



RESERVE BANK OF AUSTRALIA

Speech

Uncertainty

Guy Debelle ^[*] Deputy Governor

7th Warren Hogan Memorial Lecture Sydney – 26 October 2017



Uncertainty is one of the few certainties in monetary policy decision-making. It enters at nearly every stage of the process – from understanding where the economy is at the moment to knowing where it will be in the future. Tonight, I will discuss some of the main ways that uncertainty affects things. In doing so, I will draw on the 'Superforecasting' template described by Philip Tetlock. ^[1] I will also discuss the monetary policy reaction function, which is one area where we can try to minimise uncertainty.

In describing these various manifestations of uncertainty, I will outline some forthcoming changes to the way uncertainty is presented in the RBA's *Statement on Monetary Policy*. The intention of these changes is to portray uncertainty in a form that is usable and understandable. I would also like to discourage an excessive focus on false precision.

1. Uncertainty about Where We Are

I will start by discussing the uncertainty about the present. It is obviously important to have a good idea of where you are, in order to know where you are going. We do have some sense of where the economy is, albeit imperfect. Most of the time, the uncertainty about where exactly we are is not consequential to the setting of monetary policy, but at times it can be.

Some of the uncertainty relates to the frequency of data releases and the time it takes for data to be collected and published. Take the case of output and inflation, two of the most important summary statistics on the economy. It is now late October. But we won't receive an official read on GDP in the current quarter until the December quarter national accounts are released in early March of next year. That's more than four months away. This is by no means intended as any criticism of the ABS. It just highlights the challenges of compiling such statistics for an entity as large and complex as the Australian economy.

For inflation – which is also published quarterly in Australia – we won't get an official read on the current rate until the December quarter Consumer Price Index (CPI) is released in late January, three months from now. In most other countries, the CPI is published monthly, so the wait to get an assessment on current inflation is not so long elsewhere.

More timely and more frequent estimates of output and inflation are not unambiguously desirable. There is clearly a trade-off between timeliness and accuracy. But, in the case of inflation, a more frequent estimate would help to identify changes in the trend in inflation sooner; it probably comes with more noise, but we have ways to deal with that. Any reading on inflation always contains varying degrees of signal and noise about the 'true' inflation process. At the moment, we need to wait three more months to gain a better understanding as to whether any particular read on inflation is signalling a possible change in trend or is just noise. That is one of the reasons why the RBA has long advocated a shift to monthly calculation of the CPI.

That said, we do not depend solely on GDP and the CPI to assess the current state of the economy. We spend a lot of time and effort piecing together information from a large number of other sources. These include higher frequency and more timely data, including from the ABS, but also from a wide range of other data providers. The information we obtain from talking to people, particularly through our business liaison program, is also invaluable.

The question then arises as to how we can filter the information we receive from all these different sources to gain an overall picture about inflation and the state of the overall economy. Take GDP as an example. Some of the data released before the national accounts, such as monthly retail sales and international trade, feed directly into the calculation of GDP. So we have a direct read on those. We 'nowcast' other components of GDP using data that are more timely. Let me illustrate for household consumption. We get a good measurement of consumption of goods by looking at monthly retail sales and sales of motor vehicles and fuel. But there is very little timely information on household consumption of services, so the nowcast of this component relies more on statistical relationships. Some of these relationships are pretty weak, so we also supplement this with information on sales from our regular discussions with our business liaison contacts. This then gives us an estimate of consumption for the quarter. To get a preliminary nowcast for GDP growth for the quarter, we aggregate our best estimate for each of the relevant components. We then ask ourselves whether this estimate is consistent with other information that we have, such as the monthly labour market data, as well as predictions from our macro forecasting models.

The nowcast can be then updated with new information as it comes to hand. That said, my observation from a couple of decades of forecasting is that your first estimate of GDP (three months out) is often the best, and that additional information is often noise rather than signal.

Measurement uncertainty

Aside from when data are published, uncertainty about the present also arises from how things are measured. This takes two forms. First, there is the methodology used to actually measure the variable in question. Second, there are the revisions to data after they were first published.

On the first, a good example is the CPI. The CPI measures prices for a large number of items purchased by households. When aggregating these to calculate the overall consumer price index, each item is assigned a weight based on its average share of household expenditure. That is, the aim is to weight each price by the amount households spend on it, on average, in the period in question.

Obviously, these weights can change through time. But the weights used in the CPI are only updated each time the ABS conducts a Household Expenditure Survey, which, in recent times, has been every five or six years.

In between each household expenditure survey, a number of things can happen. First of all, some new goods and services can come along that weren't there before. One example you might think of is a mobile phone. Though it's not quite that straightforward, as before mobile phones, households spent money on landline phone bills and on cameras. So often these 'new' goods are providing similar services to something that was there before. Nevertheless, the ABS needs to take account of these new goods coming in, as well as some old items dropping out.

Secondly, households adjust their spending in response to movements in prices and income. In practice, households tend to substitute towards items that have become relatively less expensive, and substitute away from items that have become relatively more expensive. But the expenditure weights in the CPI are only updated every five or six years. Over time, the effective expenditure weights in the CPI become less representative of actual household expenditure patterns. That is, they are putting more weight on items whose prices are rising than households are actually spending on them. This introduces a bias in the measured CPI – known as substitution bias – which only is addressed when the expenditure weights are updated. Because households tend to shift expenditure towards relatively cheaper items, infrequent updating of weights tends to overstate measured CPI inflation.

