Speech

The Why, How and What of Forecasting

RESERVE BANK OF AUSTRALIA

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Thank you for coming today. It's great to be with you in Perth after such long time when we couldn't be together. As you would know, the Reserve Bank Board met yesterday here at the Bank's office in Western Australia. The Governor discussed the monetary policy decision last night, so I'm not going to repeat that discussion today. Instead, I'm going to talk about the forecasts that we presented to the Board yesterday, which informed their decision. The details of those forecasts will be published on Friday in our *Statement on Monetary Policy* (SMP).

Today I'm going to preview some of the highlights of those forecasts and provide some context to them. Before I get to those details, I'd like to talk about why and how central banks forecast. I will also make some observations about some principles we need to observe when we forecast.

The Why

Long and variable lags

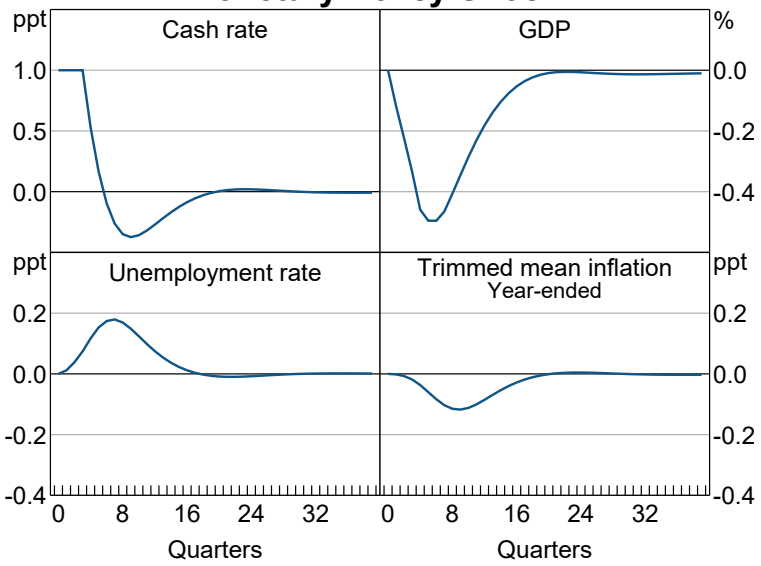
Forecasts are a key tool for central bank decision-making. It takes time for monetary policy to affect economic activity and inflation. These so-called 'long and variable' lags of monetary policy mean that central banks need to have a view on how the economy will be tracking in the future.[1]

Financial factors, including the exchange rate, asset prices and borrowing behaviour, respond soonest to a change in policy interest rates. Next comes real activity, followed by the labour market and finally inflation. It takes a while for these effects to flow right through the economy. Economic models give us some guide on how long we might expect these lags to be. In MARTIN – our full system economic model – a higher cash rate starts flowing through to GDP relatively quickly, but the peak effect is around 1½ years later. The lower level of economic activity translates into an increase in the unemployment rate, with a peak effect at around two years after the policy rate change (Graph 1). Inflation is the last to move, with the peak effect at a little over two years. The timing and magnitude of the effects varies between models and over time, and the estimates are typically imprecise; the results from MARTIN are broadly consistent with other models that we look at.

In line with these lags, our forecasts typically cover the coming 2½ years. These are presented to the Board each quarter and published in the SMP. We can also use MARTIN to extend our forecasts out further, which we do from time to time to help inform the Board's decision-making. But it should be noted that as we go further out, the forecasts become even less precise.

Graph 1

Monetary Policy Shock*



* 100 basis point increase in the cash rate that persists for four quarters; the real exchange rate is held fixed.

Source: RBA

What the forecasts are and are not

In recent years, things have turned out very differently from our earlier forecasts. With that in mind, it's important to be clear about what our forecasts are and are not. They are not pure predictions of the future. Rather, they are an indicative tool for decision-making. If the projected path for inflation and other variables isn't consistent with the Bank's inflation target, that points to a need for a different path for the cash rate. And with a different path for policy, outcomes will differ from earlier forecasts.

But neither is it a simple formula whereby policy can be mechanically set so that the forecast for inflation is always exactly at target.[2] For a start, we also have a mandate for full employment and there can be a trade-off in the short run. There are also a range of uncertainties around the forecasts that we need to bear in mind. These risks aren't always evenly balanced, although it can be difficult to assess except with hindsight. Shocks happen and economic structures evolve. That means there is inherent uncertainty about where you are now and how much you need to change policy to get to your desired result.

