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Navigating by the stars, Part 1: Estimating Australia's NAIRU

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Overview

With the Reserve Bank of Australia (RBA) committed to reaching its legislated "full employment" objective in order to finally return inflation to its 2-3% target band, full employment can be approximated by what economists awkwardly describe as the "non-accelerating inflation rate of unemployment" (NAIRU). The NAIRU is unobservable and must be inferred from the behaviour of wages, prices and unemployment, where wage growth and inflation pick up if unemployment falls below the NAIRU and slow down if unemployment exceeds the NAIRU.

Given its importance to the future course of policy, Coolabah Capital Investments (CCI) has estimated a slightly modified version of the RBA's model of the time-varying NAIRU. This model puts the NAIRU at about 4¾% in early 2021, although the significant uncertainty around this point estimate is reflected in a confidence interval that ranges from 4% to 5½%. Experimental individual state NAIRUs yielded similar results when combined to approximate the national rate.

According to CCI's analysis, the NAIRU has fallen by about 1½ percentage points (pp) since 2000, with the NAIRU below the actual unemployment rate for just over a decade. This persistent spare capacity is currently subtracting about 0.6pp from annual inflation in the low 1%s. The lower NAIRU partly reflects the ageing of the population, which accounts for 0.3pp of the overall decline since 2000. The increase in the eligibility age of the age pension and the difficulty in saving for retirement in a low-interest rate world should reinforce this downward pressure on the NAIRU in the years ahead.

In contrast, there does not appear to be material scarring of the labour market from the pandemic that would raise the NAIRU. The labour supply has quickly rebounded, although a slight increase in long-term unemployment bears watching. The closure of the border could lead to skill shortages, although we could not find a role for immigration when extending the model. Critical migration-related shortages may still develop, though we note that companies have kept wages in check over recent years despite many firms consistently reporting significant difficulty in finding suitable staff.

The RBA's current estimate of the NAIRU in the low 4%s is at the lower end of CCI's range, while the Commonwealth Treasury's estimate of 4¾% is at the midpoint. The lower RBA estimate may reflect an updating of the model and/or a slight difference in estimation periods, but, more critically and correctly in our view, it is clear that the RBA is applying judgment when using inherently uncertain NAIRU estimates. Governor Lowe is strongly influenced by the pre-pandemic experience, where, like its peers, the RBA overestimated the NAIRU in the wake of the global financial crisis, leading it to consistently overestimate wage growth and inflation.

These forecasting misses have led the RBA and other central banks to focus on "nowcasting" the economy and adjusting monetary policy based on actual wage and inflation outcomes rather than uncertain forecasts. The RBA would also recognise that the unemployment rate likely has to fall below the NAIRU for a time to ensure a sustained recovery in wages and inflation. The RBA may be reluctant to make this point publicly, but the lower NAIRU estimate plays a valuable role in signalling to financial markets its determination to keep policy accommodative for as long as needed to reach its goals.

CCI believes that all serious fixed-income investors should have their own internal NAIRU estimates if they want to allocate capital based on their expectations for future interest rate changes. This in turn requires a credible macro-econometric capability.

Central bank views on the NAIRU

"[The] fundamental structural features of the economy are also known by more familiar names such as the "natural rate of unemployment" and "potential output growth." The longer-run federal funds rate minus long-run inflation is the "neutral real interest rate." At the Fed and elsewhere, analysts talk about these values so often that they have acquired shorthand names. For example, u (pronounced "u-star") is the natural rate of unemployment, r* ("r-star") is the neutral real rate of interest, and π* ("pi-star") is the inflation objective. According to the conventional thinking, policymakers should navigate by these stars. In that sense, they are very much akin to celestial stars. … Navigating by the stars can sound straightforward. Guiding policy by the stars in practice … has been quite challenging of late because our best assessments of the location of the stars have been changing significantly."*

Federal Reserve Chair Powell
Monetary policy in a changing economy
24 August 2018

" …there is a … 'structural' core of unemployment, which mainly has to do with problems on the supply side of the labour market, and which policies aimed at stimulating demand cannot do much about. This has led to the notion of a 'natural' rate of unemployment, or what economists have called the Non-Accelerating Inflation Rate of Unemployment, or the NAIRU – either way, a terrible mouthful. In simple terms, it is a minimum unemployment rate below which the economy cannot operate for any sustained period without generating wage pressures and pushing up inflation. No-one knows precisely what this minimum rate is … [but] it is a fuzzy concept and of limited practical value."

Reserve Bank of Australia Governor Bernie Fraser
Inflation, current account deficits and unemployment
29 November 1994

"… [Recently] there have been very large shifts in estimates of full employment ("u star") and the equilibrium real interest rate ("r star"). These shifts have occurred … almost everywhere … [which] strongly suggests there are some global factors at work. It is worth noting that these shifts … have come as a surprise. … [T]he economics profession has become very good at developing explanations for why this has happened … [but] our understanding is still far from complete about what constitutes full employment … and how the equilibrium interest rate is going to move in the future. … [Helping explain the decline in u-star] is an increased perception of competition as a result of globalisation and advances in technology … [where] many more people now understand that somebody, somewhere else in the world, can do their job, perhaps at a lower rate of pay. … More competition means less pricing power, for both firms and workers."

Reserve Bank of Australia Governor Lowe
Remarks at Jackson Hole Symposium
25 August 2019

"R-star" and "u-star" are key inputs into Taylor rule estimates of the policy rate

The importance of "r-star", which is the neutral real interest rate, and "u-star", which is the natural rate of unemployment, to central banks is clear from the labour market version of the Taylor rule for the policy rate.

