COULD SUPPLY SHOCKS BE CAUSING US TO OVERSTATE THE NAIRU? A VIEW FROM THE DSGE[1]

This note attempts to assess whether supply shocks could be causing us to overstate the level of the NAIRU. I simulate outcomes following supply shocks in the DSGE model, subtract them from the recent data, and feed this counterfactual scenario into the NAIRU model to answer the question: how much lower would our estimate of the NAIRU be if those shocks never occurred? I find that cost shocks could lead to upwardly biased estimates of the NAIRU. But to get to an estimate of the NAIRU around 4 per cent we would need to assume that essentially all inflation over the past three years reflected cost shocks. I also find that productivity shocks could have led us to overestimate the NAIRU, but the magnitude is likely small and more uncertain.

Motivation and approach

Several commentators have argued that the Bank's current estimates of the NAIRU are too high, and that the true NAIRU is around 4 per cent, rather than 4.5 per cent. One reason put forward is that much of the inflation in prices and wages over recent years may have reflected unusually large and persistent supply shocks, rather than the economy operating above capacity. Our models take signal from prices and wages in trying to assess whether unemployment is above or below the NAIRU, and therefore in assessing the level of the NARU itself. As such, if they can't identify the source of the inflation, they may attribute assume that the economy is potential, and so infer that the NAIRU is higher than its 'true' level.

A large amount of excellent work has been done to adjust the NAIRU models to account for such dynamics. Still, it can be hard to assess how effective this has been from model fit alone. Instead, I take a different approach. First, I simulate supply shocks in the DSGE model. I then remove the effects of these supply shock from the observed data, essentially 'undoing' the shock. I then run this counterfactual data through the suite of NAIRU models to see how different the NAIRU estimates would be. Essentially, I ask the question: Had these shocks not occurred, how different would our NAIRU estimates be according to the models?[2]

This approach has several advantages. First, it allows us to directly test how certain supply shocks would be expected to affect our NAIRU estimates. Second, as the shocks are simulated in a structural model, we can capture various responses (e.g. of wages, inflation, and productivity) to these shocks in a consistent way. Third, it allows us to get a quantitative sense of the effects, not just a qualitative one. For example, how much of recent inflation would need to be supply side for NAIRU estimates of 4 per cent to be reasonable.

Still, it has some disadvantages. First, the DSGE's dynamics could differ to reality, especially if 'unusual' dynamics are currently at play. For example, wages may have reacted to high inflation more quickly than usual, and the DSGE wouldn't capture this (at least not without adjustments). Second, if the DSGE's dynamics are 'wrong' and differ from those embodied in the NAIRU model, it may unduly give us an indication that our estimates are biased. And third, elements of the DSGE may not always map well to the data.

This work can be seen as a direct test of one of the arguments for a lower NAIRU documented and discussed in PWL and SAMM (2025): that supply-side inflation is not well captured in our NAIRU models. As such, it should be considered alongside the broader work underway in this space.

Calibration and shocks

Cost shock

I consider a broad-based, persistent cost shock to all consumption sectors of the economy (tradables, non-tradables, imports and housing services) (Figure 1). The shock is calibrated to keep inflation close to the target. As such it can be seen as a very extreme scenario where all recent inflation was due to cost shocks. As such the scenario gives somewhat of an upper bound.

1 I would like to thank ..... for their comments on this work. Note that this work uses estimates and models from a few months earlier to demonstrate the potential effects of supply shocks. The shown measures should not be taken as current model estimates.

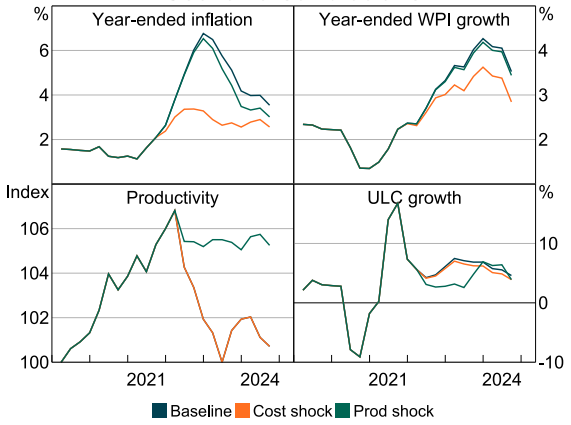
2 For more detail and discussion of conceptual issues, see Appendix A.

In the DSGE, wages are sticky so respond slowly to the change in inflation.[3] Still, the slower inflation leads to nominal wages growth in the DSGE that is around 1 percentage point lower. As such I to lower WPI and AENA growth feeding into the NAIRU models by this amount, as well ULC growth.

Regarding real outcomes, I assume that interest rates respond to stabilise hours, meaning unemployment is unchanged. As such, we are focusing on the 'nominal' effects of the shock, rather than the real effects.[4]

Figure 1

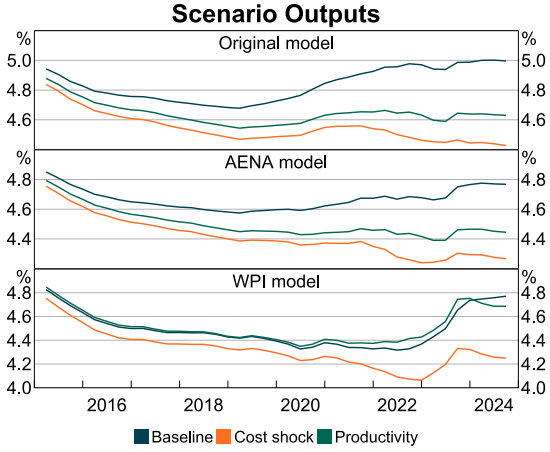
Scenario Calibrations



* Productivity indexed to March 2019=100. Inflation is trimmed-mean.

Figure 2

Scenario Outputs



Source: RBA.

Productivity

I use a sequence of persistent productivity shocks that keep productivity at its September 2021 level (Figure 1).[5] This higher productivity growth means that inflation is 0.5 percentage points lower over the period.[6] Nominal wages growth is broadly unchanged, and so therefore is AENA and WPI growth. However, nominal ULC growth is lower due to the higher productivity.

The higher productivity implies fewer hours worked, given the economy can now produce more with less (Figure A1). However, I abstract from these real effects, as it is not entirely clear how to map them onto unemployment due to hours and participation adjustment margins. If I passed some this onto unemployment in the NAIRU model, this higher unemployment would put upward pressure on the NAIRU estimates, all else equal. So the productivity scenario estimates should be thought of as an upper bound.

Results

Cost shocks

I show the results for three of the models in the NAIRU suite for parsimony. Under the cost shock scenario, estimates of the NAIRU are somewhat lower than using the observed data, declining by around 0.6 percentage points to a little above 4 per cent (Figure 2). This is uniform across all three models.

How should we interpret these findings? This suggests that if large and persistent cost shocks have been behind the inflationary dynamics over the past three years, our estimates of the NAIRU might be biased up substantially. However, it is important to note that for this scenario we have assumed essentially all inflation reflected costs shocks. As such, this can be thought of as an upper bound. Moreover, the notion that cost shocks caused all inflation is inconsistent with previous work, which suggested that demand accounted for at least half of recent inflation (Beckers et al 2023).[7] There are also credible estimates that suggest demand counted for an even larger portion of inflation (e.g. Murphy 2024).

3 I also explore a version where I make wages less rigid so that inflation has a faster effect on wages, in order to address concerns that wages may have caught up more quickly than usual during the recent period. See Appendix B for details.
4 As shown in Appendix B, this has relatively limited implications for wages growth and therefore NAIRU outcomes.
5 I do not constrain interest rates, though the response is small given the dual mandate I the Taylor rule.
6 See ER, PWL and SAMM (2024) for a discussion of productivity shocks in the DSGE.
7 One potential extension would be to use information on the actual shocks hitting the economy based on the DSGE to calibrate the scenario, using appro. I leave this to further work.