These considerations speak to the need for both policymakers and the public to see the forecasts as more than just a set of numerical predictions for specific outcomes such as inflation or unemployment. Surrounding these point forecasts are a range of judgements and risk assessments. These can be set out qualitatively as a discussion of risks and uncertainties, as we do in each issue of the *Statement*. They can be expressed quantitatively as bands around the central forecast, capturing the range of past deviations of outcomes from forecasts coming from all sources of variation and uncertainties; I'll show graphs of these shortly. We also can and do show particular scenarios. Either way, these are just as much a part of the forecasts as that numerical central forecast. They help articulate our thinking about how we would interpret signs that things are turning out differently from the central scenario. For example, in the February *Statement* we explored how declines in goods prices would affect our outlook for inflation.

Another reason why we shouldn't think of our central scenario as a true prediction – let alone a promise – is that it is predicated on paths for the cash rate and the exchange rate that are based on market expectations, rather than the Board's prediction. I'll talk about these assumptions a bit more in a moment. The main point to take away, though, is that even if those assumptions don't accord with your own view, a central scenario built on some plausible future path is still a useful tool for decision-making.[3]

The How

Know where you are

Predicting the future is hard. It's even harder when you don't entirely know where you are starting from. That is, when we make forecasts we do not have comprehensive data on economic activity in the period just past. There is necessarily a lag between when something happens and when that something is compiled into an economic statistic and published. For example, our current forecasts, here in early May, are based on official data on unemployment and inflation for March. But we don't yet know about April and we won't know what economic growth in the March quarter was until early next month.

There are several ways to address these data gaps and get a better sense of what state current economic conditions are in now when you commence forecasting; this activity is sometimes known as 'nowcasting'.[4] One approach is to combine different partial data, which includes data from the ABS and from private providers, administrative and survey data, and the extensive range of information we collect via our liaison. All of this can be used to estimate the current and most recent periods for broader measures of economic outcomes. For example, the consumption tracker that our staff developed in recent years is built up from estimates of components of consumption such as retail sales and Medicare spending.[5] There are also techniques for extracting a common trend from a range of indicators and using that as a nowcast for output.[6] Another approach is to leverage known lead–lag relationships. For example, we can use the lag between a building approval and actual construction activity to estimate the latter.[7]

At the RBA, our liaison program is an important input into our nowcasting.[8] Speaking to businesses, as well as community service and other organisations across the country, gives us a live – if partial – read on current conditions. Another benefit of these conversations is that we gain insight into the 'why' – the things that are driving people's decisions, what they are concerned about and how they might react if things change. This gives us an insight into the near future, as well as the current period.

Use models where models work

Once we get much beyond the current period, things get a bit more complex. There are no real-time indicators for periods that haven't happened. Some leading indicators – like the previously mentioned building approvals – help predict outcomes several quarters in advance. But for the most part, we must rely on economic relationships and our understanding of the data to construct a forecast. Some things tend to return to a long-term average. Others tend to wobble along broadly in sync with other variables.[9] Still others are subject to stock–flow dynamics or momentum effects. For these relationships you need a model. Ideally, you have multiple models. All models involve simplifications, and different simplifying assumptions can yield different results. It's prudent to cross-check against multiple models to ensure your forecast is as robust as possible. Where feasible, that's been our approach at the RBA. For example, our main inflation forecasting system takes the average of four different types of models; we also can cross-check against whole-economy models.[10]

Models don't always serve you well when forecasting, though. Judgement is also necessary. Sometimes that is because something unprecedented has happened, like the COVID-19 pandemic. Models are estimated on past data, so they can't handle something that never happened in data we have to hand. Other times, one of the simplifying assumptions in your model – like the importance of supply shocks – lead the model astray.

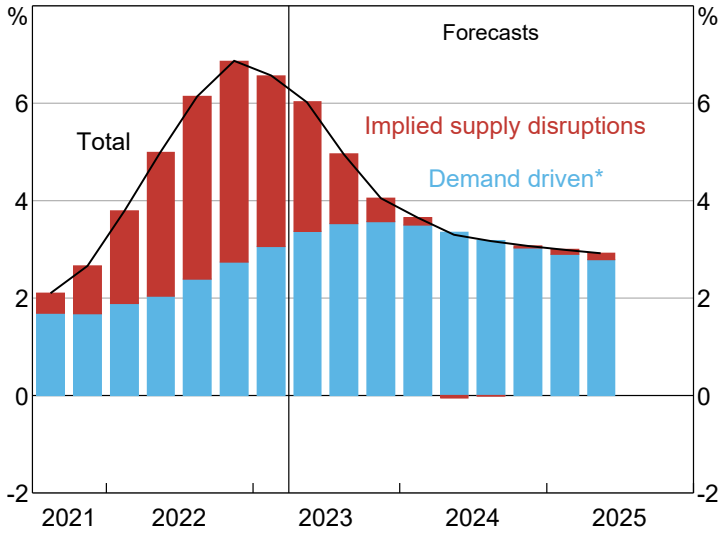
A clear example of this is for inflation. Most inflation models best capture demand-driven inflation, because historically these drivers have been the most important for explaining the persistent component of inflation. During most of the inflation-targeting era, supply shocks have tended to be benign or favourable to managing inflation.[11] But we know supply-side disruptions have added a lot to inflation over the past couple of years. We can get an indication of the contribution from supply disruptions by looking at the gap between actual