The ABS will very shortly update the expenditure weights in the CPI. Because of substitution bias, history suggests that measured CPI inflation has been overstated by an average of $\frac{1}{4}$ percentage point in the period between expenditure share updates. While we are aware of this bias, we are not able to be precise about its magnitude until the new expenditure shares are published, because past re-weightings are not necessarily a good guide. It is also not straightforward to account for this in forecasts of inflation. However, from a policy point of view, the inflation target is sufficiently flexible to accommodate the bias, given its relatively small size. [\[2\]](#)

Going forward, the ABS will update the expenditure shares annually, rather than every five or six years. This will reduce substitution bias in the measured CPI.

Another form of uncertainty about where we are, and sometimes also where we've been, comes from revisions to data after they were first published. [\[3\]](#) I will illustrate this point with a couple of recent examples. In the annual national accounts for 2015/16 released in October last year, there was a sizeable reappraisal of the allocation of total investment between the mining and non-mining sectors of the economy (Graph 1). There were upward revisions to the level of mining investment throughout the past decade, which was offset by downward revisions to the level of non-mining investment.

Why is this important? In analysing investment over the course of the past decade, it has been very useful to separately analyse investment in the mining sector and investment in the rest of the economy because of the markedly different drivers of the two and the differing sources of information we have.

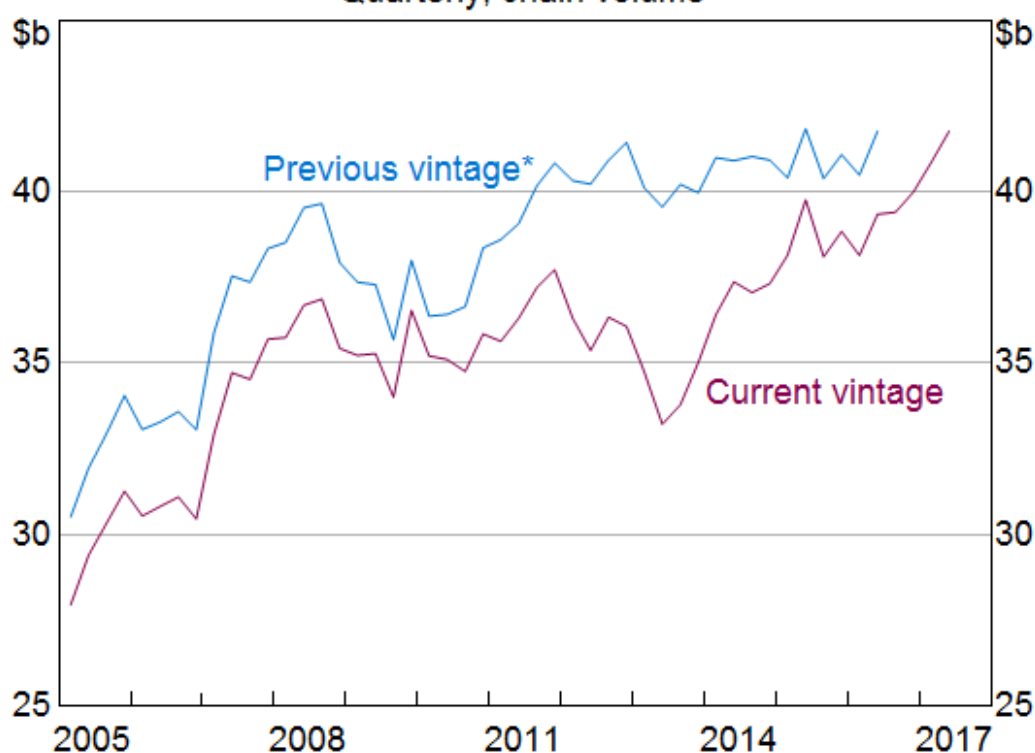
More recently, in the June quarter national accounts, the data on non-mining business investment were revised upwards. The effect of both of these two revisions has significantly changed the profile of recent years to show more substantive growth in non-mining business investment than had been recorded earlier. This is very much welcome news for the economic outlook. A rebound in investment outside the mining sector has been a core part of the RBA's forecast for a while.

So in this case, the revisions resulted in a reassessment both of where we are now, but also, of where we have come from.

Graph 1

Non-mining Business Investment

Quarterly, chain volume



* Latest vintage before the release of the 2015/16 Australian System of National Accounts; re-referenced to 2014/15 prices

Sources: ABS; RBA

Another example concerns the household saving ratio, which is useful in gauging current and prospective developments in household consumption. Revisions can have a material effect on the profile of the household saving ratio. At times, these have been substantial (in both directions), which can change our understanding of what was going on at any particular point in time. It also can complicate the estimation of economic relationships if the historical data change.

The annual national accounts, where the ABS 'confronts' the data and takes account of possible inconsistencies, as well as incorporates new information sources, is due out tomorrow, and might again change our understanding of where the economy is at currently in some key areas.

Note that again this is not at all a criticism of the ABS. The process of collecting the data before publication is time consuming and very challenging, both practically and conceptually. Many of the issues I have raised here, and more, apply to data in other economies. I am just seeking to highlight the uncertainties that enter the assessment of where we are.

Uncertain economic concepts

In addition to these uncertainties about where we are, there are also uncertainties that arise from important economic concepts that we can't measure directly.

One of these is the neutral policy rate, which I talked about recently. [\[4 \]](#)

Another is the degree of spare capacity in the labour market, which, like the neutral rate, is fundamentally important to a central bank tasked with achieving price stability and full employment. But, like the neutral rate, it is difficult to measure spare capacity directly. (The output gap is the GDP equivalent, with similar measurement challenges).

