in their home country may also diminish the incentive to hold their domestic currency as a store of value; for example, if the value of the currency is volatile due to high inflation or unexpected exchange rate fluctuations. There is evidence to suggest that the expectation of a depreciation of the Chinese yuan is associated with an increase in demand for the Australian $100 banknote (see Appendix A: Model 2).

Conclusion

Australian consumers are increasingly choosing to make payments with cards rather than cash. Despite this, the value of banknotes in circulation continues to grow broadly in line with its long-term trend, with all denominations showing positive growth. Several factors help to reconcile these contrasting trends.

Firstly, continued growth in the Australian economy has supported the transactional demand for cash. As a result, the total value of Australian consumers' cash payments has not fallen as steeply as the share of payments made with cash. Secondly, other users of Australian currency, most notably overseas visitors such as tourists and students, have contributed to the growing demand for cash.

Finally, the velocity of cash has slowed. This partly relates to the increasing prevalence of banknote-accepting and dispensing machines. While the use of this equipment is cost effective for retailers, particularly given the current low opportunity cost of holding cash, it increases the number of banknotes required to service any individual transaction. Increasing demand for cash held as a store of value has also slowed the velocity of cash.

17 The Reserve Bank offers a Damaged Banknotes Facility designed to reimburse members of the public whose banknotes have been accidentally damaged, with the aim of ensuring that they do not face financial hardship.

Appendix A

Model 1

We re-estimate the general error-correction model proposed by Cusbert and Rohling (2013):

$$\Delta c_t = \lambda\left(c_{t-1} - \beta \mathrm{X}_{t-1} - \beta_0\right) + \sum_{i=1}^{m} \delta_i \Delta c_{t-i} + \sum_{j=0}^{n} \gamma_j \Delta \mathrm{X}_{t-j} + \varepsilon_t$$

$$\mathrm{X}_t = \left[GDP_t \;\; DepositRate_t \;\; ATM_t \;\; EFTPOS_t \;\; BankBranches_t\right]$$

where c_t is the stock of cash in circulation in period t and X_t is a vector of variables including nominal GDP, the deposit interest rate, ATMs per capita, EFTPOS terminals per capita and bank branches per capita. All variables except the interest rate are in logarithms. Where necessary, variables have been seasonally adjusted. Dummy variables were also included in the model to account for structural changes in cash demand due to changes in the banknote distribution system and the global financial crisis. The parameters to be estimated are the vector of long-run parameters β, the speed of adjustment parameter λ, and the parameters for the dynamic terms δ_i and γ_j. The error term is ε_t.

For total circulation, and separately for each denomination, we estimate this model using quarterly data from March 1993 to June 2016. Table A1 presents the results of the estimated models. The constant and dummy variables have been excluded from the table for brevity. Of the dynamic terms, only the first lag of the change in the stock of $100 banknotes in circulation is significant so it is the only dynamic term retained.

Table A1: Value of Banknotes in Circulation by Denomination – Error-correction Models[a][b]

Variable	$5	$10	$20	$50	$100	Total
Speed of adjustment (λ)	–0.22***	–0.30***	–0.18***	–0.24***	–0.07***	–0.13***
	(0.04)	(0.06)	(0.05)	(0.04)	(0.02)	(0.04)
GDP_{t-1} (β_1)	0.69***	0.58***	0.29***	0.88***	1.20***	1.01***
	(0.03)	(0.02)	(0.05)	(0.03)	(0.08)	(0.05)
$DepositRate_{t-1}$ (β_2)	–	–0.02***	–	–0.02***	–0.03**	–0.02***
		(0.00)		(0.00)	(0.01)	(0.00)
ATM_{t-1} (β_3)	–	–	0.18*	0.09	–	–
			(0.11)	(0.06)		
$EFTPOS_{t-1}$ (β_4)	–0.06**	–0.06***	–0.08**	0.07***	–0.24***	–0.10**
	(0.02)	(0.01)	(0.03)	(0.02)	(0.08)	(0.04)
$BankBranches_{t-1}$ (β_5)	–0.44***	–	–	–	–1.06***	–0.61***
	(0.13)				(0.39)	(0.21)
Δc_{t-1} (δ_i)	–	–	–	–	0.57***	–
					(0.10)	
Summary statistics[c]						
Adjusted R^2	0.27	0.26	0.19	0.47	0.62	0.35
SD of dependent variable	0.013	0.013	0.018	0.012	0.011	0.008
SE of regression	0.011	0.011	0.016	0.009	0.007	0.006