outcomes and what a model tuned to demand factors would tell us (Graph 2).[12] In this exercise, we take outcomes for the unemployment rate, inflation expectations and import prices as given. Even if we had known these outcomes in advance, these kinds of models significantly under-predict recent inflation.

Graph 2

Trimmed Mean Inflation

Year-ended with contributions



* Predicted by Phillips curve model.

Sources: ABS; RBA

This type of analysis helps us understand the past and inform the judgement needed to account for these less-common events in our forecasts. This is also an example of why having a narrative around the forecasts is so important.

Make reasonable technical assumptions

Within any set of forecasts, there are always some factors that must be taken as given. Either they can't be modelled easily or there is little benefit to doing so. One example is the global outlook. Australia is a relatively small economy, so nothing we do with monetary policy here affects the rest of the world in any material sense. So, we take the global growth outlook as given when we put our forecasts together. In addition, for most countries we do not prepare our own forecasts. Instead we largely rely on the Consensus panel of forecasts. The exception is China, where we have developed our own analytical capability, including in our team working on the ground in Beijing.

Likewise, we have no real influence on most prices set in world markets. This is true for the global prices of manufactured goods as well as oil. Yet they can have a significant bearing on domestic inflation. Again, we must make assumptions. These are generally based on market pricing and external forecasts, while petrol prices are assumed to be broadly unchanged around their recent level.

The most consequential assumptions we need to make are for the path for the cash rate and the exchange rate. These need to be considered together. There is a large and long-standing literature showing that the best forecast you can make for the exchange rate is whatever level it is today.[13] This is true even though there are factors that can be shown to influence movements in the exchange rate when you look back at history. That forecast for the exchange rate will therefore be wrong, but history shows that a constant forecast at today's level is the least wrong forecast on average. So constant at the current level is the technical assumption we make for the exchange rate in our central forecast; we can choose to relax that assumption and allow the exchange rate to adjust to developments when we explore other scenarios.

Having made this assumption for the exchange rate, we then come to the cash rate assumption. To get a coherent set of forecasts that are consistent with each other, we need to use the future path of interest rates that market participants have in mind when they are trading in financial markets and so also determining the exchange rate. That points us in the direction of using the path implied by OIS rates. Market pricing can sometimes become volatile. So as a practical matter, since the February 2022 forecast round, we have taken the average of OIS rates and the cash rate forecasts of market economists.[14]

There are other approaches we could take, such as assuming a path implied by an economic model or the Board's own expectations. Some central banks do it this way, but doing so can be interpreted as a commitment or promise that isn't robust to changing circumstances.[15]

Another area where deep, technical assumptions are needed relates to the underlying trends and equilibrium 'set points' in the economy. For example, we need to take a view about future population growth. We aren't demographers, so we take the projections of the Centre for Population and base our forecasts on those. We also need to make assumptions about some fundamentally unobservable variables, such as the non-accelerating inflation rate of unemployment or 'NAIRU' (u^*) and expectations for inflation (π^*). These are sometimes known as the 'star variables' because academic literature tends to mark them with an asterisk. Luci Ellis has spoken about these star variables on other occasions so I won't dwell on them here.[16] They are defined as capturing various deep trends and equilibrium points in an economy. Differences between them and actual data are held to be important drivers of economic dynamics. But none of these 'star variables' are directly observable and they can shift. So, you need to form a view about their current and future levels. But we shouldn't forget that there are large bands of uncertainty around these – in the here and now, and even with the benefit of hindsight.

Review how you went and always seek to improve

Learning from the past is important for ensuring we deliver the best forecasts we can make. Each year, a review of the accuracy of our economic forecasts is presented to the Board to assess what we have learned about the economy and our forecasting approach. We are also constantly looking for other ways to improve how we forecast. This includes tapping into new sources of information and data, and also looking at new models and techniques.

The What

The first step of the forecasting process is in some way an exercise in answering the question: 'Are things turning out as you expected?'. Given the large and rapid increase in the cash rate over the past year, a large part of the answer turns on whether the economy is responding as expected to that shift in policy. And in the main, to date it has. There have been some changes in the economy over the pandemic that are influencing the transmission of policy. For the most part, though, the usual relationships are holding.