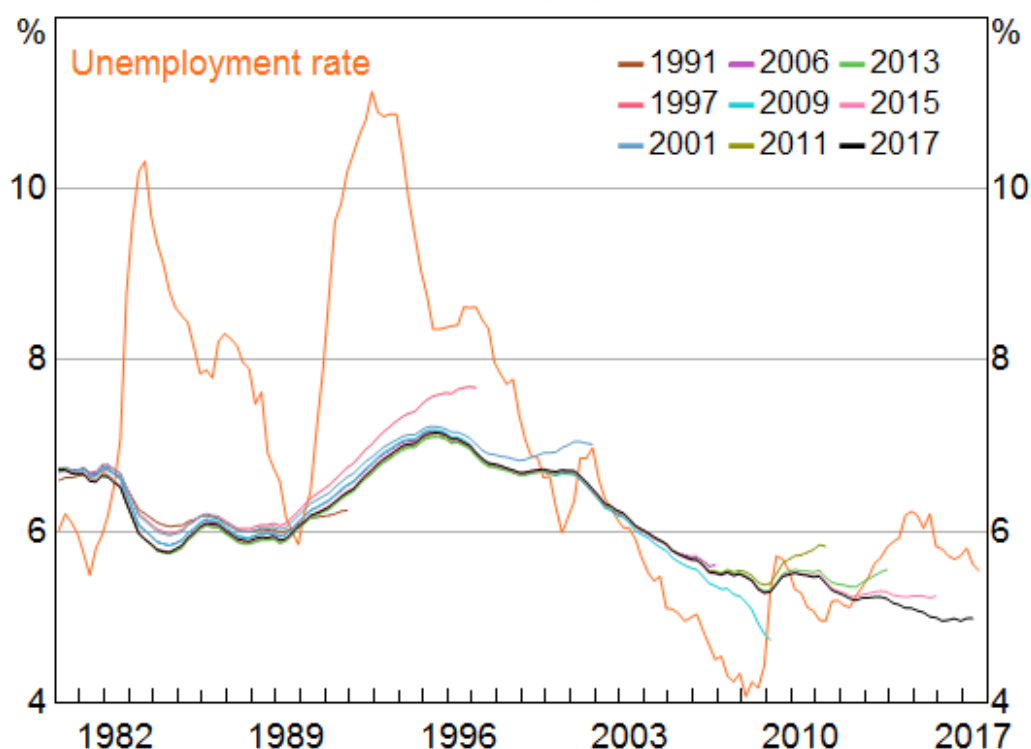
A useful benchmark for assessing the degree of spare capacity in the labour market and inflationary pressures is the NAIRU, or non-accelerating inflation rate of unemployment. When the actual unemployment rate is above the NAIRU, there is spare capacity in the labour market, which would typically exert downward pressure on wage growth and inflation. The NAIRU is not observable, but it can be estimated. [\[5 \]](#) Indeed, I have spent part of my economic life doing just that. [\[6 \]](#)

The NAIRU can only be estimated, rather than directly measured like GDP or inflation. As we get new data on unemployment, wages and inflation, we can update our estimates of the NAIRU. Graph 2 shows various vintages of estimates of the NAIRU. That is, the NAIRU is estimated using data up to the end of the period shown, so, for example, the 2001 estimate uses the data up to end of 2001, while the 2017 estimate uses the data up to the current period. As we get a set of outcomes for inflation and unemployment that are different from what our previous model of the NAIRU suggested, we can apportion that difference to either the residual in the estimated equation or to a change in our estimate of the NAIRU.

Graph 2

Vintages of NAIRU Estimates*

Per cent of labour force



* Each series shows the estimates using data up to the period when the series ends

Sources: ABS; RBA

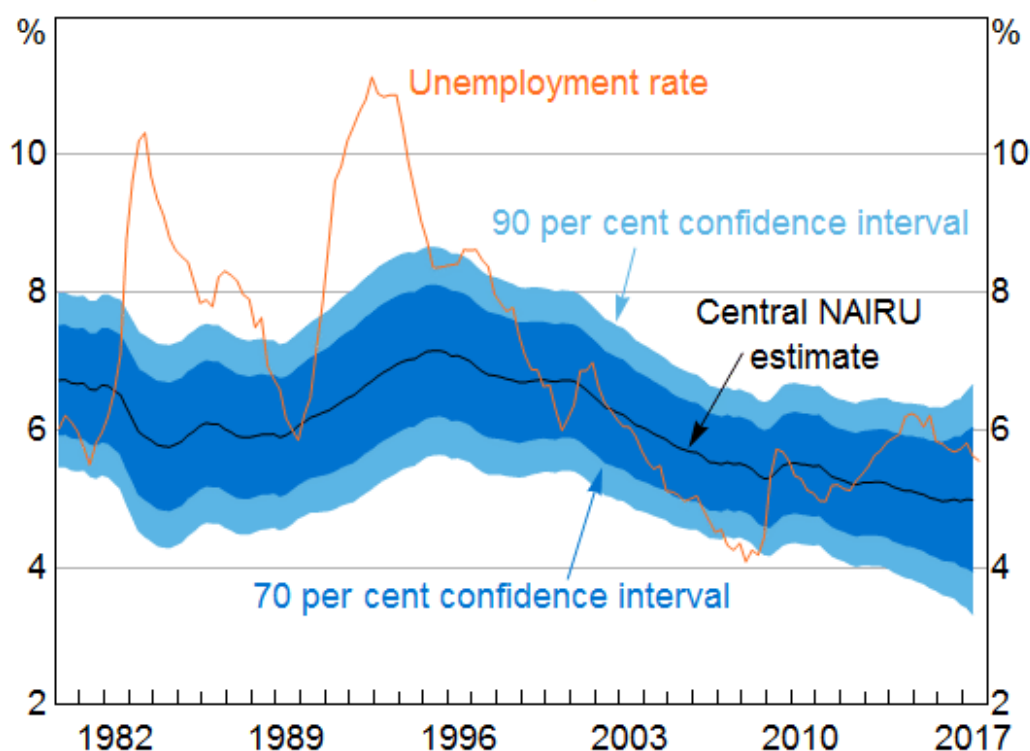
The graph shows that, most of the time, our current estimate of the NAIRU is not much different from our earlier estimates. ^[7] There are a few noteworthy divergences between different vintages of the NAIRU. Most of these divergences occur around sharp movements in the unemployment rate where, in real time, it is difficult to disentangle how much of these movements are structural versus cyclical. Note that in these circumstances, the sign of the unemployment gap is not changing, just the size of it.