The original specification of the Taylor rule is:

Policy rate = inflation rate + neutral real interest rate + α(inflation rate – inflation target) + β*(output gap)*

The unemployment version of the Taylor rule replaces the output gap with the unemployment gap – or the unemployment rate less the natural rate of unemployment – by exploiting the Okun's Law relationship between output and unemployment. That is:

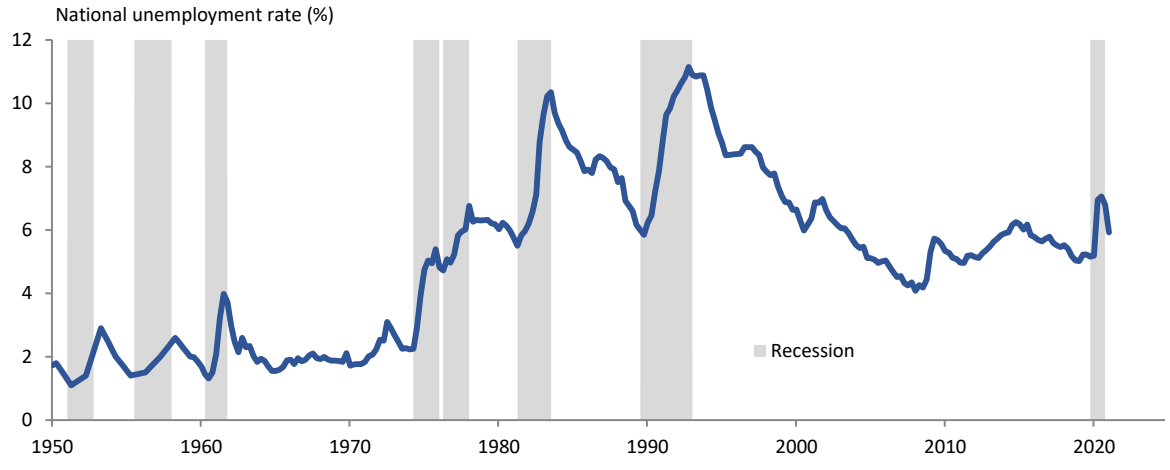
Policy rate = inflation rate + neutral real interest rate + α(inflation rate – inflation target) + γ *(unemployment rate – natural rate of unemployment)*

The natural rate of unemployment is a measure of full employment. It represents the structural unemployment rate at the point when actual production has reached the economy's potential. The natural rate captures unemployment arising from mismatches between workers and job vacancies relating to skills, experience and geographical distance, as well as frictional unemployment from workers who are in between jobs. In practice, the natural rate of unemployment is approximated by the non-accelerating inflation rate of unemployment or NAIRU. The NAIRU is a related but slightly different concept, representing the unemployment rate at which inflation holds steady.

The RBA estimates u-star as a time-varying NAIRU

Like the neutral interest rate, the NAIRU is unobservable and can vary over time. Historically, it was derived from estimating the Phillips curve relationship between unemployment and inflation, although it can also be derived from survey data on skill shortages and frictional unemployment. In Australia's case, simple estimation approaches have been complicated by the phenomenon of hysteresis, where most past recessions have led to structural increases in unemployment. This has sparked interest in using more sophisticated techniques to estimate a time-varying NAIRU.

Figure 1: The NAIRU is unlikely to be constant given hysteresis in the unemployment rate



Source: Australian Bureau of Statistics, Melbourne Institute, Waterman, Coolabah Capital Investments

The method used by the RBA and other central banks relies on a Kalman filter to infer the NAIRU from the behaviour of wages. prices and unemployment. Broadly speaking, in this framework, low wage growth and low inflation suggests that the unemployment rate exceeds the NAIRU, while high wage growth and high inflation suggests that the unemployment rate is below the NAIRU. This method gradually updates the estimated NAIRU as more data become available, which allows the NAIRU to vary over time.

The RBA's model of the NAIRU was developed by Tom Cusbert in 2017, which was later refined to allow for the possibility that the data have become less volatile over time and to incorporate an updated measure of inflation expectations. Simplifying the model, the work relies on three equations for inflation, wages and the NAIRU, namely:

- Underlying inflation = function(expected inflation, lagged inflation, lagged unit labour costs, the unemployment gap, a speed-limit effect, consumer import prices, oil prices)
- Unit labour costs = function(expected inflation, lagged unit labour costs, the unemployment gap, a speed-limit effect, oil prices)
- NAIRU = function(lagged NAIRU)

In the model, the unemployment gap measures spare capacity in the labour market and is the difference between the unemployment rate and the NAIRU, scaled by the unemployment rate. The speed-limit effect captures the impact on inflation from a rapid change in spare capacity and is defined as the change in the unemployment rate over time, also scaled by the unemployment rate. Underlying inflation is the trimmed mean CPI, backcast prior to the early 1980s. Expected inflation is the RBA series, which combines several measures of inflation expectations. The RBA series is very smooth, reflecting the dominant influence of economists' long-term inflation expectations, which are very stable at the midpoint of the RBA's 2-3% target band.[1]