Another way to think about these results is in terms of what it would take for our estimates of the NAIRU to be where they are, if the NAIRU was actually around 4 per cent. According to these models, to believe that the NAIRU was 4 per cent we would need to assume all of the inflation we have seen over the past three years reflected supply-side cost shocks.[8] In either case, this work should be considered alongside broader work assessing arguments for a lower NAIRU, as outlined in PWL and SAMM (Forthcoming).

Productivity shock

Under the productivity shock scenario, the estimates of the NAIRU from the Original, and AENA models are around 1/3 percentage point below the estimates from the models using the observed data (Figure 2). The WPI model seems quite robust to the productivity shock scenario. This reflects the fact that, in part due to adjustments to the WPI NAIRU model, the WPI NAIRU model's estimate of trend productivity is unchanged under the counterfactual scenario. And given WPI and AENA are also unchanged, there is little effect on the NAIRU estimate.

How should we interpret these findings? They suggest that, if we think the entire decline in productivity over the past two years reflected (temporary) negative shocks to productivity, our estimate of the NAIRU may be around 1/3 percentage point too high. As noted above, this can be thought of as an upper bound, as I make no adjustments to unemployment in the scenario. So while productivity shocks may have influenced our estimates of the NAIRU, it appears unlikely that they would be substantially biasing our estimate.

Senior Research Manager
Research
Economic Research Department
31 January 2025

8 A combination of productivity and cost shock could lead to an even lower NAIRU estimate. That said, we cannot take the above as additive, as the sum of the two would lead to inflation that is currently below the target.

Appendix A: Additional detail

As noted, for both cases I simulate shocks in the DSGE. This produces a set of paths for all variables in the DSGE, most importantly the price level and inflation, nominal wage level and growth, and output and hours.

I can then map these paths to the observed data that feeds into the NAIRU models. I map the change in nominal wages growth in the DSGE to both the WPI and AENA per hour for the NAIRU models. In doing so, I am assuming that the shock led to a pure change in within-job wages growth, with no implications for promotions, reallocation, or any other factors that would contribute to the gap between AENA and WPI. This is a reasonable assumption, though it may not perfectly line up to reality.

To construct nominal ULCs, which can be expressed as the ratio of Average Labour Costs to Average Labour Productivity, I treat the numerator the same as AENA and WPI, adjusting it by nominal wages growth. I adjust the denominator using productivity growth in the DSGE, which I construct using output and hours.

As discussed above, I do not adjust the unemployment rate. In the case of the cost shock, this is because I have zeroed out any real effects on hours to focus on the nominal aspects. Specifically, I allow rates to fall to offset downward pressure on employment, which in turn reflects an increase in import demand as import costs fall. As shown in Appendix B, this has limited implications for wages growth. Though if rates did not respond, hours would be lower and wages a little lower.

Keeping hours unchanged in the productivity shock scenario would require a very large policy response. So instead, I just abstract from any employment change. Ultimately, with higher productivity the economy needs less hours worked, so unemployment may be higher. Feeding a higher unemployment rate through the NAIRU models would push the NAIRU estimate back up somewhat. As such, we can think of the scenario as an upper bound of the effect the productivity shocks on the NAIRU.[9]

In both scenarios, I keep trend inflation expectations unchanged. These have been quite stable, so this is a reasonable assumption.

In doing the exercise, I re-estimate the model parameters. This allows for a more holistic assessment of the potential affect of these shocks on the NAIRU estimates, compared to the case where the parameters were held steady.

Note that the NAIRU models have had several adjustments made over recent years to account for unusual dynamics. Most of these take the form of coefficient breaks, dummy variables, or removing data periods. As these coefficients are estimated, removing the 'shock' they were intended to capture should not be a problem – if they are not needed anymore the estimated coefficients should just go to zero. The models also include a treatment for the 2022 and 2023 Award wage decision, which involves replacing data for two quarters with adjusted numbers. I turn these off, and just use the calibrated scenario data. As the calibrated scenario data is relative to the unadjusted observed data this avoids 'double counting'. Still, leaving the Award wage adjustments in, and replacing the counterfactual scenario data for the affected quarters with the adjusted numbers has very limited effects on the NAIRU estimates.

One concern with the approach taken is that, in the absence of the supply shocks interest rates would have been lower. Failing to account for this should not have any implications for the findings. If rates were lower, unemployment would be lower, and inflation and wages would be higher. This is exactly the type of demand shock that the NAIRU models are set up to capture. As such, this should have no implications for the findings in the note.

9 Under the productivity scenario potential output also changes. This shouldn't affect the NAIRU under most models of the labour market, but it is still somewhat conceptual tricky.

Appendix B: Additional specifications

One concern that has been noted is that wages might have responded more quickly to keep up with inflation than normal due to the magnitude of the inflationary shock. This would be similair to arguments that prices can become less rigid in the face of a large shocks (e.g. Cavallo et al 2024). Such a dynamic contribute to an overstatement of the NAIRU.

To try to capture this, I re-run this cost shock scenario making wages less rigid in the DSGE. This allows wages to respond more quickly to keep up with higher prices. I calibrate the change in rigidity to be equivalent to a 5 percentage point increase in the share of employment agreements that can reset each quarter, if price rigidity was expressed as a Calvo price-setting. This is in line with the findings in (Forthcoming) for the change in price rigidity over recent years. The change is equivalent to a five-fold increase in the slope of the wage Philips curve.

Under this 'cost shock – faster passthrough' scenario nominal wages move by more. As such, in calibrating the data, I lower WPI, AENA and ULCs by more (Figure A1). Running this through the NAIRU models leads to estimates of the NAIRU that are around 0.1 percentage points lower than the main cost shock scenario.

Figure B1

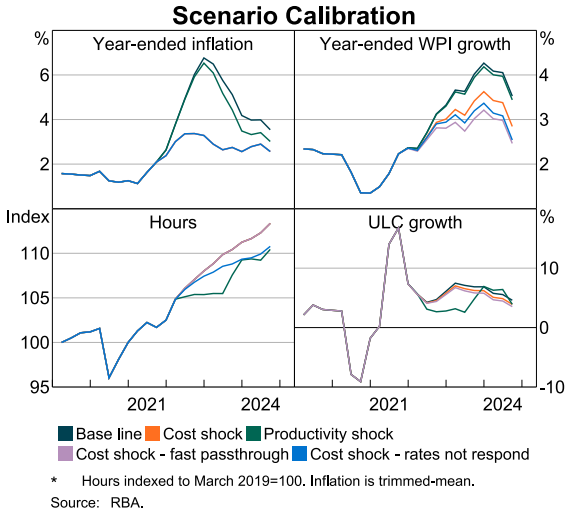
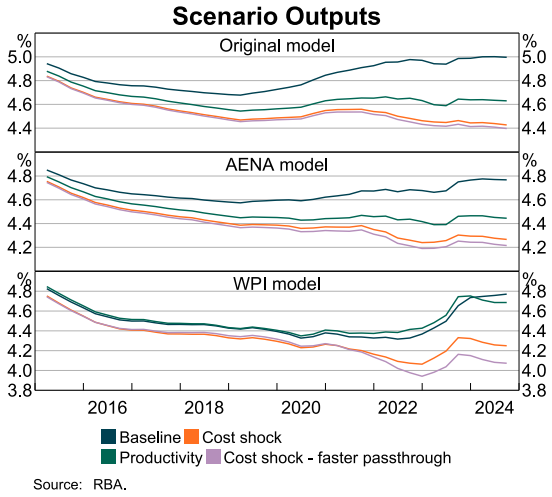


Figure B2



As noted, in the cost shock scenario I assume changes in interest rates keep hours unchanged. As shown in Figure A1, if I instead assume that there was no rates response, counterfactual hours would be somewhat lower, as would WPI growth (blue line). Mapping this change in hours to unemployment is difficult, as we do not know how much to attribute to heads versus hours, and unemployment versus participation. That said, in the case where we take the lower wages growth, and no change in unemployment, the estimated NAIRUs look almost identical to those from the main cost shock.