Policy is affecting the domestic economy in the usual way

One way we see monetary policy flow through to the economy is via the interest mortgage holders pay on their debts and the interest payments savers receive on their deposits. Together, these are known as the 'cash flow channel'. This is where most of the public attention focuses. That is completely understandable; the effects are intuitive, quick, highly visible and unevenly distributed. Indeed, some mortgage holders are experiencing a painful squeeze on their finances at the moment; the Board and the Bank are very mindful of these distributional consequences of policy.

My colleague Chris Kent recently gave a speech on two consequences of the pandemic that might mean this channel might be taking a little longer than usual. During the pandemic, more mortgages than usual were taken out at fixed rates and households accumulated large savings buffers.[17] Broadly speaking, though, the slowdown

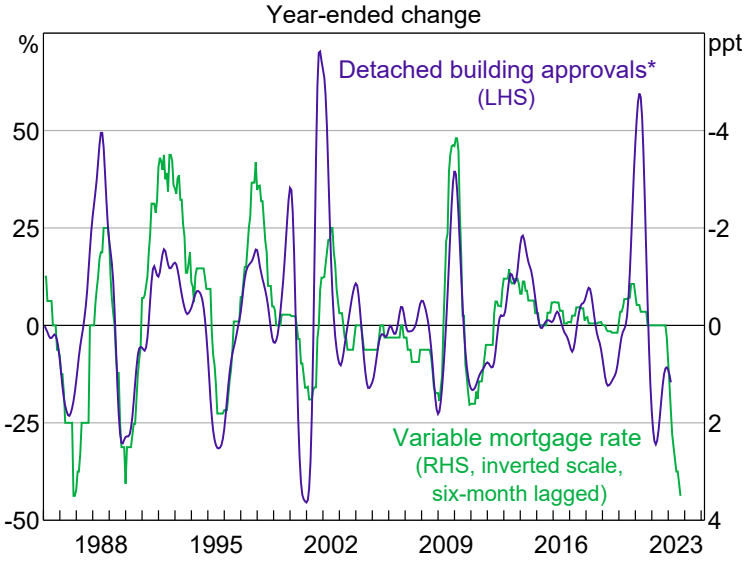
in consumption that we are seeing so far is in line with historical relationships. Another way to frame this is that the increase in interest rates seen over the past year, together with the declines in housing prices and real incomes, largely explains the difference between current outcomes (including our current forecasts) and the forecasts we made a year ago for household consumption.

Another way tighter monetary policy has affected the economy is through lower asset prices, most notably housing prices. We have seen an 8 per cent decline in housing prices since April last year. There's a wide range of estimates of what you would expect given developments in the economy since then, including the increase in the cash rate over this period, but this is in the range of those.

Lower housing prices have a flow-on effect to dwelling investment. This is a small component of GDP but is one of the most sensitive to interest rates and the business cycle more generally.[18] One way you can see this is via the close relationship between building approvals and the mortgage rate (Graph 3). This time around, the timing is a little different. Approvals were unusually high in the period before rates increased, partly because HomeBuilder brought forward some activity. Combined with delays in the construction industry due to capacity constraints, this has resulted in a large pipeline of activity that is still to be completed. The effect on actual dwelling investment could therefore take a bit longer this time. Taken over a longer period, though, we expect it to play out similarly to past tightening episodes.

Graph 3

Building Approvals and Interest Rates



* Year-ended growth in the Henderson trend level.

Sources: ABS; RBA

The exchange rate is also about where we would expect it to be based on interest rates (both in Australia and overseas), and other key determinants such as the terms of trade. On a trade-weighted basis, the Australian dollar is around its level in early 2022, when many central banks began raising their policy rates. If we hadn't increased interest rates, the exchange rate would likely be lower, adding to inflation pressures in the domestic economy.

Current forecast themes

I'll now turn to the themes coming through in the current forecasts. Due to both the monetary policy tightening I just discussed, but also because the initial bounce-back from pandemic-related restrictions had mostly run its course, growth in Australian economic activity slowed at the end of last year. We're expecting growth to remain subdued through this year as higher interest rates, the higher cost of living and earlier declines in household wealth continue to weigh on consumer spending (Graph 4). Those forces weighing on consumption are