(a) ***, ** and * indicate significance at the 1, 5 and 10 per cent level, respectively; '–' indicates that the variable was not significant and was removed from estimation
(b) Newey-West standard errors are shown in brackets
(c) Excludes the effects of single-period dummy variables
Sources: ABS; APRA; Australian Payments Network; RBA

Model 2

The distributed lag model used to estimate the relationship between $100 demand and the exchange rate is:

$$\Delta c_t = \alpha + \sum_{i=0}^{n} \delta_i \Delta USD_{t-i} + \beta RiskReversal_t + \varepsilon_t$$

where c_t is the seasonally adjusted value of $100 banknotes in circulation in period t, USD_t is the AUD/USD exchange rate and $RiskReversal_t$ is the CNY 25 delta 1-month risk reversal (a measure of expectations of a depreciation in the yuan). All variables except the risk reversal are in logarithms. Dummy variables were also included in the model to account for volatility at the time of the global financial crisis. The parameters to be estimated are α, δ_i, and β. The error term is ε_t. The full-sample model was estimated using monthly data from November 2003 to December 2016. Sub-samples were used to estimate the pre- and post-crisis models.

Table A2 presents the results of the estimated models. The dummy variables are excluded for brevity. The chosen lag lengths were based on parameter significance and the Schwarz criterion.

Table A2: Demand for the $100 Banknote – Distributed Lag Models[(a)(b)]

Variable	Full sample Nov 03 to Mar 17	Pre-crisis Nov 03 to Jul 08	Post-crisis Jan 10 to Mar 17
Constant (α)	0.01***	0.01***	0.01***
	(0.00)	(0.00)	(0.00)
ΔUSD_t (δ_0)	–0.02*	–0.02*	–0.04***
	(0.01)	(0.01)	(0.01)
ΔUSD_{t-1} (δ_1)	–0.04***	–0.04**	–0.07***
	(0.01)	(0.02)	(0.01)
ΔUSD_{t-2} (δ_2)	–0.03***	–0.02*	–0.03**
	(0.01)	(0.01)	(0.01)
$RiskReversal_t$ (β)	0.08***	0.03	0.10***
	(0.02)	(0.02)	(0.03)
Summary statistics[(c)]			
Adjusted R^2	0.30	0.10	0.48
SD of dependent variable	0.004	0.003	0.004
SE of regression	0.003	0.003	0.003

(a) ***, ** and * indicate significance at the 1, 5 and 10 per cent level, respectively
(b) Newey-West standard errors are shown in brackets
(c) Excludes the effects of single-period dummy variables
Sources: Bloomberg; RBA; Thomson Reuters

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Trends in Global Foreign Currency Reserves

David Sunner*

Over the decade to 2014, global foreign currency reserves doubled relative to GDP, though balances have declined a little since then. Accompanying this growth has been a shift in the composition of reserves towards higher-yielding assets, including equities and non-traditional reserve currencies, such as the Australian dollar. This article examines the overall growth trend as well as the potential causes of the compositional shift in reserves, including a decline in yields offered by traditional reserve assets and higher reserve balances.

Introduction

Central banks hold foreign currency reserves for a number of reasons, the most important being so that they can intervene in the foreign exchange market (or as a result of previous intervention).[1] Central banks can sell reserves and purchase their own currency to support its value (and vice versa). In Australia's case, over the past 20 or so years the Bank has intervened only in exceptional circumstances, such as in response to significant short-term dislocations in market functioning or to fundamental exchange rate misalignment (Newman, Potter and Wright 2011). For example, during the global financial crisis, the Bank purchased Australian dollars to restore liquidity and reduce exchange rate volatility when market conditions became disorderly (Poole and D'Arcy 2008). Other economies with freely floating currencies also hold reserves in part to restore market function in times of stress (IMF 2015).