CCI's version of the RBA's model puts the national NAIRU at about 4¾%

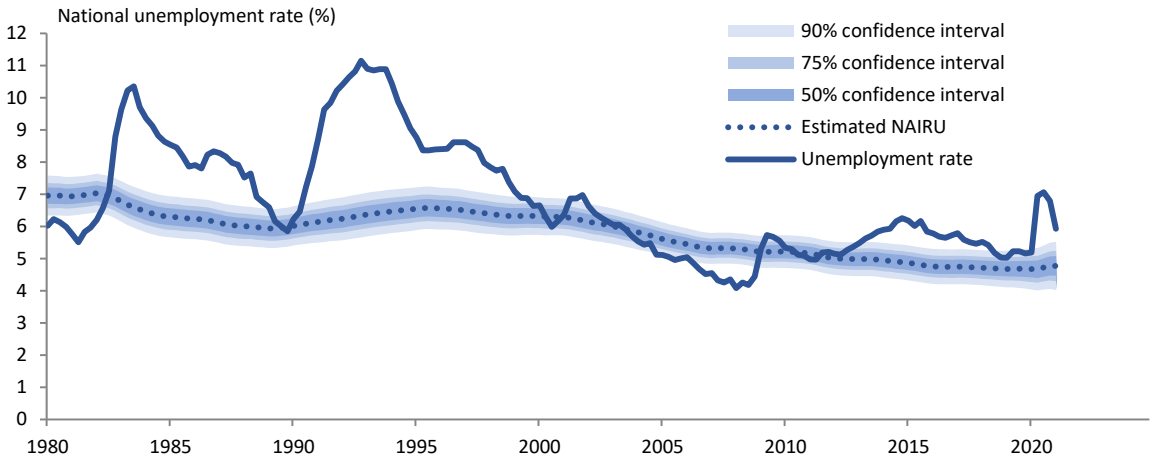
In our analysis, we used a version of the RBA's model using code kindly provided by David Stephan at the World Bank. The main change was to leave oil prices out of the calculation given they did not seem to influence inflation and wages post the 1970s. We also made some minor changes to the model specification and backcast both nominal unit labour costs and the RBA's measure of inflation expectations.[2] The model was estimated using quarterly data over a shorter period from 1980 to early 2021 to avoid backcasting the measure of inflation expectations over the volatile period of the 1970s (the start date for the RBA's 2017 analysis was 1968). Not all data were available for Q1 2021 and the model results could change slightly when unit labour costs and import prices are published next month.

[1] Economists' long-term inflation expectations are published twice a year by Consensus Economics. One downside to this measure is that not many banks forecast inflation beyond a two-year horizon.
[2] Nominal unit labour costs were backcast prior to the mid 1980s using the ratio of labour costs to real GDP for the non-farm sector, where labour costs included payroll taxes. The RBA measure of inflation expectations is only available from the mid 1980s onwards. We backcast the series using: (1) the Melbourne Institute measure of year-ahead consumer inflation expectations; (2) the 10-year Commonwealth nominal bond yield; (3) actual inflation; and (4) oil prices. There are economist inflation expectations for the 1980s, but we did not have access to a time series.

Mindful that experimenting with different model specifications and assumptions produced slightly different results:

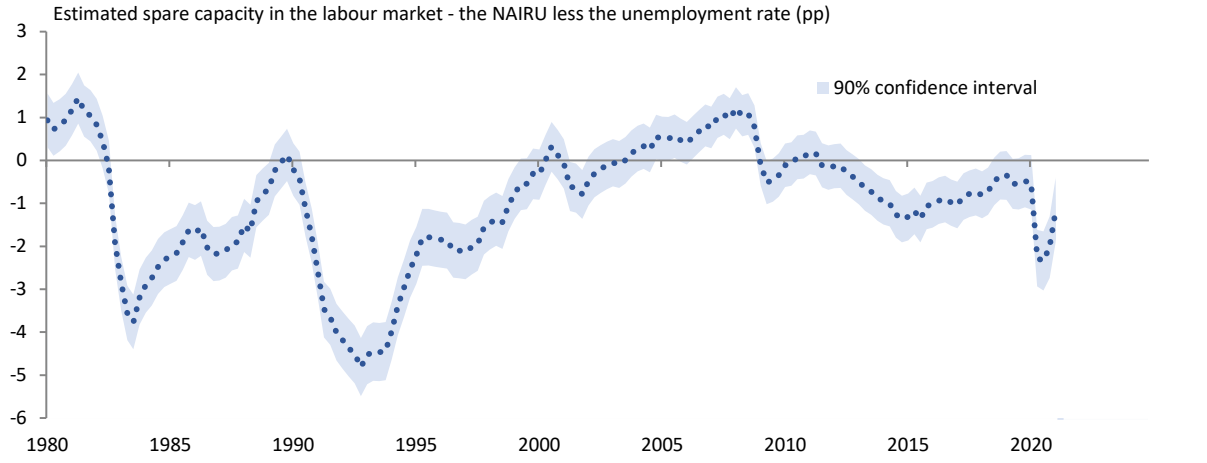
- The national NAIRU is currently about 4¾%, although there is significant uncertainty around this estimate as reflected in a 90% confidence interval ranging from 4% to 5½%.
- Most of the recent decline in the NAIRU occurred during the 2000s and the NAIRU has been stable since mid 2010. In rounded terms, the NAIRU was 7% in 1980, 6% in 1990, 6¼% in 2000, and 5¼% in 2010, holding at 4¾% since 2015.
- There has been persistent spare capacity in the labour market for just over a decade, with the unemployment rate above the estimated NAIRU since 2010. The last time there was material overheating in the labour market was in 2008, in the early stages of the global financial crisis. At that time, the unemployment rate fell to 4%, well below the then NAIRU of 5¼%.
- Persistent spare capacity is currently subtracting 0.6pp from annual inflation. Annual inflation was 1.1% in Q1 2021, such that if the unemployment rate was at the NAIRU, inflation would be 1.7%, approaching the bottom of the RBA's 2-3% target band (there would also be some boost from the "speed-limit" effect depending how quickly unemployment reached the NAIRU).