WHAT WE COULD EXPECT IF THE NAIRU WERE 4 PER CENT[1]

- *We consider the various cases mounted externally for a lower NAIRU and conclude that the more compelling of these arguments amount to a set of beliefs that a) trend productivity growth is higher than recent data suggest (or at least that this is factored into wage negotiations), b) supply-side shocks account for a larger share of recent inflation and wages growth, and/or c) recent inflation weakness in the December quarter print is more persistent than we expect. We think there is possible merit to these arguments, but not enough to suggest a substantially lower NAIRU (e.g. 4 per cent or below). Overall, we think that the data had been more consistent with a NAIRU around our central assumption of 4½ per cent, although there are risks in both directions.*
- *We use MARTIN to provide an alternative world view under a counterfactual NAIRU assumption of 4 per cent and examine how it would change our historical assessment and the outlook. In this alternative view, MARTIN predicts lower inflation and WPI growth over recent years, such that we require a larger contribution from supply-side shocks to justify actual outcomes. With the counterfactual NAIRU assumption, the inflation outlook is materially lower than under the official NAIRU assumption of 4.5 per cent.*
- *We also use the historical relationship between a range of labour market indicators and the unemployment gap to generate implied NAIRU estimates. We find that the current level of indicators tend to be more consistent with our current NAIRU assumption than the counterfactual NAIRU assumption.*

The case for a lower NAIRU has been mounted externally

Several market economist reports have stated or made the case for a NAIRU lower than the RBA's assumption of 4½ per cent. The mean NAIRU estimate from the RBA Market Economists Survey in November 2024 was 4.3 per cent (ranging from 3.75 to 4.7). The case for a lower NAIRU has also been reported in the media and academia, at times directly contrasting against the RBA estimate (e.g. Borland et al 2025 and Tingle 2024). All of these estimates are supported by a narrative interpretation of economic data rather than models.[2] Overall, we think there is possible merit to these arguments, but not enough to suggest a substantially lower NAIRU (e.g. 4 per cent or below), although there are risks around the central assumption in both directions. The arguments tend to focus on:

Low or lower-than-expected wage growth: Jeff Borland (2024) argues that wage growth is no higher than during the mining boom and is not excessive. This is justified on the basis of weak productivity growth being temporary. Borland et al, CBA and ANZ argue wage growth has been softer than RBA expectations. CBA argue that WPI growth is close to the level that is consistent with the inflation target, citing Lowe's comments in 2021 that 'for inflation to be sustainably within the 2-3 per cent range, it is likely that wages growth will need to be sustainably above 3 per cent'. Response: Clearly the pre-GFC period is not a reasonable benchmark for wages growth as inflation was above the band and increasing. B 2024 proposes a rule of thumb for sustainable WPI growth over the longer term as the inflation target plus half of trend labour productivity growth. Declining trend productivity will have lowered sustainable WPI growth over time.

1 We thank ... for feedback

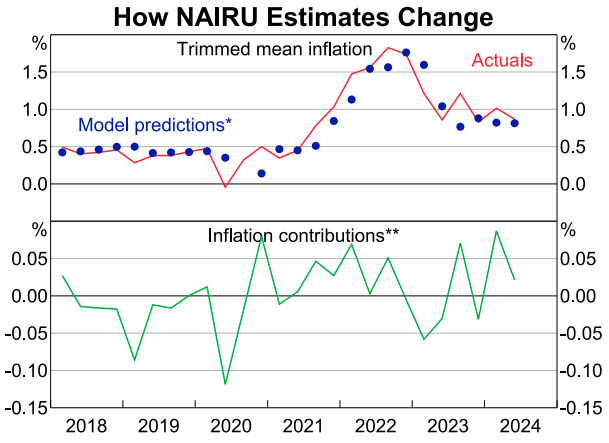
2 Other than Treasury, currently we are not aware of any external Australian model-based NAIRU estimates that are regularly updated. The OECD previously released estimates but ceased updating and publishing these over recent years. Chris Murphy (ANU) uses a piecewise linear estimate of the NAIRU in his model, currently estimated to be around 4½ per cent.

With the recent decline in productivity growth, our current view of the sustainable WPI growth is around 3 per cent (based on forecasts assuming trend productivity growth returns to around 1 per cent). A belief that trend productivity growth is higher than recent data suggest, or at least that this is factored into wage negotiations, could support a lower NAIRU. Indeed, it is possible (though not our central view) that firms are setting wages based on a higher rate of productivity growth. This may be the case if they are very forward-looking and optimistic, or if they perceive current productivity growth to be higher than in the ABS data.

- **Lack of corroborating evidence from other labour market indicators**: Goldman Sachs (GS) argued that once controlling for structural trends, the full employment indicators chart in the SMP actually suggests that the labour market is close to balance.
  Response: GS identify a valid critique that the historical range is not a meaningful benchmark of the 'full-employment consistent' level of an indicator, if the indicators are trending.[3] However, their approach does not consider that the NAIRU has fallen over time; they use a constant 4.3 per cent NAIRU anchored by Michele Bullock's public comments from June 2024. Our own version of the analysis corrects for these issues and finds that the current levels of most labour market indicators are broadly consistent with our assessment of a tight labour market from our NAIRU estimate and some suggest an even tighter labour market (see page 7). A substantially lower NAIRU would then imply that there has been structural shifts in the broader set of labour market indicators that make their elevated levels consistent with a balanced labour market.

- **Supply-side inflation has been inadequately captured in RBA models.**
  Response: The models have been adjusted to account for supply-side inflation effects using an AR(1) error term over the high inflation period. This appears to work well in capturing the inflation profile. For example, Graph 2 shows predictions of inflation from our NAIRU models and the contribution of the inflation data to NAIRU estimate revisions. If anything, this adjustment may strip too much signal out of inflation; however, it is also possible that supply-side inflation effects have taken longer to flow through than what we have accounted for with the adjustment ending after 2023Q2. Other work has been done to assess how robust the NAIRU estimates are to various supply side shocks, calibrated based on the DSGE model.Negative productivity shocks could have led us to overestimate the NAIRU, but the magnitude is likely small.
  Likewise, cost shocks could have also led to upwardly biased estimates of the NAIRU; but would require essentially all inflation over recent years to reflect cost shocks for the NAIRU to be at 4 per cent. More broadly, for a substantially lower NAIRU to be justified, it requires a belief that supply-side shocks account for a larger share of recent inflation than we currently assume (see page 5).

Graph 2



* Model estimates and predictions are from the NAIRU WPI model.
** Contributions of inflation to NAIRU model average estimate revisions, as at 2024Q2.
Source: RBA.

- **The December quarter inflation print** is evidence that inflation is close to target while the unemployment rate is at 4 per cent.

3 We are currently undertaking work to estimate a full-employment consistent level of these indicators and more thorough treatment of whether the indicators proxy the *level* or *change in the level* of tightness.

Response: The December quarter trimmed mean inflation outcome was 0.5 per cent, showing faster disinflation that we had expected. However, we judge that recent disinflation has been partly driven by factors that are likely to unwind in the medium term, including government subsidies, weakness in new dwelling inflation, and the earlier easing in the labour market. Furthermore, the outcome is only one data point, which is not sufficient basis for assessing slow-moving structural change. The revision on our NAIRU model estimates incorporating the new data is roughly 10–15 basis points, lowering the estimates but remaining above our central assumption of 4½ per cent (and this will change with the full set of December quarter data). That being said, a series of low prints or clear evidence that recent disinflation was driven by persistent factors that will continue to weigh on inflation would help to justify a lower NAIRU.