Graph 3 shows the confidence intervals around the estimates of the NAIRU. As can be seen in the graph, the current estimate of the NAIRU from this model is around 5 per cent. The 70 per cent confidence interval around this estimate is ± 1 percentage point. That is, we can be fairly sure that the NAIRU lies between 4 and 6 per cent.

Graph 3

NAIRU Estimate

Per cent of labour force



Sources: ABS; RBA

But what does this uncertainty about the NAIRU mean from a monetary policy point of view? How much of a problem is it that it is difficult to pin down the estimate of spare capacity in the labour market that precisely?

The estimates suggest that the NAIRU is slow moving most of the time. Changes in the actual unemployment rate generally give you a pretty good gauge as to what is going on in terms of the general direction and extent of change in spare capacity in the labour market. We can then see how outcomes in terms of wage and price growth evolve in subsequent periods to assess whether we need to revise our estimates of spare capacity, but most of the time we are unlikely to revise those estimates materially. That is why I find the unemployment rate to be a particularly useful guide to the current state of the economy.

We can bring other pieces of information to bear to confirm the assessment of the current state of spare capacity in the labour market, including information from business surveys. Measures of underemployment are also helpful. Of particular benefit is our business liaison program, which can give us an indication of whether wage and price pressures are starting to emerge in particular parts of the economy.

That said, there are periods where this ability to rely on the gradual evolution of estimates of spare capacity breaks down, most notably the 1970s. So we always need to be alert to these possible regime shifts.

Most recently, this has been an issue (to some extent a pleasant issue) for a number of central banks. The unemployment rate has approached and gone below previous estimates of the NAIRU in the US, Germany and Japan, yet wage and price inflation has remained subdued. As a consequence, estimates of the NAIRU in those countries have continued to be revised lower. This can, presumably, only go on for so long, as eventually the laws of supply and demand mean that as new workers become increasingly hard to find, companies will actually have to pay higher wages to fill jobs.

Here in Australia, our assessment is that there still remains a sizeable degree of spare capacity in the labour market. Our forecast is that spare capacity will be gradually reduced in the period ahead. But, as it is reduced, we will be alert to the possibility that these developments we see in other labour markets, in terms of subdued inflation in the face of minimal spare capacity, occur here too.

2. Uncertainty about the Future

Having talked about uncertainty about the present (and the past), I will now turn to discuss uncertainty about the future. As I said in a speech on uncertainty almost a decade ago, the late Jim Morrison put it best: 'the future's uncertain and the end is always near'. [\[8\]](#)

Monetary policy affects the economy with a lag. Changes in interest rates affect output, employment and inflation over a period of time. In Australia, we estimate that a change in the policy interest rate today has its peak impact on aggregate demand in about 12 to 18 months. The peak impact on inflation is closer to two years.

So, in thinking about the appropriate stance of monetary policy today, we need to make an assessment about the likely state of the economy over the next couple of years. We need to make forecasts. How much output will be produced in the economy in 18 months' time? How fast will prices be rising in two years' time? How would changing the level of interest rates now affect these outcomes? These questions are difficult to answer with any degree of precision. The inaccuracy of economic forecasts is well documented and often much maligned.

As Glenn Stevens noted when speaking on forecasting a few years ago, 'one big difference in economics is that some decisions based on forecasts may alter the outcomes – as in the case of economic policy decisions, or spending decisions by businesses and households'. [\[9\]](#) He went on to observe that this is one advantage weather forecasters have over the economics profession. Human behaviour doesn't change the weather, at least over short horizons. Economics has to deal with the vagaries of human behaviour, which seem to be more difficult to predict and are more consequential than the vagaries of the weather.

The economics profession has developed a range of methods to deal with forecast uncertainty. Rather than try and summarise that work, I would like to discuss some of the ways we deal with forecast uncertainty at the RBA.

Before I do that, it will be useful for me to outline how RBA staff generate forecasts for key variables like output growth, inflation and the unemployment rate. [\[10\]](#)

As I alluded to above, we begin with very careful analysis of the data; trying to understand where things are at now. It is always useful to have some idea of where you are, before working out where you are going! We monitor thousands of variables relating to the domestic and global economies and financial markets. And we try to understand the relationships between these variables. We also try and gain a better understanding of developments in the economy by talking to people – firms, unions and employee groups, financial market participants, other public institutions and government departments, academics, think tanks. Much of this occurs through the RBA's liaison program. We also talk to our colleagues at other central banks, and participate in a range of international forums to try and understand global economic developments and how they might affect Australia.