Figure 2: We estimated a time-varying NAIRU using a version of the RBA's model that currently puts the NAIRU at 4¾%



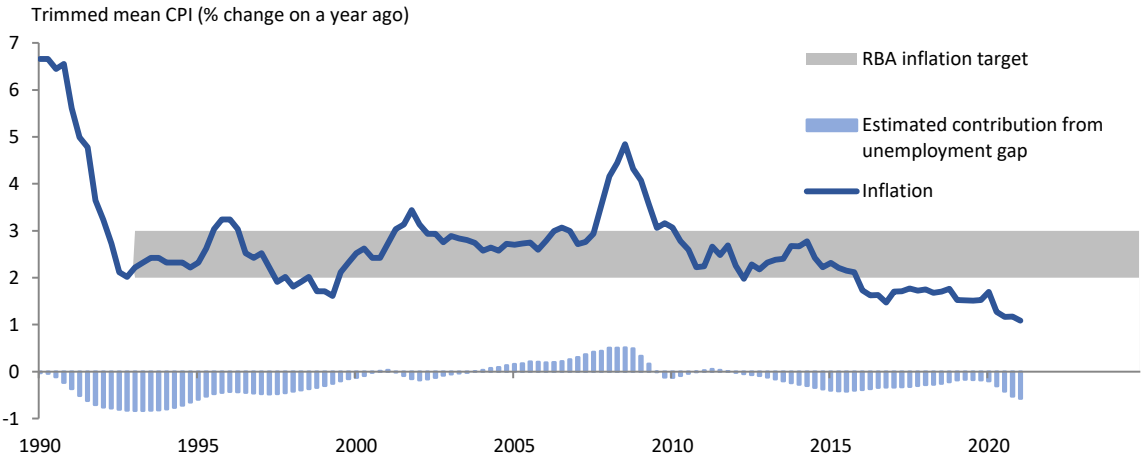
Source: Australian Bureau of Statistics, Reserve Bank of Australia, Coolabah Capital Investments

Figure 3: The estimation results point to persistent spare capacity in the labour market for just over a decade …



Source: Australian Bureau of Statistics, Reserve Bank of Australia, Coolabah Capital Investments

Figure 4: … subtracting 0.6pp from current annual inflation

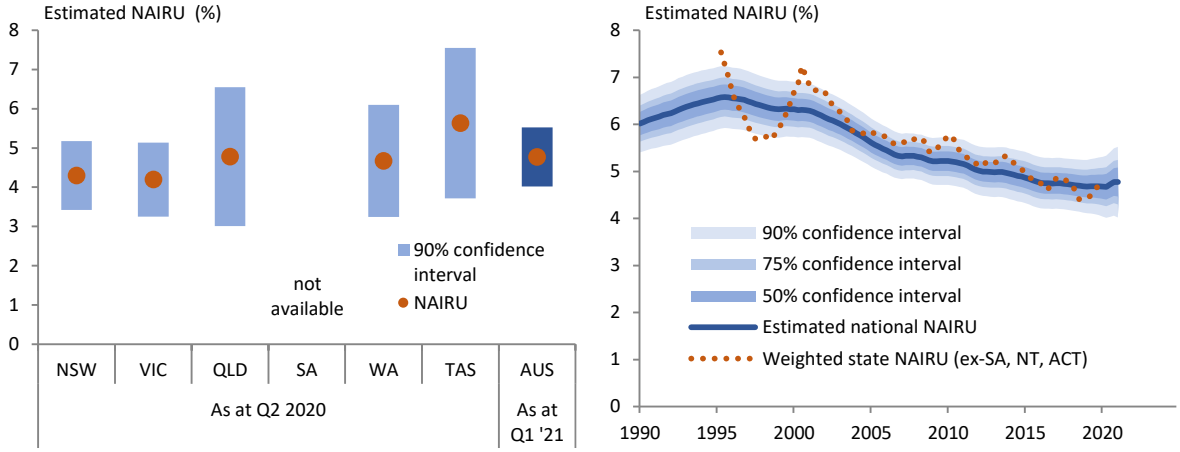


Source: Australian Bureau of Statistics, Reserve Bank of Australia, Coolabah Capital Investments

As a cross-check on the results, we estimated state NAIRUs using the same approach. These estimates are experimental because we used proxies for two key indicators and retained the specification for the national model for every state. Inflation was proxied using capital city estimates of the CPI excluding volatile items, spliced with the CPI excluding food and energy in history. Nominal unit labour costs were proxied by the ratio of the state wages bill to real state gross state product (GSP), where state GSP was interpolated from financial-year estimates. The estimation period was limited to 1995 to mid 2020 as a longer span yielded some implausible results.

The rounded state results put the NAIRU at about 4¼% in both New South Wales and Victoria, 4¾% in both Queensland and Western Australia, and 5¾% in Tasmania. Unfortunately, estimation produced implausible results for South Australia and the territories. Encouragingly, the state estimates broadly tracked the national estimate when combined using shares of the national labour force, matching the Australia-wide NAIRU at 4¾% in mid 2020. That said, the state estimates are more volatile and more uncertain, particularly for the smaller states, as reflected in wider confidence intervals.