In contrast, authorities in countries with an exchange rate that is fixed (pegged) to a particular currency or to a basket of currencies intervene in the foreign exchange market to ensure that the exchange rate is not (too far) above or below its targeted rate.[2] Such intervention can be persistent and can be a key determinant of the level of reserves held. Central banks with pegged or otherwise managed exchange rate regimes may be required to hold large amounts of foreign exchange reserves in order to demonstrate their ability to defend the exchange rate against speculative attacks (Obstfeld and Rogoff 1995). These reserves also provide a protective buffer for a central bank that can be called upon to meet balance of payments financing needs if required, which is important in

* The author is from International Department.

1 In some countries, such as Japan, reserves are owned and/or controlled by the ministry of finance rather than the central bank. Australia's foreign currency reserves are managed by the Reserve Bank and sit on the Bank's balance sheet.

2 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 as pegged arrangements. This article applies the exchange rate classification from the 2015 IMF Annual Report on Exchange Arrangements and Exchange Restrictions throughout the entire period under analysis. Exchange rate regimes may vary over time. Of note, some countries that had a pegged currency for a period, such as Switzerland, are classified as floating for the purposes of this article.

ensuring the orderly functioning of capital and foreign exchange markets.[3]

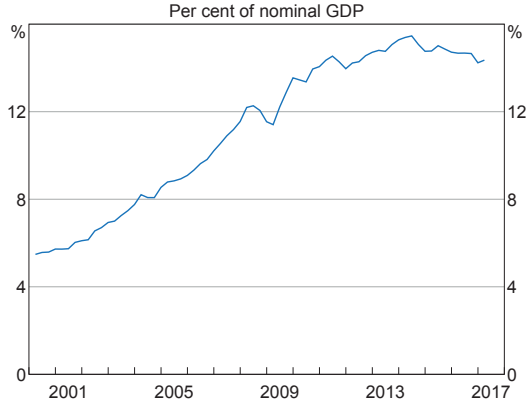
Foreign currency reserves are primarily invested in high-quality assets, such as the sovereign bonds of advanced economies. Such assets offer more stable returns than assets such as equities and, therefore, provide assurance that the value of reserves will be maintained and available when needed. However, holding foreign currency reserves in high-quality assets is costly since reserves could be invested in other types of assets that earn higher income (have a higher yield).

Reserve holdings can have implications for a central bank's balance sheet. Holding unhedged foreign currency assets (whereby the currency exposure is not converted back to local currency with derivatives) results in an exposure to exchange rate fluctuations, and central banks also face interest rate risk and credit risk on the foreign currency securities that they hold.

Drivers of Growth in Foreign Currency Reserves

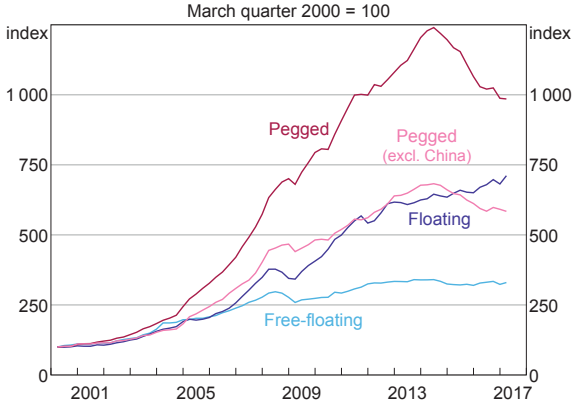
Global foreign currency reserves increased significantly over the decade to 2014, almost doubling as a share of global nominal GDP (Graph 1).[4] However, balances have declined a little since then. These moves have predominantly reflected trends in the reserves balances of countries that maintain an exchange rate pegged to a particular currency or to a basket of currencies (Graph 2). The most important of these is China, which accounted for around 40 per cent of the rise in global reserves over the decade to 2014. Countries with floating exchange rates, but which intervene occasionally, also contributed to the increase in reserves in the decade up to 2014. In contrast, countries that rarely intervene in the foreign exchange market, and so are classified as having freely floating exchange rates, have had more modest growth in reserves over the period.