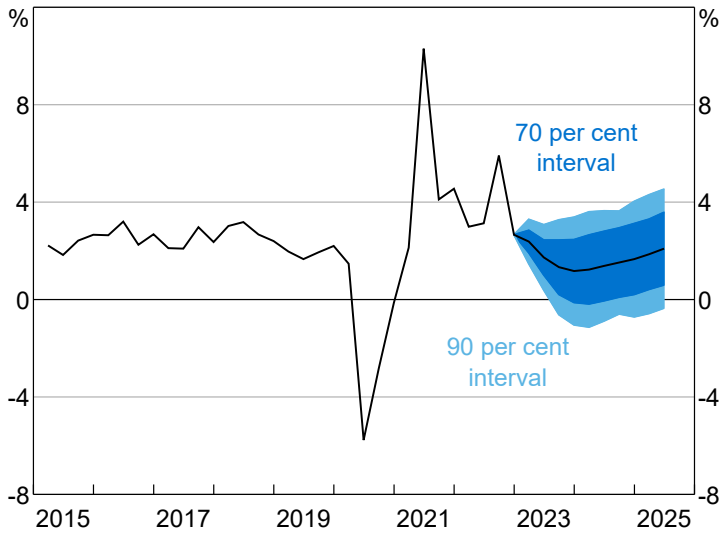
competing with some more supportive forces coming from the tight labour market, resulting in strong growth in labour incomes and the savings accumulated during the pandemic. How these opposing forces play out in overall growth in consumption is one of the main uncertainties surrounding the forecasts, and has been for some time.

From 2024, we're forecasting growth to remain below trend but pick up a little, as the effect of the earlier monetary policy tightening wanes, inflation moderates and household wealth recovers.

Graph 4

GDP Growth Forecast*

Year-ended



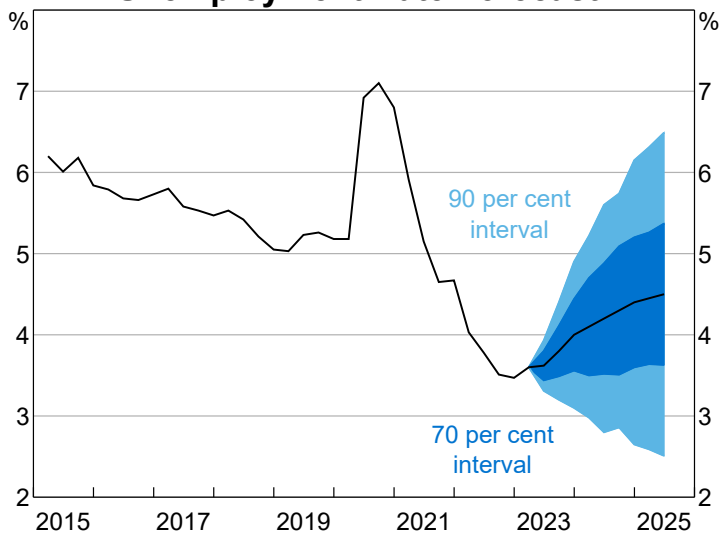
* Confidence intervals reflect RBA forecast errors since 1993.

Sources: ABS; RBA

In line with the usual lags, the recent softness in economic activity is expected to take some time to flow through to the labour market and inflation. The labour market is still very tight. The unemployment rate is around multi-decade lows, and it is expected to remain below pre-pandemic levels over the next couple of years. Underemployment is also low relative to historical experience. That said, the balance between labour demand and supply has started to improve recently. As the economy slows, the unemployment rate is expected to increase gradually over the next couple of years (Graph 5).

Graph 5

Unemployment Rate Forecast*



* Confidence intervals reflect RBA forecast errors since 1993.

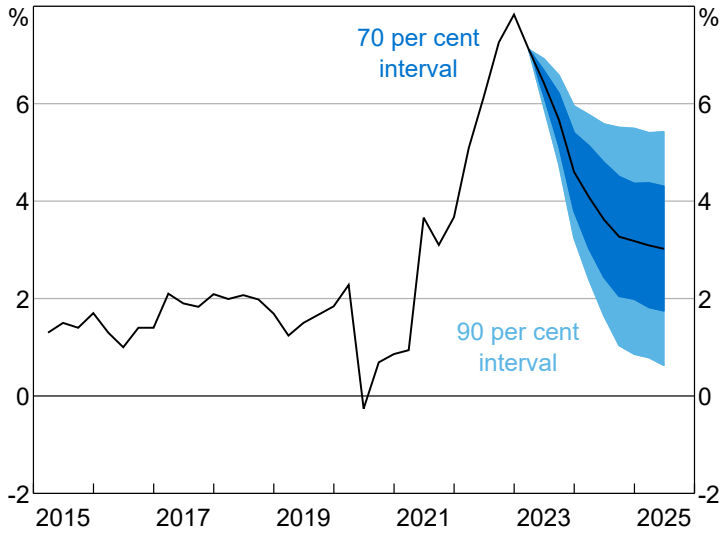
Sources: ABS; RBA

That brings us to the outlook for inflation. Consumer price inflation in Australia eased in the March quarter (Graph 6). We are expecting it to decline further over 2023. As I mentioned earlier, two competing forces are driving the inflation outlook. The ongoing tightness in the labour market and high level of demand for services lead us to expect domestic inflationary pressures to continue. On the other hand, goods price inflation should ease, as the resolution of supply chain issues flows through to the prices paid by consumers in Australia.