The forecasts for key variables are generated using a combination of econometric models and our judgement. We try and take an eclectic approach to this. For any given variable, we don't know what the 'true' model is, or the true data-generating process is, if you would like to take a more atheoretical approach. There is rarely one single model that outperforms all the rest. Or, even if we thought we knew what that model was today, structural changes in the economy means that it mightn't be the true model tomorrow.

So we typically estimate a range of different models for each of the key variables that we are interested in. To some extent, this is utilising the wisdom of crowds. To illustrate, consider the models we use to forecast inflation. One approach is an extension of the Phillips Curve, that I was discussing above when talking about the NAIRU, where inflation is a function of spare capacity in the labour market, import prices and inflation expectations. Another approach is to model inflation as a mark-up over input costs, such as growth in labour costs and import prices. 'Bottom-up' approaches are also used; for example, forecasting non-tradable and tradable inflation separately, and aggregating those to get a forecast for overall inflation. We can also use time series techniques to estimate the data-generating process only using the inflation data itself.

These give us a range of forecasts for inflation. They highlight the issue of model uncertainty, that is, we are not sure which model is the right model for inflation. It poses the difficult challenge of how to process/weight the different forecasts that we have. This is where the art of forecasting comes in, though science can help us with this challenge too. Here it is important, in my view, to be flexible and eclectic rather than rigid and dogmatic.

In addition to single-equation models, we also have a number of macroeconomic and multi-equation models that are used to cross-check the forecasts. These models have the advantage of incorporating feedback effects. For example, higher wage growth increases firm's input costs and could lead to higher inflation. That, in turn, could increase inflation expectations and encourage workers to push for higher wage growth. The macro models also impose internal consistency, so we can have greater confidence that forecasts for individual variables are consistent with each other. It is also useful to check that adding up constraints aren't being violated!

Often we use our judgement to augment the forecasts generated by the econometric models. Applying judgement is appropriate for a number of reasons.

We do not have a fully articulated behavioural model of the economy where we are confident about the evolution of all the parameters. Hence we estimate models that are the average outcomes over the time period over which they are estimated. The model fits the data, on average, with some degree of imprecision. At any point in time there are residuals. That is, at any point in time, the current outcome is not likely to be exactly where the model expects it to be.

We can bring judgement to bear on those residuals and their possible evolution. There is likely to be information about the current state of the variable in question that is not easily incorporated in the model. For example, over the past decade, the information we have gained from our liaison program from talking to the large resource companies has been very informative and, most importantly, quite accurate about the profile of investment in the resources sector. But this information was difficult to incorporate directly into standard models of business investment.

The nature of these idiosyncratic residuals or shocks may have some degree of predictability to them, which, again, we can utilise in the forecasts. We may have some reason to believe the residuals are likely to be correlated in the immediate future, if we have some understanding as to what underpins them today.

At other times, we may have reason to believe that the econometric model has broken down. Behavioural parameters may change through time, particularly in the face of policy changes. In the words of the standard investment disclaimer: past behaviour may not be a good guide to future performance.

Although judgement is necessary, we are also mindful of its dangers. It can lead to biases, for example, the tendency to see persistent patterns in random data. And it can be harder to explain, replicate and refine than quantitative models. As elsewhere, a balance is needed.

So, we must always ask the question: how relevant is the past for forecasting the future? Does history repeat, rhyme or is it bunk?

Dealing with forecast uncertainty

Despite these efforts, the history of economic forecasting tells us that our central forecast will almost certainly be wrong. But there are things we can do to manage this uncertainty.

The methodology in Philip Tetlock's *Superforecasting* is very helpful: try, fail, analyse, adjust, try again. [\[11\]](#)

It is essential to ask, after the fact, what *did* cause our forecasts to be wrong? Evaluating forecasts *ex post* is as important as generating the forecasts. This can be described in three stages:

Where were we wrong? For which variables were our forecast misses the largest?

Why were we wrong? There are a number of possible reasons. Was it because the model was the wrong model? Has the model changed? Was our judgemental adjustment wrong? Was our forecast for an explanatory variable wrong? Was there an economic event or 'shock' that we didn't anticipate?