- **Real wage growth reflects real wage catch-up.** The RBA models have been modified to largely remove the direct effects of supply-driven inflation over the pandemic (up to mid 2023); however, recent wage growth outcomes may be primarily driven by real-wage catch-up associated with past inflation rather than a tight labour market. The models may not adequately strip out the effects of past inflation on wage growth, thus leading to upward biased estimates of the NAIRU.
  Response: There could be some validity to this view. Cost-of-living pressures and high inflation are referred to in union wage demands and EBAs, so there is some evidence for real-wage catch-up driving wage negotiations. However, we expect for these demands to influence actual wage outcomes, firms perceive some level of difficulty in replacing staff (i.e. a tight labour market). Furthermore, G&McG 2024 find mixed evidence for real wage catch-up.[4]

  The models are built to capture the typical effect of past inflation outcomes on wages growth (WPI, AENA and ULCs), along with the effect of long-term inflation expectations.[5] The models impose full nominal pass-through of a weighted average of long-term inflation expectations and past inflation to wage growth. This may understate real-wage catch-up because this weighted average has been lower than headline inflation (due to long-term inflation expectations remaining anchored) and because the relationship is in growth rates not levels (so bygones are bygones). Any potential threshold effects in the expectation formation and wage bargaining processes are also not captured by the models – because they impose a linear historical relationship – and could bias NAIRU estimates higher. Further work would need to be done to quantify whether this issue could in fact result in a *substantially* lower NAIRU estimate, but we think it unlikely.

- Recent labour market tightness has been largely supported by the **non-market sector** and this may be having a lesser bearing on wage outcomes.
  Response: Labour market tightness appears to be evident in both non-market and market sectors. The strength in health employment has partly stemmed from workers switching from market industries, particularly from the hospitality industries. This has occurred alongside elevated job vacancy rates and a high share of firms reporting labour constraints, including from some industries that are competing for staff from the health industry. Thus, while health sector wages growth is similar to other industries, this may partly reflect upward pressure on wage growth being dispersed across industries due to this competition.
  There is potentially some support for the notion that the non-market sector is having less bearing on wage outcomes in the short run. It is possible that there may be a longer lag between employment and wages in the non-market sector relative to the market sector, given the greater share of EBA and awards in the non-market sector (and there is also suggestive evidence that public WPI tends to lag

4 The level of real unit labour costs is above average (i.e. recent nominal ULC growth has outpaced GDP deflator growth and CPI) providing little reason to expect catch-up in the forecast period. However, real WPI adjusted by quality-adjusted labour productivity is below trend suggesting that recent nominal wages growth has been slower than expected given productivity and inflation, giving some reason to expect some real wages catch-up in the forecast period.

5 The specification differs across models and can include one or two lags of quarterly trimmed mean inflation outcomes, or a 2-year average of the GDP deflator. The coefficient on these terms range from 0.1–0.3. Across all models, the coefficients on these terms, lags of the dependent variable and inflation expectations sum to one (i.e. full nominal pass-through). This means that over time, wages growth reflects a weighted average of expectations and past inflation (along with some measure of productivity growth).

private WPI). But it is also possible that wage pressures have been muted by an expansion in labour supply into the sector. In addition, the quits rates (which is often correlated with wage growth through between-firm competition) in the non-market sector has not picked up alongside higher employment growth, while the quits rate has fallen in the market sector. Therefore, the current composition of labour demand, being strong in the non-market sector and weak in the market sector, may be associated with less wage-based competition to retain staff than would be expected given other labour market indicators, such as the unemployment rate.[6] However, since market sector employment growth is expected to pick up alongside the recovery in activity, it is likely that aggregate quits will increase over the forecast period. More broadly, for these factors to substantially affect our NAIRU estimates, it must be that we expect these forces to be persistent.

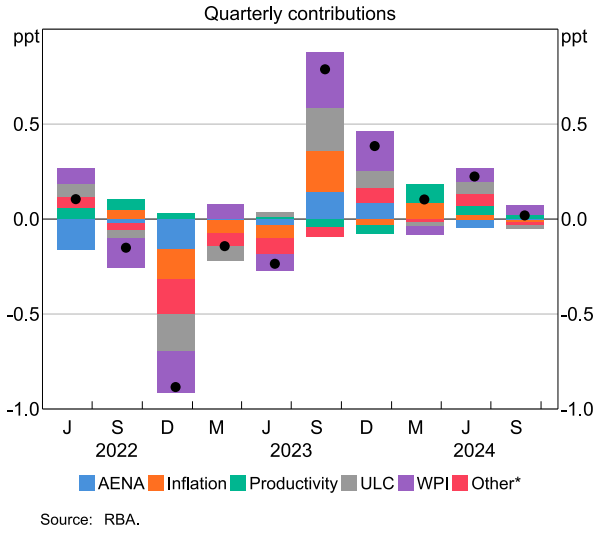
Further reflections on the case for a lower NAIRU

To complement external views, we have also considered potential shortcomings of the models and alternative rationales for a lower NAIRU. Three considerations arose: how the models fit recent data, the treatment of wages growth in late 2023, and how the rationale might interact with the outlook.

NAIRU model predictions and data outcomes

NAIRU estimates are revised in response to the unexpected portion of data outcomes. The NAIRU models predict a value for each signal variable, and when the actual outcome differs from the model prediction, the NAIRU estimates are revised. For example, if the model was predicting a 0.8 per cent inflation outcome, but actual inflation came in at 0.5 per cent (as in December quarter), the NAIRU would be revised downwards to make the unemployment gap smaller (all else equal).

Graph 4
Data Contributions to NAIRU Model Average



Source: RBA.

Graph 4 shows how recent data outcomes contributed to changes in the NAIRU model average. As shown, over the past three quarters most variables have contributed to modest upwards revisions in the NAIRU, totalling 35 bps. This suggests that recent outcomes have been much more consistent with a higher NAIRU, above 4½ per cent, than a lower one. For the NAIRU to move lower, the models would need to see persistently *lower-than-expected* outcomes for AENA, inflation, ULCs and WPI; and/or *higher-than-expected* outcomes for productivity (as this will increase the sustainable level of WPI growth).

The treatment of wages growth in late 2023

The outcomes in 2023H2 contribute to an upward revision in the NAIRU estimates of around 120 bps (Graph 4). This period saw wages growth peak and inflationary pressure sustained, but it coincided with the implementation of the unusually high Fair Work Commission decision on award wages. We have adjusted the models to remove the excess wage growth in WPI and AENA for the September quarter 2023, using estimates from McC & T 2024. This issue has been covered in previous material. Nonetheless, WPI and AENA contribute a combined 45 bps of upward NAIRU revision in September quarter 2023. It could be argued that these adjustments do not remove enough from wages growth in this period, although they remain our best estimates.

6 Consistent with this, the aggregate quits rate is lower than would be expected given its historical relationship with the estimated unemployment gap (see below).

Mismeasurement of key input variables

The way we measure key input variables, such as inflation expectations and trend labour productivity, also have a bearing on the NAIRU. For example, suppose we have mismeasured inflation expectations and they are higher than we currently think. All else equal, higher inflation expectations translate to a lower NAIRU since we can attribute higher inflation and wages growth in history to expectations rather than the unemployment gap. Our NAIRU models do not contain short-run inflation expectations, which have been well above trend expectations recently, but use past inflation as a proxy; if this is imperfect our estimates may be biased. Likewise, higher trend labour productivity growth would translate into a lower NAIRU since we can attribute higher wages growth in history to productivity rather than to strong demand for labour.

