

DIGEST: THE LITERATURE ON NON-LINEAR PHILLIPS CURVES¹

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Insights are short analytical notes in which RBA staff present their own analysis of range of topics in economics and central banking. The content could align with, extend or even directly challenge the findings of other work undertaken at the Bank.

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Key takeaways

- Recent academic literature on non-linear Phillips curves explores multiple reasons why inflation tends to rise relatively sharply at low levels of unemployment, but all suggest that shocks can have a larger impact on inflation when the economy is already close to capacity or is hit by a large shock.
- The non-linear relationship between inflation and unemployment can reflect different factors, such as the fact that wages tend not to fall, supply constraints, and changes in firms' pricing-behaviour when their costs are increasing sharply.
- While it is crucial to understand the underlying mechanisms, they all tend to suggest that when the economy is hit by a large shock, or a shock when the economy is already near capacity, the inflationary impacts will be larger than otherwise. Accounting for this in forecasting inflation, output and unemployment is important.

This digest summarises recent academic literature on nonlinear Phillips curves. It reviews theory and evidence for two key sources of nonlinearity: (i) nonlinearities in the relationship between unemployment and costs, and (ii) nonlinearities in the passthrough of costs to prices. It then discusses the policy implications, most notably that nonlinearities imply a smaller inflation/activity trade-off for monetary policy when conditions are tight or inflation is high, as we lie on the steep part of the curve. Consequently, policy should tend to focus more on bringing down inflation, as it can do so with less loss of activity. Finally, the digest discusses how the Bank's Phillips curve models incorporate these nonlinearities. These models capture some labour-market driven nonlinearities, but won't tend to capture other sources of nonlinearity, such as those reflecting supply chain disruptions or changes in firms' price-setting behaviour.

Non-linear Phillips curves: Overview and history

The Phillips curve captures the relationship between wage or price inflation (π_t) and firms' marginal costs (MC_t) (eq 1), where the latter is usually proxied by the output gap or the unemployment gap (eq 2).

$$\pi_t = \beta E_t(\pi_{t+1}) + g(MC_t) \quad (1)$$

$$\pi_t = \beta E_t(\pi_{t+1}) + g(Ugap_t), \text{ where } Ugap_t = f(MC_t) \quad (2)$$

Early thinking and evidence highlighted nonlinearities in the Phillips curve, with inflation and wages picking up more strongly at low levels of unemployment (e.g. Phillips 1958). Leading up to COVID, more

¹ We would like to thank Matt Read and Kevin Lane for comments on this note.

focus was placed on the apparent flattening of the Phillips curve. But more recently, there has been increased focus on nonlinearities, reflecting the pick-up in inflation and methodological improvements.

From a theoretical standpoint, nonlinear Phillips curve models can be motivated in two ways: 1) there is a nonlinear relationship between marginal costs faced by firms and the proxies used in models (i.e. $f(MC_t)$); and/or 2) there is a nonlinear relationship between marginal costs and prices (i.e. $g(MC_t)$).²

Nonlinearities in the relationship between costs and activity

Frictions in the labour market can generate a nonlinear link between marginal labour costs (e.g. wages and recruiting costs) and unemployment. This can reflect two sources: nonlinearity in the relationship between unemployment and tightness, or in the relationship between tightness and wages/prices.

On the first, in many models the ‘true’ measure of labour market tightness that influences firms’ marginal costs is the vacancy-to-unemployment rate (v/u). The relationship between vacancies and unemployment (the Beveridge curve) is thought to be convex, with vacancies (and v/u) picking up sharply at low levels of unemployment. This reflects the fact that it is harder to create new job matches when there are only a small number of unemployed.³ This convex relationship between unemployment and tightness implies a convex relationship between unemployment and labour costs, and thus between unemployment and inflation. This generates a convex Phillips curve with a steep slope when unemployment is low and flatter slope when it is high. Figura and Waller (2024) emphasise the convexity of the Beveridge curve as the reason why the US could achieve a ‘soft landing’ over 2022 to 2023. Benigno and Eggertsson (2023, 2024) propose a ‘Beveridge threshold’ at $\frac{v}{u} = 1$, where the Beveridge curve suddenly steepens.⁴