Graph 6

Headline Inflation Forecast*

Year-ended



* Confidence intervals reflect RBA forecast errors since 1993.

Sources: ABS; RBA

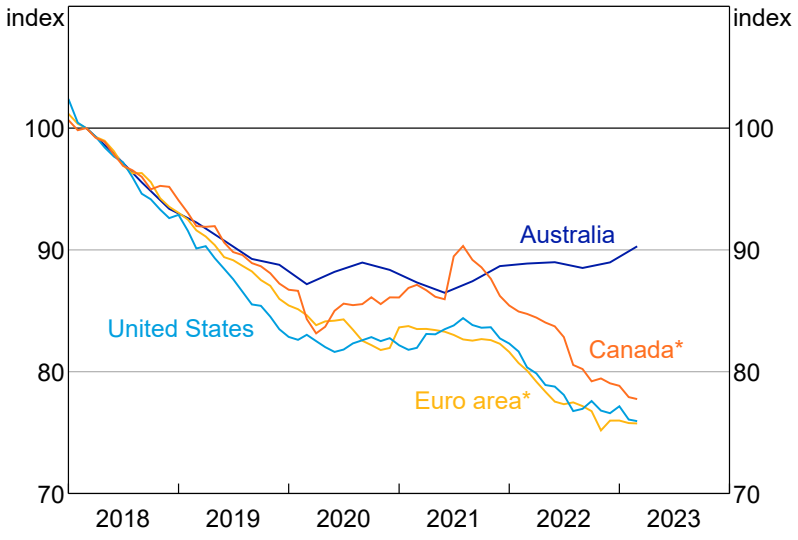
We can have some confidence that goods price inflation will moderate this year. It is already doing so in our peer economies, including in categories such as audio-visual equipment (Graph 7). These goods were the quintessential example of the effects of the pandemic on patterns of demand and supply chains. For example, demand increased sharply for flat screen TVs, and wholesale panel prices more than doubled. But the increase was quickly unwound as supply chains and demand normalised. The decline in wholesale panel prices has

flowed through to retail prices of TVs and other audio and visual equipment in other advanced economies. But prices of these types of goods are yet to decline in Australia.

Graph 7

Retail Audio and Visual Equipment Prices

March 2018 = 100



* Seasonally adjusted by the RBA.

Sources: ABS; BLS; Eurostat; RBA; Statistics Canada

What's changed since three to six months ago

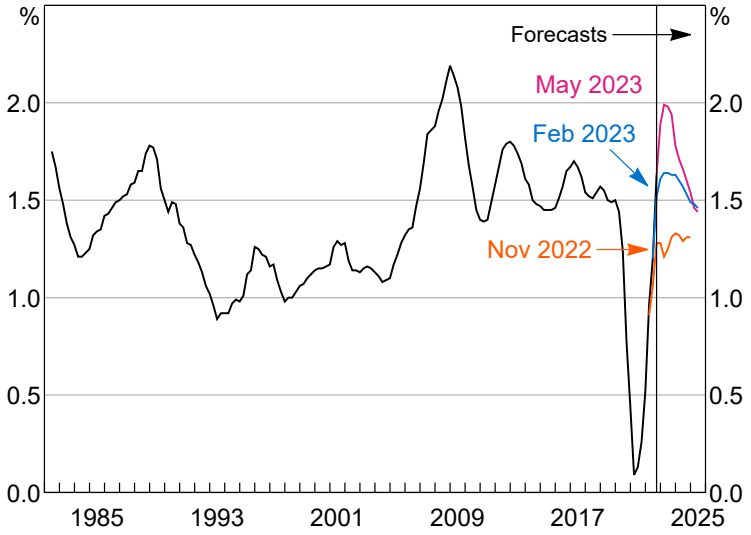
When putting together the forecasts, it is often good to step back and think about the key things we've learnt over the past three to six months. I've already touched on one of these: the increased confidence we have in the turn-around on goods inflation.

One of the biggest changes in view has come from population growth, which has been stronger than was expected six months ago (Graph 8). This largely reflects faster-than-expected return of international students and working holidaymakers following the reopening of the international border, and low levels of departures. This has affected the economy in several ways. Firstly, the higher population growth increases demand for housing. Initially we expect this adjustment to come through higher rents and higher average household size as growth in the population is faster than the dwelling stock. But in the longer run, there is also a boost to dwelling investment.