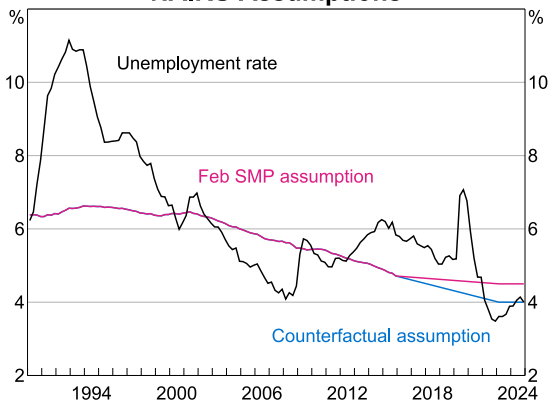
A counterfactual NAIRU to provide a coherent alternative view

If the NAIRU were 4 per cent, this would change the way that we interpret recent data and would change our outlook[7]. The motivation or narrative for this counterfactual can be taken from the views covered above, particularly that wage growth has primarily been a response to past inflation and ongoing supply shocks are biasing the NAIRU estimates higher. The December quarter CPI outcome could also be taken as evidence of rapid progress on disinflation while the unemployment rate remains at 4 per cent, suggesting a lower NAIRU. To reiterate, we think this counterfactual is a quite unlikely scenario.

Previous work has investigated how a lower NAIRU might affect the forecasts and policy strategy. The analysis here differs in specifying an historical counterfactual path for the NAIRU to provide an alternative baseline that is used to re-interpret recent data and produce alternative baseline forecasts. This is an important difference because the NAIRU is slow moving and so changing our assessment of where it currently is forces a reinterpretation of recent labour market dynamics, both in the models and our narrative. We design the counterfactual NAIRU to linearly decline at a pace similar to what is estimated during the 2010s and to arrive at 4 per cent at the start of 2023 and remaining constant thereafter. The decline troughs around the period in which we observed the tightest labour market conditions, which aligns with a 'positive hysteresis' story that tight conditions helped to lower the NAIRU by providing experience and on-the-job training to marginally attached workers. As can be seen in Graph 5 the counterfactual differs from our central estimates beginning in 2016 – this means that several years of labour market conditions must be re-interpreted.

Graph 5

NAIRU Assumptions



Source: RBA.

MARTIN's view of a counterfactual 4 per cent NAIRU

MARTIN can provide a perspective on how the counterfactual NAIRU changes our historical assessment and the outlook. To do this we re-estimate the model using the counterfactual NAIRU profile, which means that parameters in the wage growth and inflation models might change to fit the new data. Doing so is a coherent approach to simulating an alternative world view, rather than simply shocking the model under the assumption that all relationships are identical to the baseline that is conditioned on the central NAIRU assumption.

How MARTIN re-interprets recent history

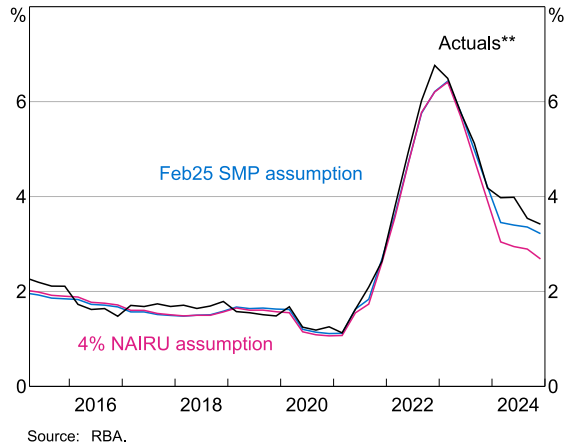
The NAIRU plays a key role in the WPI and trimmed mean inflation equations in MARTIN. Re-estimating on the counterfactual NAIRU leads to slightly smaller slope coefficients on the unemployment gap terms (declines of around 5 per cent). This suggests that labour market conditions play a smaller role in explaining WPI growth and inflation outcomes across the entire samples of over 25 years. Inflation is estimated to be a little more persistent (larger AR(1) coefficient) and WPI growth has a larger response to the lagged GDP

7 A NAIRU of 4 per cent is around the two standard error band for the WPI model estimate.

deflator. Overall, these differences are minor, but the changes align with an intuitive re-interpretation of recent history that puts less weight on labour market tightness and more on inflation dynamics to explain the data.

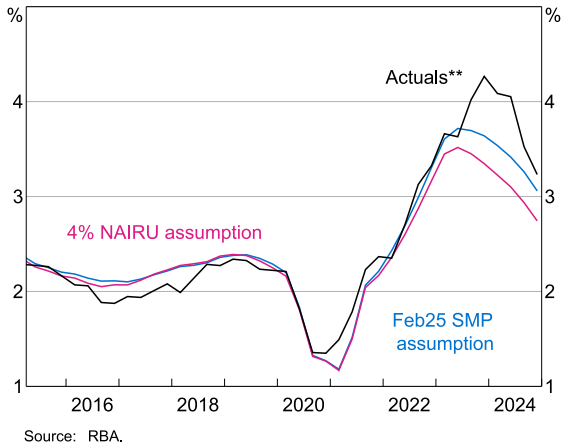
The different NAIRU estimates and parameters will result in the models fitting the data differently, shown in Graphs 6 and 7. With a 4 per cent NAIRU, MARTIN suggests lower inflation outcomes over 2024, undershooting year-ended outcomes by a little less than an additional 50 bps. For this alternative view to be justified, we must be willing to attribute that additional shortfall to supply-side drivers (or at least non-labour market drivers, perhaps related to the housing market). A similar story follows for WPI growth, with fitted values being about 30 bps lower using a NAIRU of 4 per cent compared to the baseline 4.5 per cent assumption. As with inflation, we would need further reasons to explain the larger wedge between the model fitted values and the actual outcomes. Although the re-estimated model puts a higher weight on lags of the GDP deflator – in line with the real wage catch-up narrative – it is not sufficient to make up the shortfall. As such, explaining recent wage growth as a reaction to past inflation must appeal to a unique feature of the recent episode that is not apparent in the previous 20 years of data.

Graph 6
Trimmed Mean Inflation



Source: RBA.

Graph 7
Wage Price Index Growth



Source: RBA.

How MARTIN re-interprets the forecasts

What would happen to the forecasts if the NAIRU were 4 per cent? We use MARTIN to run a scenario based on the November SMP where:

- we change the NAIRU assumption to the counterfactual assumption shown in Graph 4. This amounts to downwards revision to the NAIRU of 45 basis points, when compared to the November 2024 SMP.
- we 'update' our view of how the economy functions, by re-estimating the MARTIN equations based on the counterfactual NAIRU series
- we condition on all other new information received since the November SMP. This includes: the December quarter LFS outcome and the complete set of PWLs and DATs nowcasts.

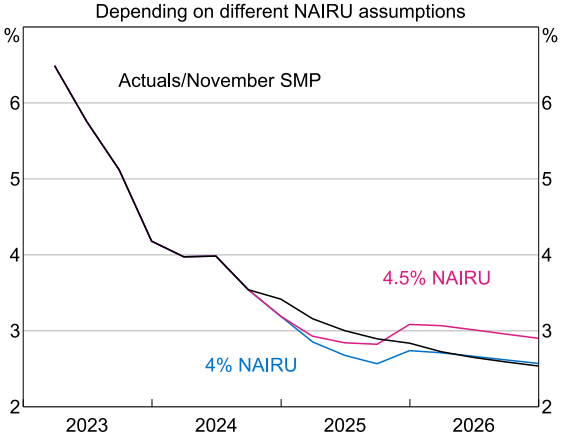
As a comparison point, we run the same exercise as explained above, but we condition on the February 2025 SMP staff assumption for the NAIRU, which is 4.5 per cent. The difference between these two simulations captures the effect of the NAIRU being lower over the past and over the forecast. The work in this section has since been extended by the scenarios team to compare to the new preliminary staff forecasts and will be presented at the Policy Environment Meeting.

Under a 4 per cent NAIRU assumption, inflation is materially lower than under the official NAIRU assumption of 4.5 per cent (Graph 8). Additionally, inflation converges back to the November forecasts near the end of the forecast horizon. This is because recent labour market outcomes suggest a large downwards revision to the unemployment rate forecast which is (i) commensurate with the change in the NAIRU (which is 45 basis points under the 4 per cent scenario) and (ii) similarly sized whether the NAIRU is 4 per cent or 4.5 per cent. That is, if the NAIRU were 4 per cent, the unemployment gap is largely unchanged over the forecasts, compared to November. But since the exercise also revises the unemployment gap in *history* as well as in the *future*, and we condition on PWL's weak DQ nowcast for trimmed mean, inflation is lower over the next year or so.