On the second, nonlinearities in the relationship between tightness and labour costs could come from downward nominal wage rigidity (DNWR). Intuitively, when labour markets are loose or inflation is low, wages are constrained from below by DNWR. So further weakening doesn’t lower wages. Economic improvements after a period of weakness may also not immediately turn into wage gains, as wages may remain *too high*, having previously been constrained. But when inflation is high or markets are tight, wages won’t be constrained by DNWR so can respond to tightness. Papers have argued that DNWR can explain both the apparent flattening in the Phillips curve during and after the GFC, and the steepening in the recent period (e.g. Schmitt-Grohe and Uribe 2025; Mineyama 2023; Daly and Hobijn 2018).⁵

Nonlinearity between tightness and labour costs could also come from hiring costs. When firms aren’t hiring, recruiting costs are zero regardless of whether conditions are so weak that they are firing workers, or just not strong enough to hire workers. When firms are hiring, recruiting costs increase, and the increase can be nonlinear in the hiring rate, for example as (fixed) cost of posting an ad becomes a larger share of labour costs (Chodorow-Reich 2024; Petrosky-Nadeau and Zhang 2017). So firms’ recruiting costs don’t vary with tightness in a loose labour market, but could increase nonlinearly as tightness increases.

Ongoing RBA work develops a microfounded model that includes each of these three forms of nonlinearity. It shows that they can generate significant nonlinearity in the relationship between unemployment and inflation in Australia (Brassil and Ryan, 2025).

² Inflation expectations may also change, shifting the curve and creating the appearance of non-linearity. See discussion below.

³ More precisely, vacancies and unemployment are complements in the matching technology. The layoff rate may also be nonlinear in unemployment/the size of the shock, as there may be more matches that are only marginally worth maintaining when the economy is weak (e.g. Dupraz, Nakamura and Steinsson 2025). Hence, large unemployment spikes are often found to be driven by large increases in the layoff rate.

⁴ This threshold is motivated by reduced-form correlations between vacancies and unemployment in US data, not by theory. They also argue that the relationship between inflation and v/u may be nonlinear beyond this point, reflecting wage rigidities.

⁵ Schmitt-Grohe and Uribe (2025) derive a microfounded convex wage Phillips curve from DNWR and estimate it using US regional data. Mineyama (2023) instead uses micro-evidence on nominal wage adjustments to calibrate a model with DNWR.

Outside of the labour market, constraints in the supply of non-labour inputs can also generate nonlinearities in the relationship between activity and firms' costs, and so in the Phillips curve. The intuition being that, when firms can't get key inputs, it becomes very costly for firms to produce more, or even impossible so they may start 'rationing' what they can produce by setting high prices. Comin, Johnson and Jones (2024) develop a New Keynesian model with occasionally binding capacity constraints, and find that such constraints can explain half of the increase in inflation in the US over 2021-2022. The constraints created a nonlinear interaction between supply and demand shocks in the period: supply shocks tightened the constraints, so accommodative monetary policy had a more inflationary effect.

Nonlinearities in passthrough of costs to prices

Firms' price-setting behaviour can create a nonlinear relationship between their marginal costs and their prices (and so inflation). But this is dependent on assumptions around how firms set prices.