Figure 5: State estimates of the NAIRU are more uncertain, but broadly track the national estimate



Note: The aggregate state NAIRU weights the state estimates using labour force weights. The state estimates are updated to Q2 2020. Estimation yielded implausible results for South Australia and the territories.
Source: Australian Bureau of Statistics, Reserve Bank of Australia, Coolabah Capital Investments

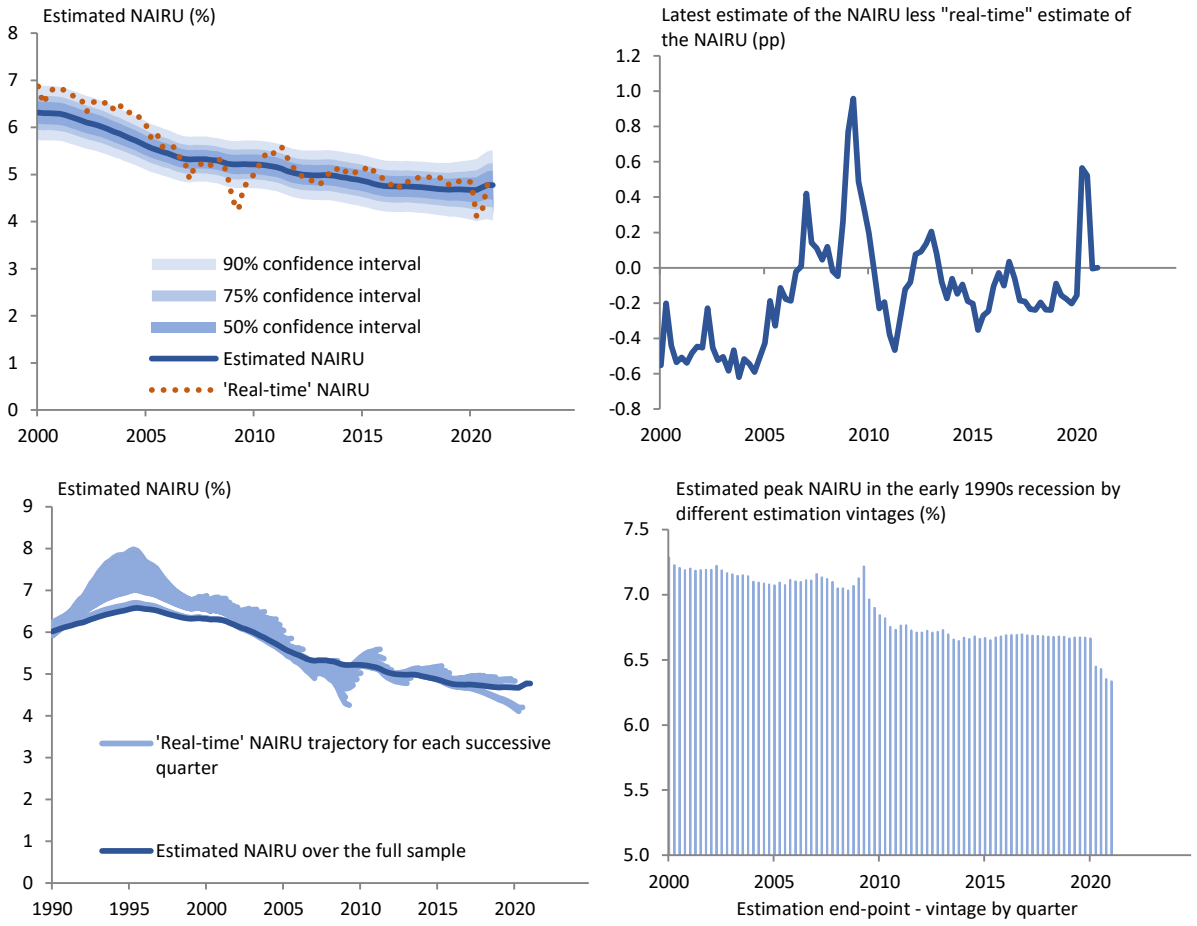
Recent estimates and past profiles of the NAIRU can be significantly revised

Given that the NAIRU is unobservable, it is not surprising that the 90% confidence interval around the estimated rate of 4¾% is large, ranging from 4% to 5½%. As a more practical way of conveying the uncertainty around the estimated NAIRU, we also constructed quasi-"real-time" estimates from 2000 onwards. This involved estimating the NAIRU using data through to Q1 2000 and then rolling the model forward a quarter to repeat the exercise through to Q1 2021.[3] The real-time estimates track the NAIRU calculated over the full sample, with an average absolute revision of 0.3pp from the initial to the latest estimates of the NAIRU. Some revisions were large, though; for example, the initial estimate of the NAIRU in mid 2009 of about 4¼% was revised up by about 1pp to 5¼% when the model was estimated over the full sample.

Encouragingly, the initial estimates of the NAIRU were nearly always within the 90% confidence interval around the NAIRU calculated using the full sample. However, it is worth noting that there were sometimes substantial revisions to the initial estimated trajectory of the NAIRU. These revisions can greatly alter the perspective of the past stance of monetary policy when relying on a NAIRU-based Taylor rule. For example, the peak NAIRU during the early 1990s recession was initially estimated at about 7-7¼% when the model was estimated with an end-point ranging from 2000 up to the global financial crisis. However, when the model was estimated using data from later than the crisis, the peak NAIRU in that earlier recession was revised down to about 6¾%, stepping down when the end-date ran through to 2020/early 2021 to around 6¼-6½%.

[3] These were quasi-"real-time" estimates because the exercise relied on the latest revised indicators rather than the first published estimates of the inputs. Also, the model relied on the specification estimated over the entire period rather than revising the specification as the model was rolled through the data.