Graph 1
Global Foreign Currency Reserves
Per cent of nominal GDP



Sources: IMF; RBA

Graph 2
Foreign Currency Reserves
March quarter 2000 = 100



Sources: IMF; RBA

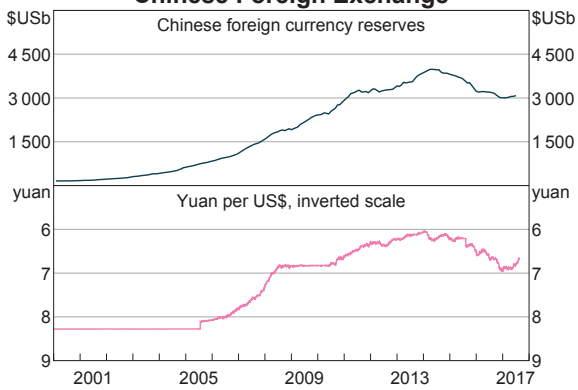
3 In Australia's case, reserves can also assist in domestic liquidity management operations and foreign exchange transactions on behalf of the government (Vallence 2012).

4 In this article we use gross reserves data from the IMF and limit our assessment to foreign currency reserves excluding gold and other holdings. This measure accounts for the majority of official reserve assets. Gross reserve balances include outright purchases of foreign currency and also 'borrowed' foreign currency such as that accumulated via a foreign exchange swap. The currency composition of these reserves is likely to differ from net reserve balances reported by country authorities. Where the value of foreign exchange swaps is significant, gross reserves data might not reflect a portfolio's underlying exchange rate risk.

Movements in the US dollar appear to have driven a large share of the movements in global foreign currency reserves over the past 15 years. This reflects both the large, persistent movements in the US dollar over this period and the importance of the US dollar as a currency peg. The US dollar is the most common bilateral peg; it is a major component of many currency baskets and around one-quarter of all currencies are pegged directly to it. Between 2002 and 2008, the US dollar depreciated by around 30 per cent on a trade-weighted basis, contributing to upward pressure on currencies pegged to it. The US dollar remained at a low level until 2014 when it started appreciating in anticipation of the (gradual) removal of monetary stimulus in the United States.

The importance of US dollar movements to foreign currency reserves is evident from its role in the rapid build-up of Chinese foreign currency reserves (Graph 3). For much of the period after mid 2005 (when the de facto peg to the US dollar was removed), the People's Bank of China (PBC) has managed the renminbi within a tight trading band against an undisclosed basket of currencies, of which the US dollar was considered to be the most important.[5] As the US dollar depreciated, the PBC intervened in the spot foreign exchange market to contain appreciation pressure on the renminbi. Although the CNY/USD exchange rate appreciated (aside from a two-year pause beginning in mid 2008 associated with the global financial crisis), the trade surplus remained large as a share of GDP, which contributed to foreign currency inflows. While not as important

Graph 3
Chinese Foreign Exchange



Sources: Bloomberg; CEIC Data; RBA

as the trade surplus, foreigners continued to invest in China, placing additional appreciation pressure on the currency. These inflows were driven by expectations of high rates of return on investments in China given rapid productivity growth, the gradual relaxation of restrictions on capital inflows and expectations of further appreciation in the renminbi (Hatzvi, Meredith and Nixon 2015). In order to manage the currency, the Chinese authorities sold renminbi to purchase foreign currency reserves.

There has been some reversal of this effect since the US dollar started to appreciate in 2014. Indeed, China has accounted for the overwhelming majority of the decline in global reserves since that time. Up until recently, this occurred alongside net capital outflows from China. In part, these capital outflows reflected expectations that the renminbi would depreciate. But they also reflected changing expectations for Chinese economic growth, which has reduced the attractiveness of China as a place to invest. Chinese economic and financial market policy has also had an influence. For instance, the gradual relaxation of capital account restrictions, notwithstanding some recent tightening with respect to outflows, and the increased flexibility in the exchange rate from 2014 are likely to have

5 From mid 2005 to August 2015 the PBC managed the renminbi within a gradually widening band against an undisclosed basket of currencies (the band was widened from ±0.3 per cent around a mid point, to ±0.5 per cent in May 2007; ±1 per cent in April 2012; and ±2 per cent from March 2014). Since then, the PBC has managed the trading band against the US dollar, as well as with reference to the currencies included in the published China Foreign Exchange Trade System effective exchange rate basket (with the trading band for these currencies greater than ±2 per cent).

made it easier for Chinese residents to make investments outside of China.