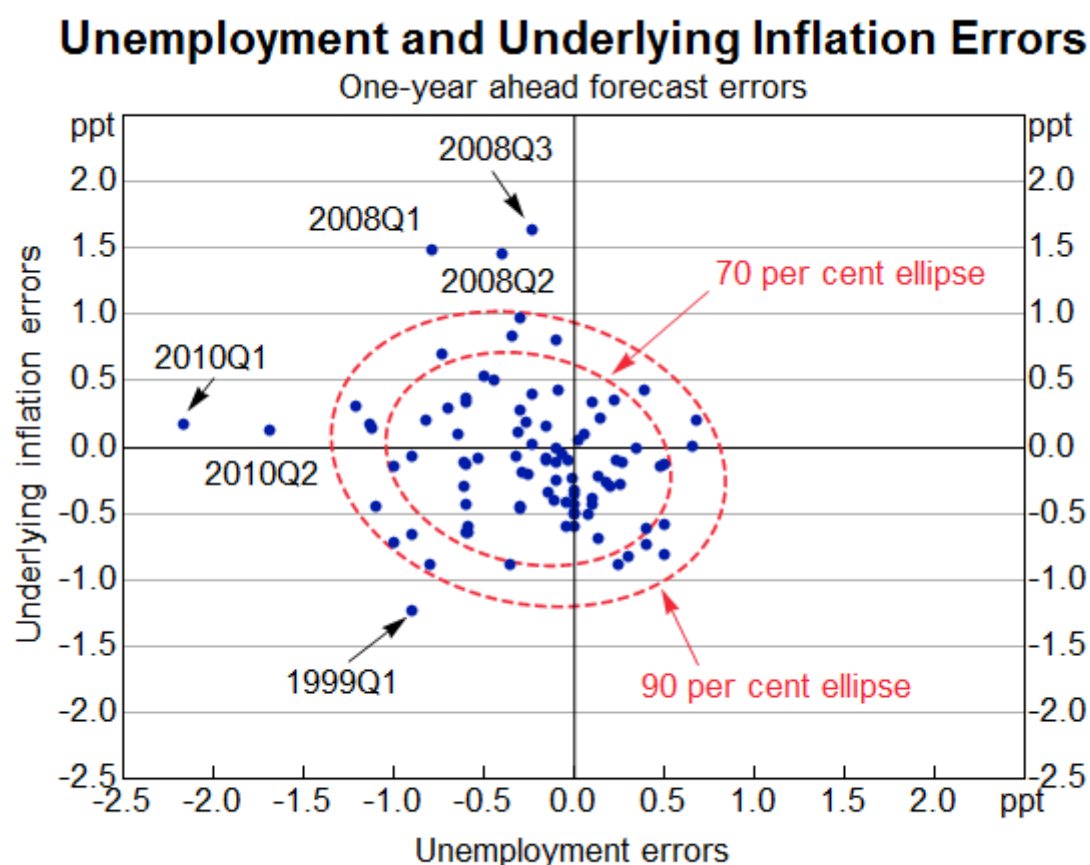
Having attempted to answer these questions, we can then ask what can we learn? What, if anything, do we need to adjust in our forecasting framework?

To understand forecast misses, it is important to ask whether there were any unanticipated economic events or 'shocks'. It is just as important to understand the source of these shocks; not only can that help us understand the forecast misses, but it can also help us understand economic developments more generally.

That said, it is important to be mindful of hindsight bias. Hindsight is always the best forecaster. So it is important to differentiate between what we should have known *ex ante* and what we can only have learnt *ex post*.

I will illustrate the issue arising from forecast uncertainty by showing the forecast misses for underlying inflation and the unemployment rate since 1993 (Graph 4). [\[12\]](#)

Graph 4



Not surprisingly, forecast misses are more common than not, as I have already noted. The inflation misses (the vertical axis) are centred on zero; they have been unbiased. But the unemployment misses (the horizontal axis) have been negative more often than positive. That is, on average over this period, the unemployment rate has been lower than we had forecast. That's a good economic outcome. But, as a forecaster, this bias is something we would hope to avoid.

I have labelled on the graph some of our biggest misses. The cluster on the left represents the financial crisis, which we thought was going to deliver much lower growth and higher unemployment in 2010 than it did. Again, from an economic outcomes point of view, it is better that it turned out this way. If we ask ourselves, why did things turn out to be better than feared in this instance, a large part of the explanation was the unexpectedly large fiscal stimulus in China in 2008-09, which was particularly beneficial for the Australian economy. There was also the beneficial effect of fiscal actions in Australia and the labour market turned out to be more flexible than we had expected. Finally, there was the domestic monetary policy response and the depreciation of the exchange rate, the extent of which were not forecast. Most of these fall into the category of *ex post* events, which were difficult to foresee *ex ante*.

The cluster at the top represents the increase in underlying inflation in 2008, which we did not fully anticipate. In the bottom left is 1999, when both unemployment and inflation turned out surprisingly well. But these outliers are unusual, with most of our errors clustered around the centre. To reinforce that point, I have drawn ellipses – under certain assumptions we would expect 70 per cent and 90 per cent of our forecast errors to fall within these ellipses, respectively.

A feature of the chart is how featureless it is. It is tempting to assume that forecast misses for unemployment and inflation would be negatively correlated; if unemployment is surprisingly low, then inflation would be surprisingly high. This would be consistent with demand shocks. But, in reality, there is not much correlation. Supply shocks – where, for example, both unemployment and inflation were surprisingly low – have been about as common as demand shocks.