Figure 6: "Real-time" estimates of the NAIRU are often revised, sometimes substantially and sometimes over preceding years



Source: Australian Bureau of Statistics, Reserve Bank of Australia, Coolabah Capital Investments

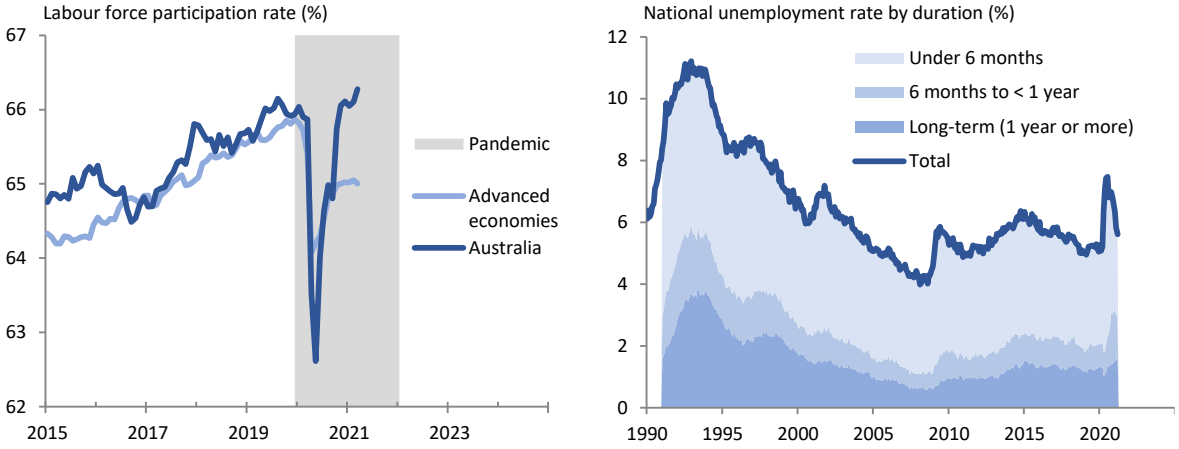
The ageing of the population should continue to gradually reduce the NAIRU

Considering potential influences on the NAIRU, we examined three factors that could affect structural unemployment over the next few years, namely:

- Scarring from last year's recession;
- Skill shortages from the closure of the international border; and
- The ageing of the population.

At this stage, there does not appear to be material scarring of the labour market from the pandemic. The aggregate labour supply, as measured by the participation rate, quickly rebounded from the pandemic and has reached a new all-time high. This contrasts with other advanced economies, where labour supply remains well below pre-pandemic levels in Europe and the US. That said, long-term unemployment, which covers people who have been out of work for more than a year, has increased from 1.3% of the labour force prior to the pandemic to 1.8% and bears watching.

Figure 7: There does not seem to be material scarring of the labour market at this point

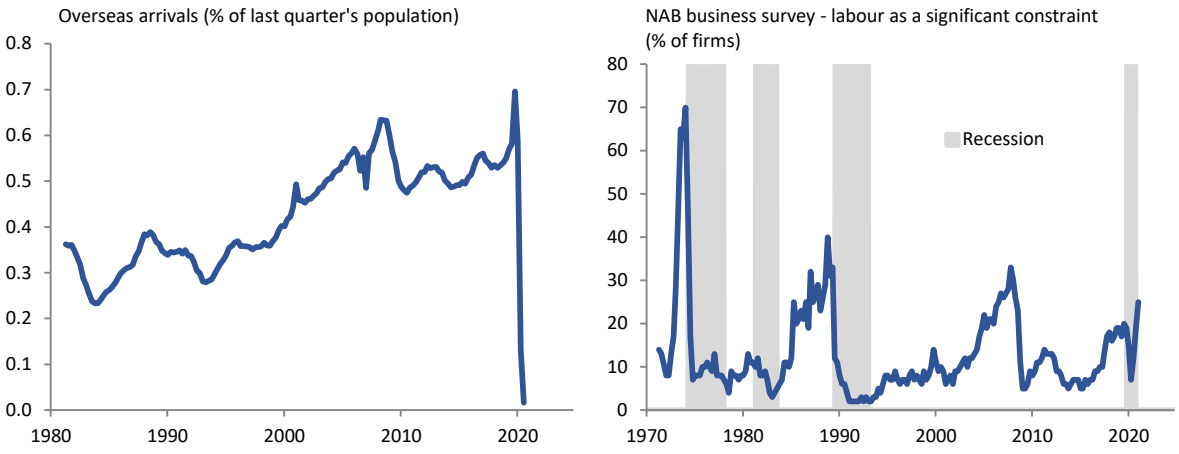


Note: The advanced economy participation rate is a PPP-weighted combination of the euro area, Japan and the US, where the Q1 2021 participation rate in the euro area was estimated.
Source: Australian Bureau of Statistics, Eurostat, Federal Reserve Bank of St Louis, International Monetary Fund, Statistics Bureau of Japan, Coolabah Capital Investments

Even though the total labour supply has recovered from the pandemic, the closure of the international border may have an effect on the NAIRU via potential skill shortages. Using overseas arrivals as a proxy for skilled migration, we were unable to find a statistically consistent effect on the NAIRU. We experimented with other proxies but with the same result. It could be that it is too early to judge the effect of the closure of the border on the labour market.

More importantly, though, even if widespread skill shortages develop there is still the question of how companies react. The National Australia Bank business survey reports that the supply of suitable labour has been a significant constraint on about 10-20% of companies for several years, spiking to 25% in Q1 2021. Historically, such significant constraints were associated with faster wage growth, but in recent years wage growth has been subdued, slowing further during the pandemic. Some firms could be responding to shortages by increasing investment, but we suspect that a more common reaction is to trade off higher wages with increased flexibility in employment arrangements for sought-after workers.