Graph 8

MARTIN Revised Inflation Forecast*

Depending on different NAIRU assumptions



* MARTIN's suggested revision to November SMP forecasts given updated data, technical assumptions, and staff nowcasts received since November.

Source: RBA.

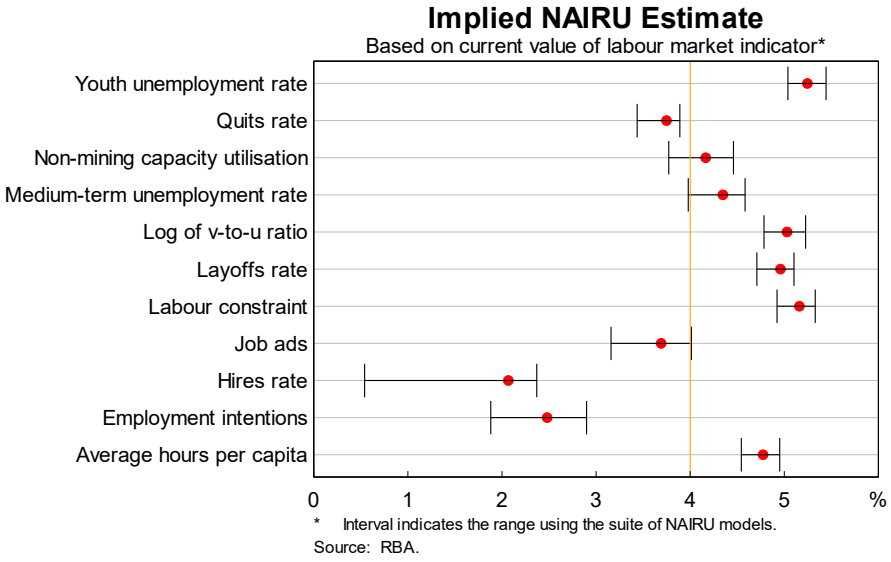
As explained above, there are several reasons *why* the NAIRU could be lower than we currently assume. Those reasons are important for how we expect the outlook to change if we revise our NAIRU assumption, but are not factored into these scenarios. Some of the possibilities might imply more persistent inflation despite a lower NAIRU (e.g. mismeasured inflation expectations) or a faster disinflation than currently expected (e.g. mismeasured trend productivity).

Broader labour market indicators with a counterfactual 4 per cent NAIRU

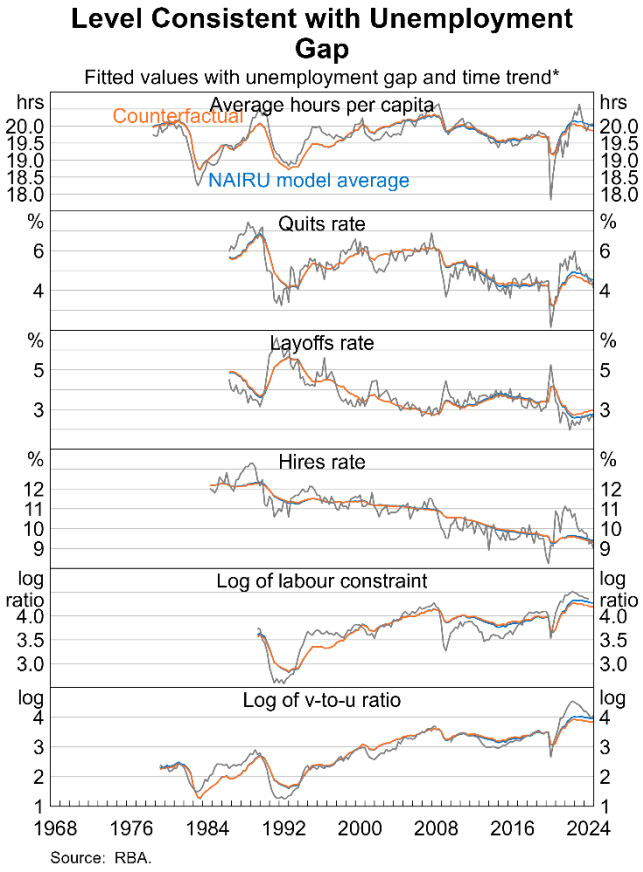
Another way to assess our NAIRU mode is to consider the historical relationship between other labour market indicators and our estimated unemployment gap. We can then estimate what the implied NAIRU would be given the current level of these indicators, while also controlling for linear trends in the indicators, such as the upward trend in vacancies (Major forthcoming). This exercise effectively runs an OLS regression of each indicator on the unemployment gap, a constant and a linear time trend. (We are currently working on an alternative approach that estimates the 'full-employment' consistent level of these indicators allowing for a non-linear trend using state-space models.)

Graph 9 shows the results of this exercise and Graph 10 and 11 demonstrates how good the fit is between each indicator and the unemployment gaps. The exercise shows that most indicators (except job ads, quits rate, hires rate and employment intentions) imply a NAIRU estimate of above 4 per cent. Furthermore, we tend to place less weight on the flow-based job ads and liaison employment intentions series because we think they better capture a 'flow' rather than 'stock' concept (just as weak GDP growth tells us about the likely change in the output gap rather than the level of the output gap, weak employment growth tells us more about the change in the unemployment gap rather than the level of the unemployment gap). Note also that liaison employment intentions disproportionately captures the market sector, so this series can be weak even as aggregate employment growth is strong, as has been the case lately.

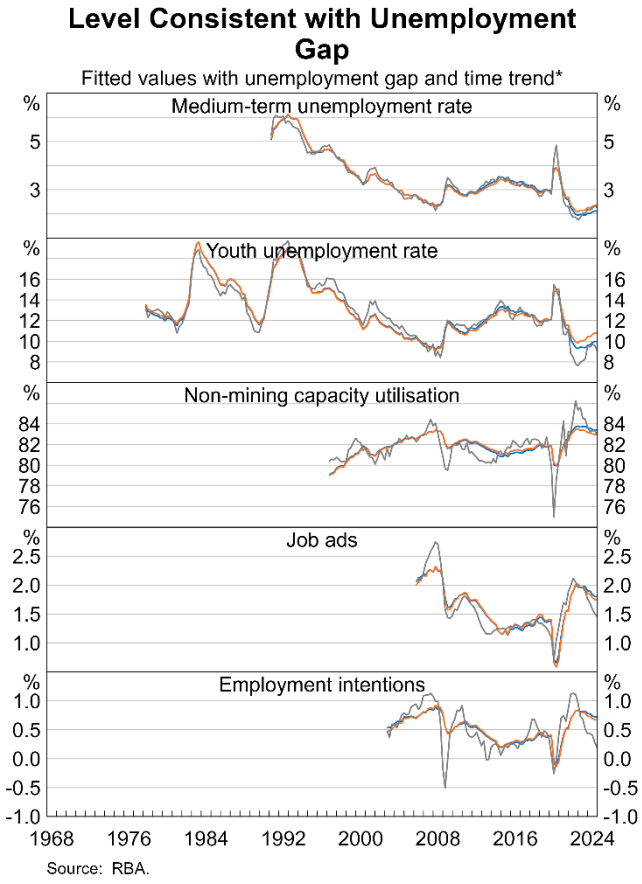
Graph 9



Graph 10



Graph 11



PWL & SAMM
Economic Analysis Department
31 January 2025

NAIRU AND OUTPUT GAP UPDATE - DECEMBER QUARTER 2024[1]

This document details the impact of new data and model updates on the NAIRU and output gap estimates for the December quarter 2024. The model average NAIRU estimate decreased from 4.75 per cent at the time of February SMP to 4.69 per cent. The 6 bps decline reflects the flow of new data (-11 bps) and pre-National Accounts data revisions (+5 bps). The model average estimate of the output gap has been revised from 0.5 per cent to 0.7 per cent in the December quarter. The revision reflects non-farm GDP levels coming in higher than forecast, and model estimates of potential output coming in weaker than implied by the House view assumption. However, the estimates still indicate the output gap is narrowing.