While growth in reserves in China has been particularly important for global reserves growth, there has also been significant growth in reserves held by other countries with currencies pegged to the US dollar, either directly or as part of a currency basket, such as Hong Kong and Singapore. Movements in the euro are also likely to have contributed to growth in reserves for countries that maintain a currency peg. For example, the Central Bank of Denmark and the Czech National Bank increased intervention to offset substantial inflows following the European debt crisis and the move to negative yields in the euro area. However, movements in the euro are likely to have had a smaller effect on foreign currency reserves than those in the US dollar. The euro depreciated by less than the US dollar (20 per cent against a broad range of currencies from 2009 to 2015) and, although it is the most common currency peg on a bilateral basis behind the US dollar, countries pegged to the euro account for a smaller share of global foreign exchange reserves than those pegged to the US dollar. For currencies that are pegged to a basket, the euro also tends to have a smaller weight in these currency baskets than the US dollar.

Movements in the US dollar and the euro are also likely to have contributed to the growth in reserves in countries with floating currencies (market-determined currencies that are subject to occasional intervention). This group of currencies includes those from some European and south-east Asian economies, which have strong trade links with the United States and the euro area. A number of these countries have explicitly stated that they intervened to offset appreciation pressure from movements in the US dollar or the euro. For example, reserves held by the Swiss National Bank have grown noticeably since the financial crisis as a result of extensive intervention; reserve accumulation occurred both within and outside the three-year period when the Swiss franc was pegged to the euro (Jordan 2016).[6] In south-east Asia, the Bank of Thailand intervened to offset appreciation pressure on its currency as a result of unconventional monetary policies of advanced countries, while Bank Indonesia has consistently intervened to stabilise its currency (Bank Indonesia 2017; Bank of Thailand 2013). However, foreign currency reserve accumulation was broadly based among economies with currencies classified as floating.

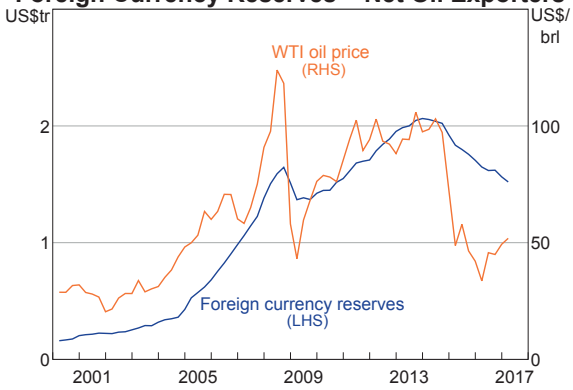
In contrast, reserves held by countries with a free-floating exchange rate – those with no prescribed target and only occasional intervention in response to exceptional circumstances such as the Australian dollar – have only increased modestly since the early 2000s. Accordingly, these countries tend to hold lower reserve balances than countries with other currency arrangements. Australia's foreign currency reserves have grown by around 6 per cent over this period, around half of the pace of growth of global reserves. This group of countries partly holds foreign currency reserves for precautionary reasons, but it is not clear to what extent reserves growth reflects growth in these requirements.[7]

6 The Swiss franc was pegged to the euro between late 2011 and early 2015. However, this article (based on exchange rate regimes in 2015) classifies Switzerland as having a floating exchange rate. Changing Switzerland's classification does not materially affect the results.

7 There is no widely accepted framework to determine the value of foreign currency reserves a country should hold for precautionary purposes. Some commonly cited metrics include the ratio of a country's foreign currency reserves to imports, short-term debt and broad money (IMF 2015). However, the usefulness of these metrics depends largely on country-specific characteristics, such as capital account openness. Different metrics can yield very different results for reserves adequacy. For example, IMF guidelines indicate that China's current level of reserves are 'sufficient' based on the import and short-term debt coverage ratios, but not according to the broad money ratio (Table 3 of IMF (2016)).