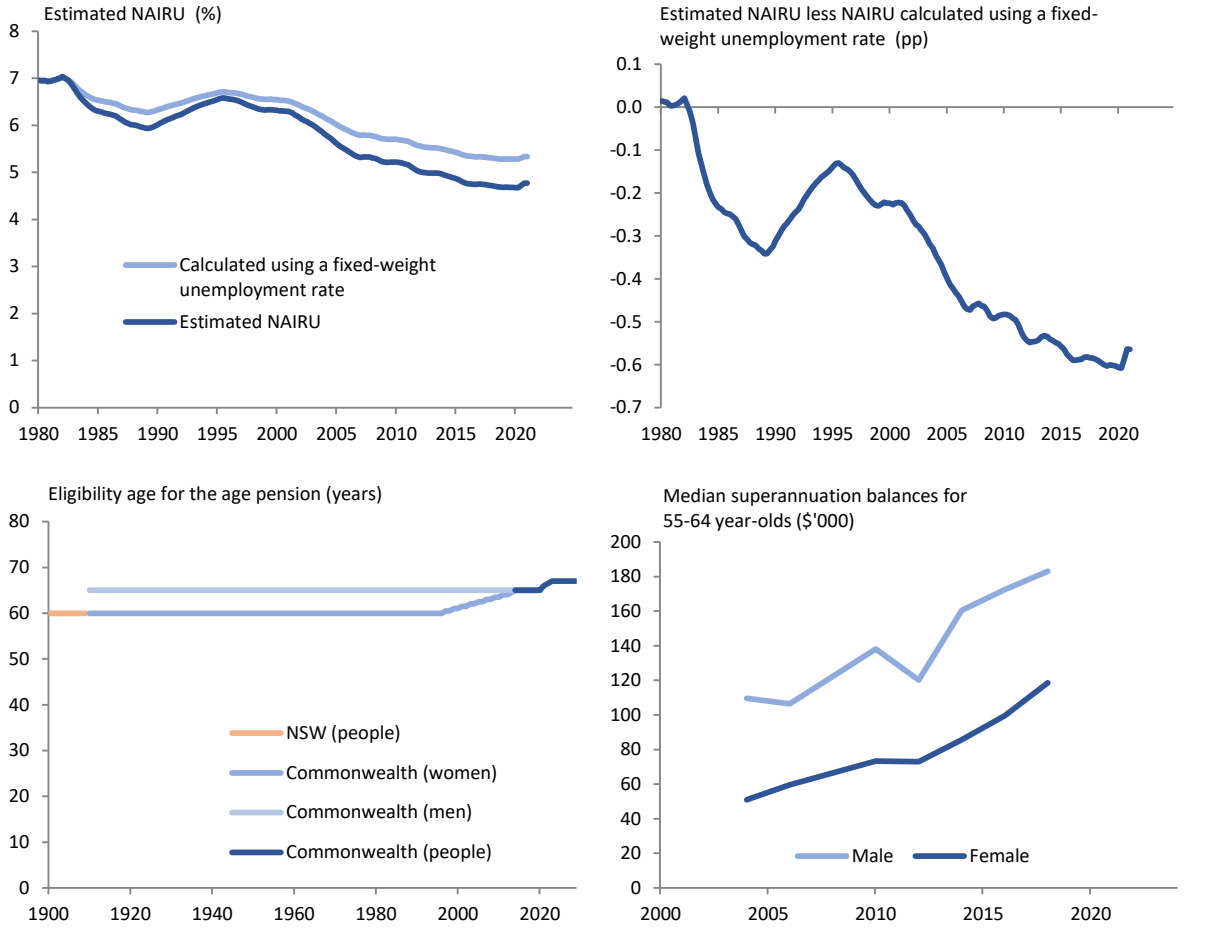
Figure 8: Overseas migration does not have a measurable effect on the NAIRU, at least to date, while persistent skill shortages have failed to lift wages in recent years



Note: Overseas arrivals and population were seasonally adjusted by CCI.
Source: Australian Bureau of Statistics, Melbourne Institute, National Australia Bank, Coolabah Capital Investments

In contrast, the ageing of the population has had a clear effect on the NAIRU, contributing to the decline in the estimated NAIRU over recent years. This is evident from re-estimating the model using a Perry-weighted unemployment rate to control for the ageing of the population, where the current NAIRU is 0.6pp lower than the age-adjusted NAIRU.[4] Comparing the trend in the two series, the ageing of the population has accounted for about 0.3pp of the 1½pp decline in the NAIRU since 2000. This ongoing effect should be reinforced by policy changes over the next 3-5 years as older Australians remain in the workforce for longer given the increase in the eligibility age for the age pension from 65 to 67 years and the difficulty in saving for retirement in a low interest rate world, particularly when median pension savings for Australians approaching retirement age are still relatively low.

Figure 9: The ageing of the population has reduced the current NAIRU by just over ½pp and a higher eligibility age for the pension in a low interest rate world should boost this ongoing effect



Note: The median superannuation balances are interpolated annual estimates.
Source: Australian Bureau of Statistics, Department of Social Security, Reserve Bank of Australia, Coolabah Capital Investments

How to reconcile this analysis with the RBA's lower estimate of the NAIRU?

The most recent RBA estimate of the NAIRU is at the low end of the model's confidence interval of 4% to 5½%. The RBA has revised down its estimate of the NAIRU over time, with Governor Lowe recently suggesting that "it is certainly possible that Australia can achieve and sustain an unemployment rate in the low 4s" and admitting that it was "entirely possible" that the NAIRU could be in the 3s. Previously, Cusbert's work had put the NAIRU at about 5% in 2017, down from the RBA's earlier

[4] The Perry-weighted unemployment rate is a fixed-weight combination of unemployment rates for different age groups split by gender. The weights were average shares of the total labour force for each group, calculated over the period from 1978 to 2021.

estimate of 5¼% in 2016. In 2019, the RBA's Ellis said the estimate had been revised down to 4½%. This compares with recent work by the Commonwealth Treasury, which saw it revise down its estimate of the NAIRU in 2019 from 5½% to about 5%, although in applying judgment to the results it thought the NAIRU could range between 4½-5% with a midpoint of 4¾%.