Graph 8

Resident Population Growth*

Year-ended



* Coloured lines represent forecasts in the Statement on Monetary Policy.

Sources: ABS; RBA

In terms of the effect on the labour market, higher population growth by itself is expected to increase employment growth. Overall, the outlook for key labour market ratios – such as the unemployment rate and participation rate – are little changed by the faster population growth. There might be differences across different regions and industries, though. The recent migration has been concentrated in students and other temporary residents, such as working-holiday makers. The increase in demand for housing will therefore be concentrated in the largest cities. Similarly, the expansion in labour supply will be most evident in hospitality and other sectors that employ higher shares of temporary residents than average.

A second change in view comes from some policy changes affecting future energy costs. Following the very large increase in wholesale electricity costs last year, a large increase in electricity bills is due in the September quarter of this year. Regulators have announced draft determination increases to the default offers for electricity prices in the eastern states in the 2023/24 financial year of 20–30 per cent, and market offers are assumed to increase by a similar amount. This is still a significant increase, but it is smaller than what we expected six months ago. Government policies announced since then have moderated the expected increases in energy costs somewhat. We reflected that in our February forecasts, as well as in the new ones to be published on Friday.

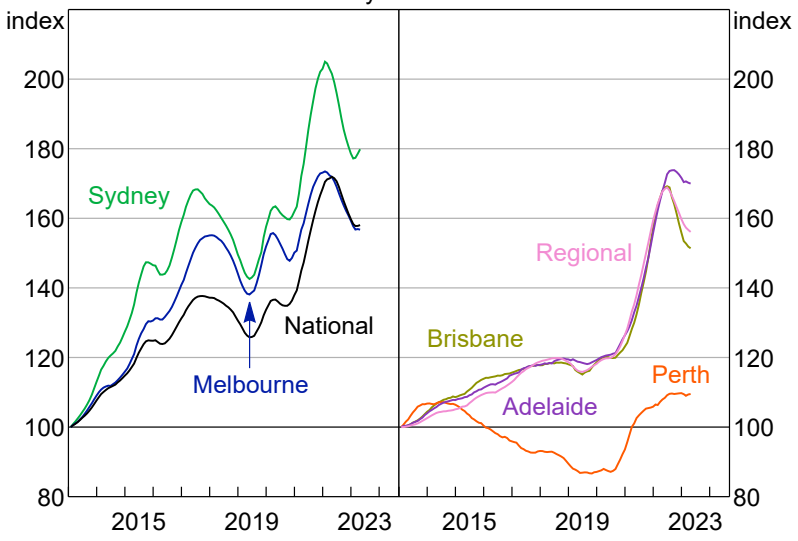
These changes highlight a key point about some of the assumptions that need to be made when forecasting. Forecasts can only be reasonably based on the fiscal and other government policies that are already known at the time. Until those policies have been announced (and in some cases, legislated), you can't know whether and how they will affect the outlook.

A third thing that's changed is that the established housing market has been a bit more resilient than might have been expected (Graph 9). After falling for most of last year, national housing prices have started to stabilise in recent months. That is a little earlier than most observers expected. Our assessment is that this probably reflects low supply and stronger fundamentals, such as population growth and higher rents, along with changes to the interest rate outlook. Lower housing prices generally dampen consumption, and the effects of the earlier decline in prices is still working its way through. But with housing prices seemingly stabilising a bit sooner (and at a higher level) than most observers would have expected, the total effect of lower housing prices on consumption will be a bit smaller.

Graph 9

Housing Prices

January 2013 = 100



Sources: CoreLogic; RBA

Conclusion

To conclude, forecasting is a valuable tool for central bankers, but we will never be able to tell the future perfectly. And there will always be new things to learn and ways we can improve. With that in mind, the Bank will be carefully considering the recommendations made by the RBA Review as they relate to our forecasting.

In the past few months, things have been turning out broadly as expected on the macro front. But the faster recovery in the population could turn out to have unanticipated or more pervasive effects. We will also be carefully monitoring how the competing forces affecting both consumer spending and the labour market are playing out, and how the easing in cost pressures coming from global supply chains translates into domestic prices.

Thank you for your time.

Endnotes

[*] Thanks to Luci Ellis, who wrote the original version of this speech with Iris Day. While this talk draws from the collective forecasting and analytical efforts of the entire Economic Group, I would particularly like to thank Tomas Cokis and Jono Vandenberg for specific contributions. It has also benefited from the comments and suggestions of a number of colleagues, including Alex Ballantyne, Leon Berkelmans, Sue Black, Kate McLoughlin, Matt Read, Tom Rosewall, Tim Taylor, Tom Williams and Michelle Wright.