In particular, standard models of price-setting used in macro models, such as time-dependent Calvo prices or Rotemberg quadratic adjustment costs, imply a constant passthrough of changes in costs through to prices, and so a linear Phillips curve. For example, in the Calvo case a constant share of firms are allowed to change their price every quarter. It doesn't matter how quickly costs are rising, only a set share of firms can reset their prices to reflect current costs. As such, only a set proportion of the cost change are passed through to aggregate prices.⁶

The more recent literature has begun building in other assumptions, reflecting microdata evidence that firms change their prices much more frequently when inflation is high, such as post COVID.⁷ 'Menu cost' models, where firms pay a fixed cost to change prices, have become popular. In these models, when faced by a large shock more firms change their prices, as it becomes cost effective to do so. This means a larger and faster passthrough of large cost changes to prices and inflation. As such, the Phillips curve is nonlinear. It looks linear in normal times, but it steepens when big shocks hit as firms pass through more of their costs. So while menu-cost and standard models perform similarly in normal times, the former predict a large inflation response following a large shock (Auclert et al 2024; Blanco *et al* 2024, 2025).⁸

Nonlinearities in the passthrough of marginal costs into prices might also exist due to nonlinearities in the elasticity of demand that firms face. For example, Harding, Linde and Trabandt (2022, 2024) show that, when using some standard demand functions (Kimball aggregators) in a nonlinear model, firms have the incentive to change prices by more in response to cost increases than to decreases. Moreover, this incentive is stronger for larger cost changes, implying a nonlinear Phillips curve. They show that such a model can explain the lack of disinflation after the GFC, and strong inflation after COVID.

Policy implications

What are the policy implications of a nonlinear Phillips curve?

1. When faced by a large shock (or further shock when inflation/tightness is already elevated), standard models with a linear Phillips curve will underpredict the rise (and fall) in inflation. Other models, or judgements, will be needed in these cases.

⁶ More precisely, there can be some nonlinearity in pass-through and the Phillips Curve in these standard models when they are solved nonlinearly, rather than using a linear approximation as is standard. However, the degree of nonlinearity tends to be small, which in part motivates the use of a linear approximation (e.g. see Blanco et al 2025 Figure 7)

⁷ See Rudolf and Seiler (2022) for Switzerland, Montag and Villar (2023) for the US, Henkel et al. (2023) for euro area countries, Klein et al. (2024) for Sweden, Bilyk et al. (2024) for Canada, and Fink and Hambur (2026) for Australia.

⁸ These models have been used to explain the extent of inflation post-COVID (Dedola et al. 2023; Cavallo, Lippi and Miyahara 2024; Blanco et al. 2024, 2025). Fink and Hambur (2026) find that up to 1.3 percentage points of post COVID inflation in Australia could reflect changing price-setting rigidities.

2. The steeper Phillips curve means the trade-off between bringing down inflation and dampening activity is smaller. So policy should more aggressively target inflation, especially in the context of a supply shock, as we can bring down inflation without increasing unemployment as much (Benigno and Eggertsson 2023; Karadi et al 2024; Blanco *et al* 2025; Fink and Hambur 2026).^{9,10}
3. Policy should respond to uncertainty with a tightening bias. This is because, if inflation/tightness turns out higher, the consequences for inflation will be larger and policy will be more effective in bringing down inflation (relative to output). If inflation/tightness turns out lower, the inflationary consequences will be smaller, and less affected by policy (relative to output).

Are Phillips curves actually non-linear?

Some have argued that the strong pick-up in inflation post-COVID does not reflect nonlinearities in Phillips curves. Rather it reflects increases in inflation expectations. One approach to addressing this issue is to estimate Phillips curves at a regional level using panel regressions, which allow us to control for aggregate factors like inflation expectations. In the US, Beaudry, Hou and Portier (2025) found no clear evidence of nonlinearity in city-level Phillips curves, though previous papers had found more evidence.¹¹ Using regional approaches there is stronger evidence of nonlinear regional Phillips curves in the Euro Area (Faber and Zullig 2025) and in Australia (Bishop and Greenland 2021).