Figure 10: CCI, RBA and Treasury estimates of the NAIRU

(1) RBA national estimates

	2016	2017	2018	2019	2021
NAIRU (%)	5¼	5	5	4½	Low 4s, but "entirely possible" in the 3s
- 90% confidence interval	..	3¼-6¾	..	..	..
- 95% confidence interval	..	..	..	3½-5½	..

(2) Treasury national estimates

	Previous approach 2019	Updated approach 2019	Judgement 2019
NAIRU (%)	5½	5	4¾
- range	..	..	4½-5

(3) CCI state and national estimates

(state estimates are experimental)	NSW Q2 2020	VIC Q2 2020	QLD Q2 2020	SA	WA Q2 2020	TAS Q2 2020	NT	ACT	AUS Q1 2021
NAIRU (%)	4¼	4¼	4¾	..	4¾	5¾	..	..	4¾
- 90% confidence interval	3½-5¼	3¼-5¼	3-6½	..	3¼-6	3¾-7½	..	..	4-5½

Source: Department of Treasury, Reserve Bank of Australia, Coolabah Capital Investments

Considering possible reasons for the difference between the CCI and RBA estimated NAIRUs:

- The RBA model structure may have been updated in the past few years. The minor changes we made to the 2017 model did make much difference to the results. Comparing the RBA's estimates up to 2017 with the model's estimates of the same vintage, they are similar except for the first half of the 1980s, which is likely due to our crude backcasting of the inflation expectations series prior to 1985.[5]

- Another candidate to explain the difference may be the choice of estimation period. Estimating the model through to Q2/Q3 2020 puts the NAIRU at about 4¼%, lower than the 4¾% estimate for the full period to Q1 2021. It is possible, though, that the Q1 estimate is revised because it is based on assumptions for yet-to-be-released labour costs and import prices in the quarter.

- Judgement likely played a very important role. As Lowe has said, "over the past decade, the estimates of the unemployment rate associated with full employment have been repeatedly lowered both here and overseas … [and,] based on this experience, it is certainly possible that Australia can achieve and sustain an unemployment rate in the low 4s, although only time will tell". As he highlighted, "prior to the pandemic, multi-decade lows in unemployment rates were recorded in many countries, yet even then there was only a modest lift in wages growth and inflation … and here in Australia, even though unemployment rates in some states fell to levels last recorded in the early 1970s, wage growth remained subdued".

- Another likely factor – although one that will probably be left unsaid by the RBA – is a recognition that the unemployment rate will need to fall below the NAIRU in order to ensure a sustained increase in wage growth and inflation.

The key role of judgement in influencing the RBA's assessment of full employment is a practical acknowledgement of the difficulty in identifying the NAIRU in real time, even using sophisticated estimation techniques, and is grounded in the pre-pandemic experience where the RBA had

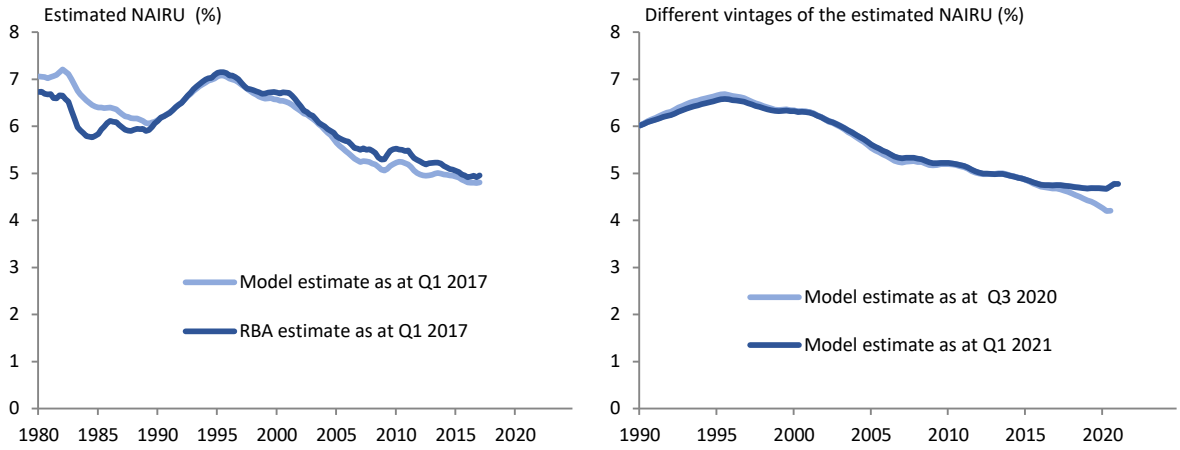
[5] The historical estimates from Cusbert's analysis were kindly supplied by the RBA.

undershot its inflation target for several years. Also, with the RBA explicitly placing more weight on reacting to *actual* rather than forecast wages growth and inflation, the RBA's lower NAIRU estimate plays a critical role as a signalling device to financial markets, which are prone to extrapolating from the faster-than-expected recovery to date when judging when the RBA will start withdrawing monetary support to the economy.

For our part, we are mindful that the model results may be less reliable than usual given the massive swings in unit labour costs during the pandemic. A cleaner read on the NAIRU should become available later this year, by which time it should also be apparent whether the recession and closure of the border have meaningfully scarred the labour market and/or led to widespread skill shortages. More likely, any impact of the pandemic should be offset by the ongoing downward pressure on the NAIRU from the ageing of the population, spurred on by a higher hurdle to obtaining the age pension and the difficulty in saving for retirement in a low-interest rate world.

As a next step, we plan to experiment with other measures of wages to see if they make much difference to the NAIRU, as well as assess whether it is worth extending the unemployment rate to include underemployed workers.

Figure 11: The RBA may have updated its model and could have used a different estimation period



Source: Australian Bureau of Statistics, Reserve Bank of Australia, Coolabah Capital Investments

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