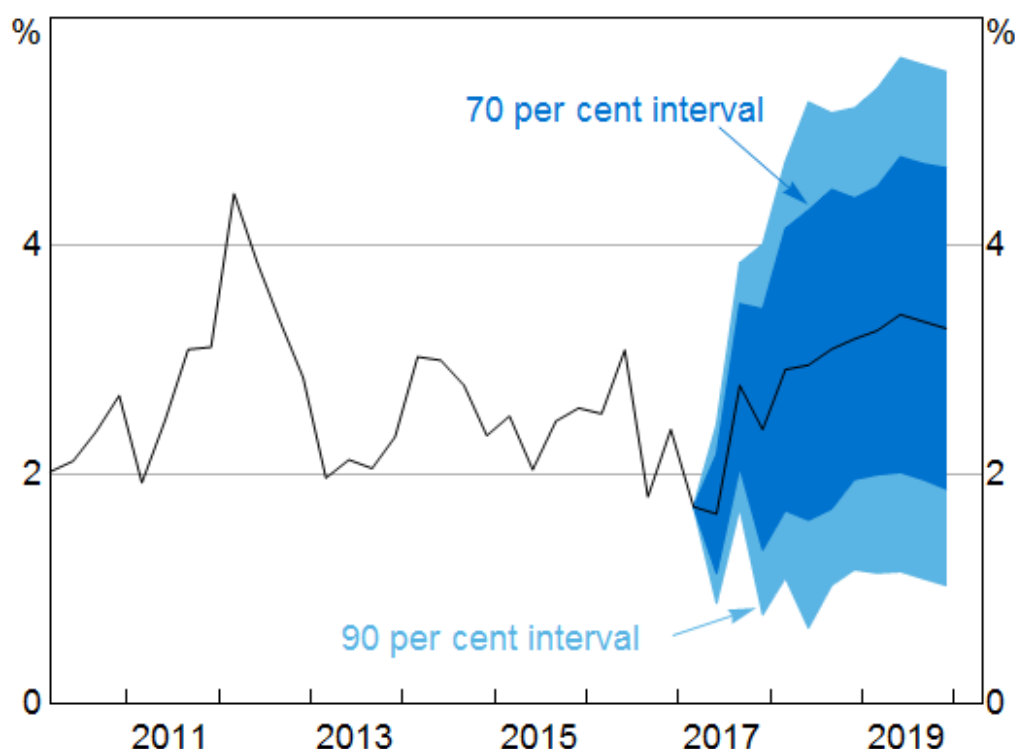
How consequential are these forecast errors for the actual setting of monetary policy? To a large extent, that is the acid test. The answer to that question is dependent on whether the forecast misses were foreseeable *ex ante* and *ex post*. It also depends on what the monetary policy response has been between when the forecast was made and when the outcome is actually realised. As I noted earlier, one challenging dynamic in forecasting the economy is that we are all participants in the process and can have an impact on the actual outcomes with our future actions.

How we communicate uncertainty

So far I have discussed how we think about forecast uncertainty and some of the approaches we use to make our forecasts as robust as possible.

But how do we communicate forecast uncertainty? In the RBA's quarterly *Statement on Monetary Policy*, our approach is to show graphically confidence intervals around the central forecasts. [\[13\]](#) The following graph from the August *Statement* shows this for year-ended GDP growth (Graph 5).

Graph 5
GDP Growth Forecast*
 Year-ended



* Confidence intervals reflect RBA forecast errors since 1993

Sources: ABS; RBA

The black line shows actual GDP growth up to the latest data point, and then the central forecast. This is the modal forecast; the outcome we consider most likely.

The dark blue area is the 70 per cent confidence interval around the central forecast, based on our forecasts errors since 1993. Roughly speaking, it says that – if we make similar forecast errors to those in the past – there is a 70 per cent chance that GDP growth in two years' time will be between 2 and 4½ per cent. [\[14\]](#) The light blue area is the 90 per cent confidence interval. These intervals show that there is considerable uncertainty around the forecasts for GDP. This is true for other forecasters, as well as GDP forecasts for other economies.

In the *Statement on Monetary Policy*, we have also published a table of forecasts for key variables. Recently these forecasts have been published as ranges, for example, 2–3 per cent for inflation. In the next *Statement*, these ranges will be replaced by the central forecasts to the nearest quarter point. Anything more precise than that is false precision in my view.

This evolution in the approach to portraying the forecasts and the uncertainty around them is because the technology has improved. We are making the change because we think that we can provide more useful information about the central forecast and the degree of uncertainty around the forecast.

Given the uncertainty around the central forecasts, I would strongly encourage you not to place too much significance on small changes from quarter to quarter. That is, avoid falling into the trap of

false precision. The exact estimates are, in the end, not that important. The sense of central tendency conveyed by the graphs is more important and the accompanying text will continue to provide our assessment as to whether the changes are material or not. The monetary policy reaction is more likely to be affected by where the actual outcomes for inflation and growth fall within those intervals in the graph than whether or not the forecast in the table is actually achieved.

Similarly, focussing on how exactly the point estimates in the table change from quarter to quarter is likely to be less informative than the evolution of the information in the graphs.

We will also continue to supplement this information with a discussion of some of the uncertainties around the forecast. This gives some sense as to what are some of the forces that could cause the outcome to depart from the modal forecast. That is, they may be low probability events, but, if realised, they would be highly consequential for the Australian economy.

The discussion of these different scenarios comes from asking ourselves the question: *ex ante*, what things could cause our central forecast to be wrong? What would our forecasts look like (say) if the exchange rate was 10 per cent lower than we assumed? Or if Chinese GDP growth slowed sharply? Or if households save less income than we assumed?

These scenarios involve changing a key assumption or central forecast for a particular variable, and then evaluating the outcome relative to the central forecasts. The scenario effectively picks out a different point in the distribution of possible forecast outcomes. Macro models are an effective tool for scenario analysis. At the RBA, we have several macro models we can use, depending on the scenario we want to evaluate. Over the period ahead, we will be conveying the potential outcomes of such scenario analysis in the *Statement on Monetary Policy*.