Another important, but less influential, factor for global foreign currency reserves growth is the price of oil (Graph 4). Many oil-exporting countries receive significant US dollar inflows in the form of oil sale proceeds, and these can contribute to the build-up of foreign currency reserve balances. Indeed, the foreign currency reserve balances of oil-exporting countries broadly tracks the price of oil. Oil exporters' reserves increased noticeably up to the end of 2014, but have declined considerably since. It is difficult to determine how significant the oil price is for growth in reserves of oil-exporting countries since many oil-producing nations peg their currency to the US dollar, and therefore changes in reserve balances may reflect intervention to maintain the currency peg. Also, many oil-producing nations deposit the proceeds of oil exports into sovereign wealth funds, which are typically reported separately to foreign currency reserves.[8]

Graph 4
Foreign Currency Reserves – Net Oil Exporters

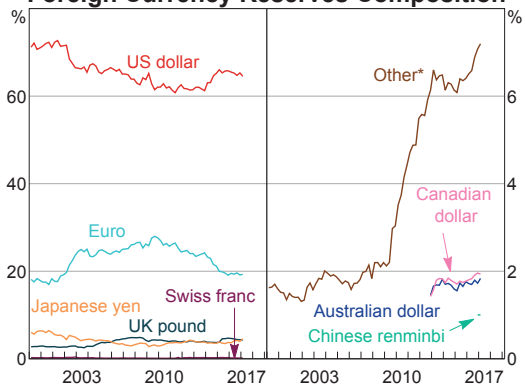


Sources: Bloomberg; IMF; RBA

Trends in Asset and Currency Allocation

As discussed, foreign currency reserves are generally held in low-risk (and lower-yielding) assets such as the sovereign bonds of advanced economies and cash deposits at other central banks (Table 1). They have also typically been concentrated in a few advanced economy currencies, with the US dollar accounting for around two-thirds of global reserves (Graph 5).

Graph 5
Foreign Currency Reserves Composition



* 'Other' currencies includes Australian dollar, Canadian dollar, Chinese renminbi as well as currencies not separately identified in the IMF data

Sources: IMF; RBA

In the case of Australia, foreign currency reserves are primarily invested in these assets.[9]

High-quality liquid assets denominated in traditional reserve currencies still account for the majority of countries' reserve holdings. Nevertheless, since the global financial crisis there has been a shift towards higher-yielding assets, such as corporate bonds and equities, as well as assets denominated in non-traditional

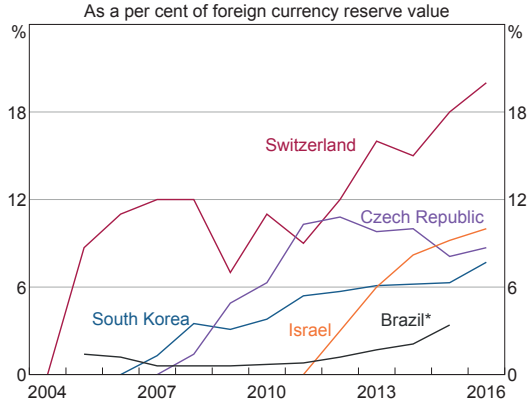
8 Sovereign wealth funds (SWFs) facilitate the saving and intergenerational transfer of wealth accumulated from the sale of non-renewable resources. They also assist in insulating economies from swings in commodity prices. Reflecting their longer-term objectives, SWFs are typically invested in higher-yielding assets than foreign currency reserves. Similarly to reserve balances, SWFs have also increased considerably in size over the past 15 years.

9 Australia's foreign currency reserve holdings are limited to deposits at official institutions, including central banks, and debt instruments guaranteed or issued by sovereigns, central banks and supranationals. The currency allocation of Australia's reserve holdings is guided by an internal benchmark, which is predominantly denominated in US dollars and euros. This benchmark also includes Canadian dollars, Chinese renminbi, Japanese yen, South Korean won and UK pounds. The Bank also holds a small investment in the Asian Bond Fund. See RBA (2017) for further discussion.

reserve currencies, such as the Australian dollar. This followed a marked reduction in yields on traditional reserve assets. The share of total reserves allocated to non-traditional currencies rose from 2 per cent in 2009 to close to 7 per cent in 2017. The Australian and Canadian dollar each account for around one-quarter of total non-traditional currency reserves, and are included in around two-thirds of all reserve portfolios.