This note focuses on mechanical changes in the model estimates due to data updates and technical revisions; a more thorough update to the central estimates used in constructing the economic outlook will be provided at the start of the next forecast round.

Labour gaps

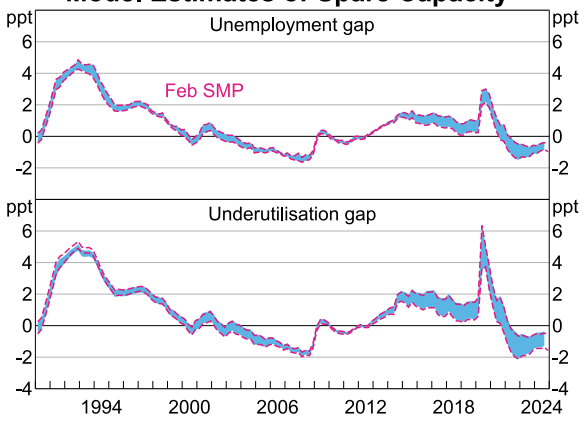
Our suite of models indicates that the unemployment gap remains negative, roughly between -1 to -0.5 per cent, and has widened relative to the February SMP (Graph 1). The widening primarily reflects the unexpected decline in the unemployment rate to 4 per cent in December. The underutilisation gap also remains negative, with the range widening to roughly between -1.6 and -0.6 per cent.

The model average NAIRU estimate, which is SAMM's preferred model-based estimate, decreased from 4.75 per cent at the time of February SMP to 4.69 per cent (Graph 2). The model estimates remain high relative to estimates from the RBA survey of market economists. The decrease in the model-based estimate of the NAIRU reflects:

- Additional quarter of data and historical revisions in the DQ2024 National Accounts: **-11bps**
  - -10bps from 2024Q4 data
  - -1bps from National Accounts revisions
- Pre National Accounts data revisions (Table 1): **+5bps**

Graph 1

Model Estimates of Spare Capacity*

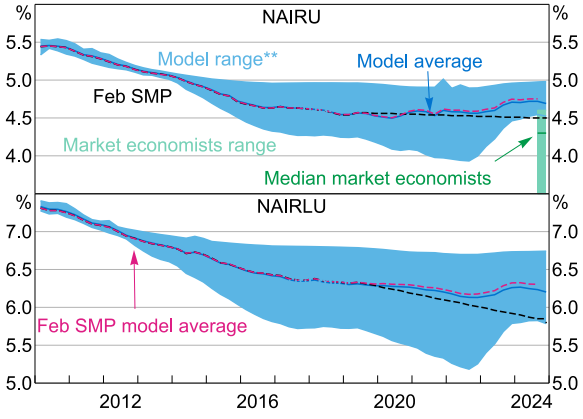


* Blue-shaded region shows illustrative range of central gap estimates from a selection of models; estimates are subject to substantial uncertainty, as well as revision due to data and model refinements.

Sources: ABS; RBA; Ruberl et al (2021).

Graph 2

Estimates of NAIRU and NAIRLU



* Using model-predicted values for the 2023Q3 observations for WPI and AENA.

** The 'Model range' refers to the range between the lowest and highest NAIRU central estimate from a suite of 6 NAIRU models.

Source: RBA.

1 We would like to thank SAMM for help with the contents of this note.

Table 1: Model Estimates

	DEC SMP	Pre-National Accounts	Post-National Accounts
	2024Q3	*2024Q3*	*2024Q4*
NAIRU	4.75	4.80	4.69
NAIRLU	6.30	6.36	6.20

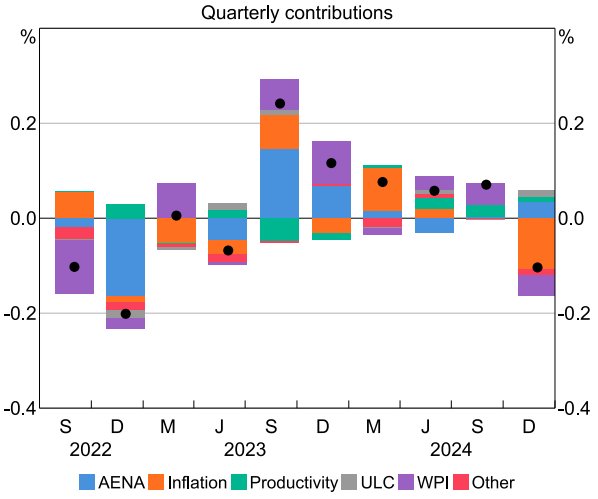
Contributions of new data

Information in the December quarter contributed to a 10 bps decline in the NAIRU model average (Graph 3). Actual inflation and WPI outcomes came in below the model predictions, contributing to -11 bps and -4 bps respectively. Other signals (primarily in the labour gap model) also contributed to the decline (-1 bps). This was partly offset by small positive contributions from AENA (+4 bps),ULCs (+1 bps) and productivity (+1 bps).

The NAIRU model range widened marginally at the bottom of the estimates while the top remained steady (Graph 4). All model estimates, excluding the Ruberl et al (2021) model, decreased in the December quarter.

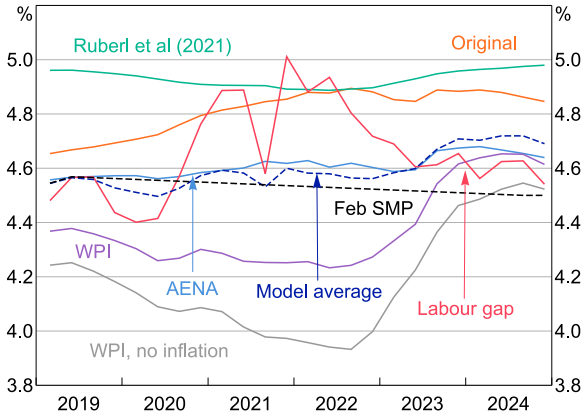
The negative contribution of new data to the NAIRU model average in the December quarter follows five previous quarters of positive movements (Graph 3). Increases in the model average over the past two years have been primarily driven by the two WPI models (Graph 4).

Graph 3
Data Contributions to NAIRU Model Average



Source: RBA.

Graph 4
NAIRU Model Estimates



Source: RBA.

Output gap

Our suite of model estimates suggests the output gap was likely still positive in December quarter 2024. The estimates range from about -1 to 1.8 per cent of potential output (Graph 5). The range of estimates is wide, reflecting different perspectives from different models in the suite. The lower bound of the range is given by the OECD's estimate of the output gap for Australia; none of the RBA's internal model estimates are below zero.