Monetary Policy and Uncertainty

At various times throughout this speech, I have raised the issue of how consequential these various sources of uncertainty are for the monetary policy decision-making process. Most of the time, the uncertainties, while needing to be acknowledged, have to be taken for what they are. That is, we can assume that they will probably evolve only slowly, in a way that gives time for monetary policy to respond appropriately as they are realised. Another way of putting this is that monetary policy responds to the modal forecast, the most likely outcome. If an uncertainty is realised that changes that modal outcome, then monetary policy responds appropriately when that information becomes available. It does not respond to the weighted average of the likelihood of all the various uncertainties. In part, this is because it is impossible to articulate all the uncertainties and/or assign probabilities to them. It is also because if we were to set policy in response to the mean, rather than the modal, forecast, we would almost certainly have the wrong policy setting in whatever future state of the world is realised. This approach is very much in keeping with Brainard's gradualism in policymaking under uncertainty. ^[15]

At times, there is a need for a decisive policy response as particularly large shocks away from the modal path come to pass. The financial crisis is a particularly good example of this. But such events tend to be the exception rather than the rule.

Whatever the circumstances, though, it is important that there is a good understanding of what the monetary policy reaction is likely to be. That is, it is important that people have a good understanding of what the reaction function is. Then they can have reasonable surety about how the central bank will respond given the outcomes for inflation, unemployment and output that actually come to pass. They can have some confidence in saying: if I think this is my most likely forecast for the economy, then it is likely that monetary policy will be adjusted in this way. At the same time, it is important to note that the monetary policy decision is 'not rigidly and mechanically linked to forecasts', not least because of all the uncertainties I have just been discussing. [\[16\]](#)

Another way of putting this is that we can try and make the monetary policy decision-making system as robust as possible to the inherent uncertainty that we have no choice but to deal with.

Conclusion

Most (all?) decisions in life are taken under some degree of uncertainty. This is because decisions are about something that will happen in the future, which is uncertain. Policymaking under uncertainty is similarly a fact of life. As Tetlock puts it, 'it is one thing to recognise the limits on predictability and quite another to dismiss all prediction as an exercise in futility.' [\[17\]](#)

In this speech, I have tried to articulate a number of ways in which uncertainty enters the monetary policy decision-making process. There is uncertainty about both where we are and where we are going. But not all these sources of uncertainty are above the materiality threshold that impinges on the actual monetary policy decision or on other economic decision-making. We need to avoid false precision in both our assessment of outcomes and forecasts and in our policy response to them.

In that regard, I have noted a change to the way we will present our forecasts to try and encourage a shift of focus to the central tendencies for the future paths of key economic variables.

We will continue to assess how our forecasts turn out and adjust our framework and methodology where and when appropriate. We will try and understand the sources of forecast misses and question whether they were knowable *ex ante* or *ex post*.

In doing so, we continue to aspire to have 'perpetual beta', recognising the need to be cautious, pragmatic, self-reflective, analytical and thoughtful updaters. [\[18\]](#)

Endnotes

[\[*\]](#) Thanks to Mick Plumb for his help.

[\[1\]](#) Tetlock P and D Gardner (2015), *Superforecasting: The Art and Science of Prediction*, Crown Publishing, New York.

[\[2\]](#) Stevens G and G DeBelle (1995), '[Monetary Policy Goals for Inflation in Australia](#)', RBA Research Discussion Paper No 9503.

[\[3\]](#) See Bishop J, T Gill and D Lancaster (2013), 'GDP Revisions: Measurement and Implications', RBA *Bulletin*, March, pp 11–22.

- [4] Debelle G (2017), '[Global Influences on Domestic Monetary Policy](#)', Speech at the Committee for Economic Development of Australia (CEDA) Mid-Year Economic Update, Adelaide, 21 July.
- [5] Cusbert T (2017), 'Estimating the NAIRU and the Unemployment Gap', RBA *Bulletin*, June, pp 13–22.
- [6] Debelle G and J Vickery (1998), 'Is the Phillips Curve a Curve? Some Evidence and Implications for Australia' *Economic Record*, 74, pp 384–398; Debelle G and D Laxton (1997), 'Is the Phillips Curve Really a Curve? Some Evidence from Canada, the United Kingdom and the United States', IMF Staff Papers, 44 (2), pp 249–282.
- [7] Note that the model to estimate the NAIRU here is not changing through time, just the sample period. There would likely be additional variation if different models were used through time.
- [8] Debelle G (2010), '[On Risk and Uncertainty](#)', Address to the Risk Australia Conference, Sydney, 31 August.
- [9] Stevens G (2011), '[On the Use of Forecasts](#)', Address to the Australian Business Economists Annual Dinner, Sydney, 24 November.
- [10] Lowe P (2010), 'Forecasting in an Uncertain World', Address to the Australian Business Economists Annual Forecasting Conference Dinner, Sydney, 8 December and Kent C (2016), 'Economic Forecasting at the Reserve Bank of Australia', Address to the Economic Society of Australia (Hobart), Hobart, 6 April.
- [11] See Tetlock and Gardner (2015), p 177.
- [12] See Tulip P and S Wallace (2012), 'Estimates of Uncertainty around the RBA's Forecasts', RBA Research Discussion Paper No 2012-07. Thanks very much to Peter Tulip for generating this graph.
- [13] See Tulip and Wallace (2012).
- [14] This is an intuitive interpretation, not the technical definition of a confidence interval.
- [15] Brainard W (1967), 'Uncertainty and the Effectiveness of Policy', *American Economic Review*, 57, pp 411–425.
- [16] Stevens G (2011), '[On the Use of Forecasts](#)', Address to the Australian Business Economists Annual Dinner, Sydney, 24 November.
- [17] See Tetlock and Gardner (2015), p 10.
- [18] See Tetlock and Gardner (2015), pp 190–192.