Similarly, holdings of equities in reserve portfolios also appear to have increased since the global financial crisis (Graph 6). Data from various reserve manager surveys suggest that around 20 per cent include equities in their reserve portfolios, up from around 10 per cent prior to the crisis (Table 1). Reserve managers of portfolios with some exposure to equities typically allocate around 7–10 per cent of their total reserve portfolio to the asset class, and this allocation appears to be weighted towards larger companies of advanced economies. This recent shift in reserve portfolios towards higher-yielding assets is significant given that allocation changes tend to occur gradually, reflecting the generally conservative nature of reserve management.

Graph 6
Equity Allocation by Reserve Manager
As a per cent of foreign currency reserve value



* Brazil data is an upper limit of possible equity holding
Source: Central banks

Generally, currency allocation and the choice of assets are driven by preferences for liquidity and capital preservation, which tend to take precedence over other considerations, such as the income earned on investments. Although they are frequently considered to be interdependent, reserve managers can

Table 1: Estimated Global Foreign Currency Reserve Asset Allocation
Per cent

	Proportion of portfolios with some exposure		Value held[a]
	2002–05	2014–17	2014–17
Deposits at central banks	95	95	10–15
US Government securities	90	90–95	na
Supranational bonds	85	90–95	na
Deposits at commercial banks	95	85	10–15
Agency bonds[b]	65–70	60–70	na
Corporate bonds	17–22	35–40	12
Equities	5–10	15–20	7–10
Emerging market bonds	na	20–30	6–7

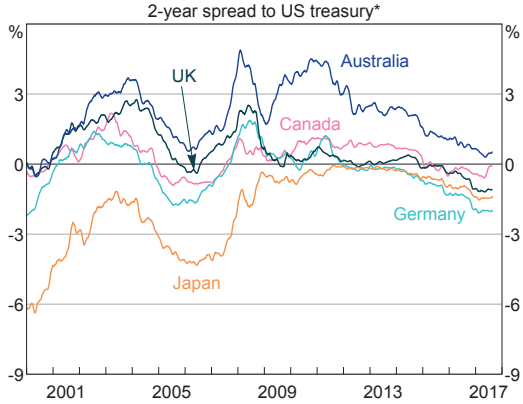
(a) Average share held by those foreign currency reserve portfolios that maintain some exposure to the asset class
(b) Bonds issued by or guaranteed by government corporations and government sponsored enterprises. For example, the Government National Mortgage Association (GNMA) and Federal National Mortgage Association (FNMA), also known as Ginnie Mae and Fannie Mae
Sources: BIS; HSBC; IMF; JP Morgan; RBS

consider the currency allocation decision separately from the choice of asset exposures. For example, a reserve manager may decide on an asset allocation, and then use other financial instruments, such as foreign exchange swaps or options, to achieve the desired currency exposure. While currency and asset allocation decisions can be driven by different factors, the fact that the shift towards non-traditional currencies and assets occurred around the same time suggests that these changes have been driven by some common factors.

There are several benefits of holding foreign currency reserves in non-traditional asset classes and currencies. By increasing the number of different types of assets in a reserve portfolio, the effect of individual risks on reserve valuations is likely reduced, as the portfolio is more diversified. Since these assets also tend to offer higher yields, they increase the income earned by portfolios. However, holding non-traditional assets comes at the expense of greater exposure to credit, liquidity and currency risks. The shift to non-traditional assets around the time of the global financial crisis partly reflects changes in the relative yields of traditional and non-traditional assets. However, it is also likely to have reflected the accumulation of large reserve balances and changes in the characteristics of sovereign bond markets. The remainder of this section discusses these factors.

During the global financial crisis, yields on traditional reserve assets, such as US Treasury bonds, declined sharply in response to more accommodative monetary policies. This low-yield environment greatly reduced the income generated on reserve balances, with some major sovereign bonds offering near-zero or negative yields. This increased the differential between the yields on US government bonds and those on government bonds from other countries (Graph 7), and is likely to have encouraged some reserve managers to diversify into these and other higher-yielding assets. This would have been especially true for those reserve managers who seek to achieve a fixed rate of return. It is also consistent with responses to various reserve manager surveys, which highlight the shift to a low-yield environment as an important consideration in the investment management process. The effect of low yields on reserve holdings is also consistent with the sharp decline in reserve holdings of euro-denominated assets in 2014 and 2015. Yields on shorter-term European sovereign bonds have been negative since around mid 2014, following a reduction of target policy rates, and have remained so since the expansion of the European Central Bank's asset purchase program in early 2015.