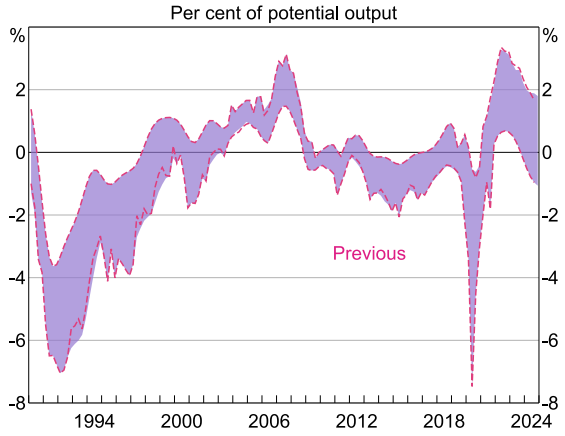
The model average output gap estimate, which is SAMM's preferred estimate, is 0.7 per cent for December quarter 2024. This is 0.2 percentage points higher than expected at the February SMP, with data on non-farm GDP levels coming in higher than expected, and model estimates of potential output coming in weaker than implied by the House view assumption (Graph 6). We do not necessarily take SAMM's preferred estimate as the SMP assumption. In previous quarters we have applied some upwards judgement to recent quarterly potential output growth.[2] The central output gap estimate for December quarter 2024, with previous

2 For the central estimate we apply judgement to the model average estimate of quarterly potential growth to offset large idiosyncratic shocks to the level of potential output that are difficult to explain. We have applied 0.1 percentage points of judgement in both June and September quarter 2024.

judgement carried over, is 0.5 per cent, which is 0.2 percentage points higher than expected at the February SMP.[3]

Graph 5

Model Estimates of Output Gap*

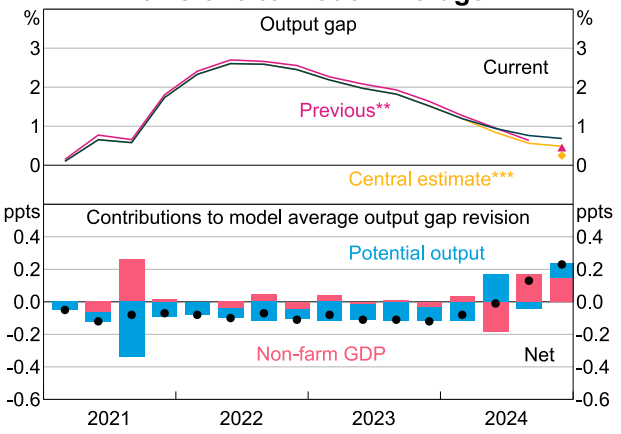


* Violet-shaded region shows illustrative range of central gap estimates from a selection of models encompassing different measures and definitions of the output gap; estimates are subject to substantial uncertainty, as well as revision due to data and model refinements.

Sources: OECD; RBA.

Graph 6

Revisions to Model Average*



* Model average reflects the average of the baseline specifications from the Production Function, SMOG and Joint-stars models, as well as SMOG-PPE.

** Triangle shows the model average estimate of the output gap at the last SMP projected forwards using the house view assumption of potential output growth and non-farm GDP growth forecasts at the last SMP.

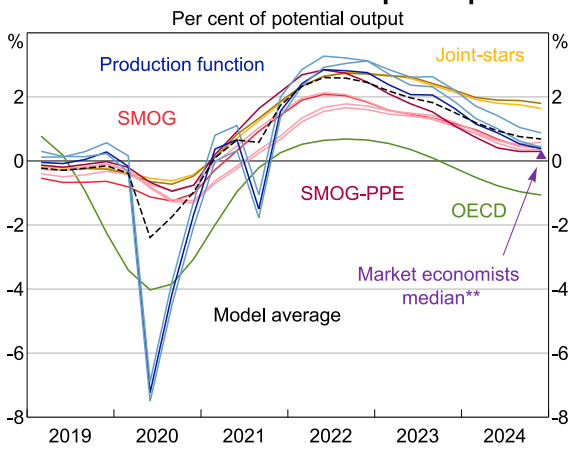
*** Yellow line shows the current central estimate, with previous judgement carried over. Yellow diamond shows the central estimate for December quarter at the last SMP.

Source: RBA.

All of the RBA's internal models show the output gap is narrowing, although at different speeds (Graph 7). Baseline estimates from the SMOG, SMOG-PPE and production function model are now around 0.4 per cent or below. The baseline estimate from the Joint-stars model remains relatively high at 1.6 per cent and continues to only gradually narrow. A decomposition of the output gap shock term in SMOG, SMOG-PPE and Joint-stars shows unemployment data in the December quarter surprised the models to the downside and is contributing to the positive output gap (Graph 8). This is partially offset by inflation data which surprised the models to the downside. In the production function model, the capital gap is the largest contributor to the output gap, with capacity utilisation remaining above its long-run average rate. The OECD's estimate continues to be substantially lower than the Bank's internal estimates, reflecting differences in data, model specifications and smoothing preferences. The median estimate from the RBA survey of market economists sits below all RBA internal models (Graph 7).

3 Note that there is no additional judgement applied on the December quarter 2024 at this stage, but this may change in the May forecasting round.

Graph 7
Model Estimates of Output Gap*

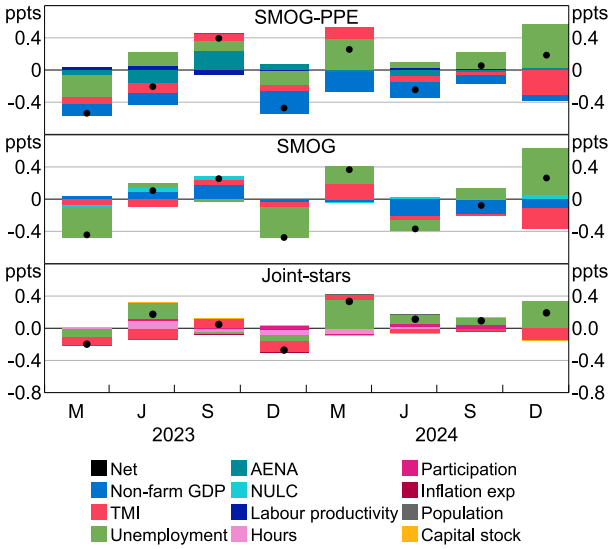


* Labels refer to baseline estimates from the models, unless otherwise specified.

** Included for comparison only. Market economists' forecasts are not included in the Bank's suite of output gap estimates.

Sources: OECD; RBA.

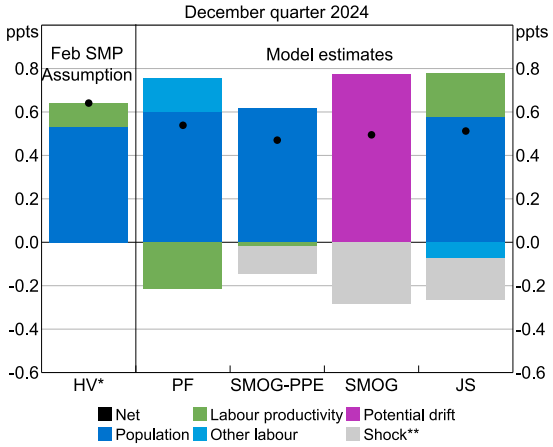
Graph 8
Contributions to Output Gap Error Term



Source: RBA.

As discussed above, model estimates of potential output for December quarter 2024 came in weaker than the House view assumption, contributing to an upward revision in the output gap. Despite a near-term downgrade to trend productivity in the February SMP, the model average estimate of trend productivity (from SMOG-PPE, Joint-stars and the production function model) undershot the house view assumption in December quarter. The model average estimate implies zero growth, while the house view assumption implied quarterly growth of 0.1 per cent. This is despite quarterly labour productivity growth coming in better than expected in the National accounts. In addition, idiosyncratic shocks continue to drag on potential output growth in the unobserved component models, albeit to a lesser degree than the previous quarter. In previous quarters we have applied 0.1 percentage points of judgment to our central estimate of potential output growth to offset some of the drag from these shocks. Given the drag is somewhat smaller this round, this suggests judgment won't be required for the December quarter estimate.

Graph 9
Contributions to Potential Output Growth



* To produce projections of the output gap we use a 'house view' of potential output growth. This view is largely based on EA's forecasting assumption for population growth and an assessment of trend labour productivity growth (with trend participation, trend average hours and changes in the NAIRU assumed to make a negligible contribution to potential growth in net terms).

** In the unobserved component models potential output in each quarter grows in a predictable way with current potential drift, but is also affected by quarterly permanent shocks to the level of potential output.

Source: RBA.

SAMM
6 March 2025