[1] See Ellis L (2018) 'On Lags', Sir Leslie Melville Memorial Lecture, Australian National University, Canberra, 17 August and Kent C (2023) 'Long and Variable Monetary Policy Lags', Speech at KangaNews DCM Summit, Sydney, 20 March.

[2] This more mechanical approach to setting monetary policy is sometimes knows as inflation forecast targeting (see Haldane A and N Batini (1998), 'Forward-Looking Rules for Monetary Policy', NBER Working Paper No 6543).

[3] For a formal framework in which forecasts constructed under an arbitrary path for the policy rate can be used by policymakers as a tool for decision-making, see Barnichon R and G Mesters (2022), 'A Sufficient Statistics Approach for Macro Policy Evaluation', Federal Reserve Bank of San Francisco Working Paper 2022-15.

[4] For example, see: Higgins P (2014) 'GDPNow: A Model for GDP 'Nowcasting'', Federal Reserve Bank of Atlanta Working Paper No 2014-7; Bańbura M, D Giannone, M Modugno and L Reichlin (2013), 'Now-casting and the Real-time Data Flow', European Central Bank Working Paper Series No 1564; Bok B, D Caratelli, D Giannone, A Sbordone and A Tambalotti (2018), 'Macroeconomic Nowcasting and Forecasting with Big Data', Annual Review of Economics, 10, pp615–643; and Giannone D, L Reichlin and

D Small (2008), 'Nowcasting: The Real-time Informational Content of Macroeconomic Data'. Journal of Monetary Economics, 55, pp665–676.

[5] Bishop R, J Boulter and T Rosewall (2022), 'Tracking Consumption During the COVID-19 Pandemic', RBA *Bulletin*, March.

[6] Various forms of this type of analysis have been used at the Bank. For example, see Gillitzer C, J Kearns and A Richards (2005), 'The Australian Business Cycle: A Coincident Indicator Approach', RBA Research Discussion Paper No 2005-07.

[7] For example, see Saunders T and P Tulip (2019), 'A Model of the Australian Housing Market', RBA Research Discussion Paper No 2019-01.

[8] Dwyer J, K McLoughlin and A Walker (2022), 'The Reserve Bank's Liaison Program Turns 21', RBA *Bulletin*, September.

[9] For the aficionado, this is my attempt to explain cointegration in Plain English.

[10] For more information, see Cassidy N, E Rankin, M Read and C Seibold (2019), 'Explaining Low Inflation Using Models', RBA *Bulletin*, June.

[11] For further discussion, see RBA (2022), 'Box C: What Explains Recent Inflation Forecast Errors?', *Statement on Monetary Policy*, November, pp76–80.

[12] For a discussion of supply and demand drivers of inflation, see RBA (2023), 'Box C: Supply and Demand Drivers of Inflation in Australia', *Statement on Monetary Policy*, February, pp66–68.

[13] The technical term is that the exchange rate behaves like a 'random walk', at least at shorter horizons (for example, see Kilian L and MP Taylor (2003), 'Why Is It So Difficult To Beat the Random Walk Forecast of Exchange Rates?' Journal of International Economics, 60(1), pp 85–107 and Taylor MP (1995), 'The Economics of Exchange Rates', Journal of Economic Literature, 33(1), pp 13–47.).

[14] We haven't always used this approach for the cash rate path. Before 2015, we typically used a constant cash rate assumption, unless that was obviously at odds with financial market pricing, such as during the global financial crisis. An assumption of constant rates had the disadvantage of embedding a policy path that wasn't consistent with the Board acting in pursuit of its mandate. The difference could be very stark when the stance of monetary policy was very expansionary or very contractionary. For this reason, since 2015 we've used a path broadly in line with market pricing.

[15] For a discussion of different approaches for policy rate paths and central bank communication, see IMF (2022), 'Central Bank Communications', Monetary and Capital Markets Department Technical Assistance Handbook, January.

[16] See Ellis L (2019), 'Watching the Invisibles', the 2019 Freebairn Lecture in Public Policy, University of Melbourne, 12 June and Ellis L (2022), 'The Neutral Rate: The Pole-star Casts Faint Light', Keynote Address to Citi Australia & New Zealand Investment Conference, Sydney, 12 October.

[17] Kent C (2023), 'Long and Variable Monetary Policy Lags', Speech at KangaNews DCM Summit, Sydney, 20 March.

[18] Leamer E (2007), 'Housing IS the Business Cycle', NBER Working Paper No 13428.