Graph 7
Bond Yield Differential
2-year spread to US treasury*



* 30-day moving average
Sources: Bloomberg; RBA

The size of reserve balances is also important. If foreign currency reserve balances have expanded as a consequence of exchange rate intervention, rather than for precautionary purposes, then there is likely to be excess capacity with which to invest in higher-yield assets. The global build-up of reserves, which in part was a result of persistent foreign exchange intervention, is therefore likely

to have facilitated the shift into higher-yielding assets.[10] Indeed, the shift towards equities in particular appears to be limited to countries that greatly expanded their reserve holdings as part of the implementation of exchange rate management practices. Some countries, such as the Czech Republic and Switzerland, have explicitly stated that the inclusion of equities in their reserve portfolio reflects a more efficient use of the reserves in excess of the amount required for precautionary purposes (Singer 2015; Maechler 2016). In contrast, many countries with a free-floating exchange rate, such as Australia, Japan and the United Kingdom, do not include equities in their portfolios.

Changes in the characteristics of sovereign bond markets may also have altered foreign currency reserve holdings. For example, downgrades in the credit ratings of sovereign bonds from a number of peripheral European countries around the time of the financial crisis reduced the pool of high-quality sovereign bonds available for inclusion in foreign currency reserve portfolios. This may have caused some reallocation into other high-quality assets, including non-traditional ones. This is likely to have been particularly important for reserve managers who limit their investments in lower-rated assets; around 30 per cent of reserve portfolios are limited to investments in AA- rated debt or higher. Concerns about the credit-worthiness of peripheral European countries may also have shaped reserve managers' outlook for the euro in 2010 and again in 2012, further reducing the attractiveness of euro-denominated investments.

In contrast, the strong credit ratings of Australia and Canada may have increased the relative attractiveness of government debt issued in these countries. In addition, increases in government debt on issue in Australia and Canada improved liquidity and the ease of transacting in these government debt markets. Taken together, these factors are likely to have encouraged the greater adoption of assets denominated in these currencies in reserve portfolios.

Implications and Outlook

Over the past 15 years, trends in global foreign currency reserves appear to have been largely driven by intervention in response to movements in the US dollar and, to a lesser extent, the euro. As such, the future direction of these currencies is likely to be important for foreign currency reserves growth. Future appreciation of one of these major currencies would tend to limit the growth of global foreign currency reserves as other countries are less likely to want to intervene to prevent their currencies appreciating. The exchange rate and capital control policies of China are also likely to continue to be an important driver of global holdings of reserves.

There is uncertainty about whether the increase in the share of reserves held in higher-yielding assets and non-traditional currencies will persist for an extended period. One reason it might is because changes in foreign currency reserve composition tend to occur slowly and be persistent. However, it is possible that demand for these assets will decline as yields on more traditional assets rise. The size of future reserve balances may also influence the allocation to higher-yielding assets given that larger balances, all else being equal, tend to provide greater capacity to invest in alternative assets, particularly equities.

Another issue is whether non-traditional reserve assets reduce the effectiveness of foreign

10 The depositing of intervention proceeds into sovereign wealth funds by some central banks may have slowed the accumulation of foreign currency reserves. Given that these funds are more likely to hold growth assets, the shift to higher-yielding assets seen in foreign currency reserves data may understate the shift in a broader measure of official foreign currency assets.

currency reserves. This is because these assets, in particular equities, can be more susceptible to falls in value, particularly in periods of market stress when reserves are more likely to be required. For example, at the height of the global financial crisis in late 2008, US equities fell by around 30 per cent over a four-week period while yields on long-term US Treasury bonds were little changed. However, there are a number of reasons why this is not likely to be a significant issue, based on the data that are available. First, the allocation to equities appears to be modest both in terms of the number of reserve funds and the value of reserves held at a global level. Second, the inclusion of equities in reserve portfolios has been more prevalent in countries that have reserves that appear to be in excess of required precautionary balances.

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