Another approach is to use aggregate data and directly control for inflation expectations. The results of this approach seems to depend on whose inflation expectations we believe are most relevant for pricing decisions. At least in the US, the aggregate Phillips curve appears nonlinear when controlling for the inflation expectations of professional forecasters, but this nonlinearity largely disappears when controlling for *household* inflation expectations instead (Beaudry, Hou and Portier 2025; Doser et al 2023).

The functional form also appears important. Bernanke and Blanchard (2025) find no evidence of a kink in the wage Phillips curve. Schmitt-Grohe and Uribe (2025) suggest this is because the wage Phillips curve is smooth and convex, not piecewise linear.

Regarding Australia, there is strong evidence of nonlinearities in the wage and price Phillips curves. DeBelle and Vickery (1997) found a nonlinear Phillips curve outperformed a linear Phillips curve in several respects. More recent work by such as Bishop and Greenland (2021) also find evidence of a nonlinear curve, in line with our main Phillips curve models.¹²

What nonlinearities are captured in the Bank's inflation and wages Phillips curve models?

Consistent with the above evidence, the Bank's main price and wages Phillips curves used in forecasting and NAIRU estimation are nonlinear. Nonlinearity is generated via a nonlinear unemployment gap term. Specifically, the Bank's Phillips Curve documented in Cassidy et al 2019 takes the form:

⁹ For a demand (or TFP) shock the divine coincidence usually continues to hold, so optimal policy is to stabilise the output gap and inflation. This may require a larger increase in rates, given many model predict the real effects of policy are smaller when inflation is high (e.g. Alvarez et al 2016; Blanco et al 2024, 2025).

¹⁰ A high weight on inflation can also be motivated in models with non-linear Phillips curves and backward-looking expectations, where the two interact to raise the cost of high inflation by entrenching it in expectations (Erceg, Linde and Tabandt 2024).

¹¹ Gitti (2025) does find nonlinearity in US city-level Phillips curves, but uses monthly data with only quarterly time fixed effects, whereas Beaudry, Hou and Portier (2025) controls for all time fixed effects. Both consider nonlinearity in the relationship between inflation and the vacancies-to-unemployment ratio, but a nonlinear Phillips curve in the unemployment rate could still exist if the vacancies-to-unemployment ratio is nonlinear in unemployment. Beaudry, Hou and Portier (2025) also note that the nonlinear Phillips curve might be due to general equilibrium mechanisms and only exist at an aggregate level. Earlier papers finding evidence of nonlinearities include Hooper et al (2020) and Kumar and Orrenius (2016).

¹² Both find evidence of curvatures in line with our main wage and price Phillips curve models, though with some differences in estimated curvature at very low unemployment rates (i.e. below 3½ per cent).

$$\pi_t = \beta_0 + \beta_1 \pi_{t-1} + \beta_2 \frac{\pi_t^e}{4} + \beta_3 \left(\frac{u_{t-2} - u_{t-2}^*}{u_{t-2}} \right) + \beta_4 \text{Import price growth}_t + \varepsilon_t$$

In this specification, the Phillips curve is convex with:

- the absolute response of inflation *decreasing* in the unemployment rate for a given NAIRU.
- the absolute response of inflation *increasing* in the NAIRU for a given unemployment rate.

The Bank's Phillips curve models can potentially capture some of the nonlinearities discussed above that relate to the labour market. The Phillips curve will be steep at low levels of unemployment, and flatter at higher levels of unemployment, as predicted by models where v/u is the true measure of labour market tightness, or where nonlinearities come from nonlinear hiring costs or DNWR.

Still, it may be less well suited to capturing other sources of nonlinearity. It has no explicit mechanism to capture nonlinearities coming from changes in firms' price-setting behaviour. And it has limited scope to capture nonlinearities from constraints in other input markets (outside import price growth).¹³

¹³ Some of these might feed through into a higher estimate of the NAIRU, as the NAIRU model interprets surprisingly high inflation as evidence of a higher NAIRU, and then into higher inflation forecasts. But this will occur slowly and partially.

References

- Alvarez F, H Le Bihan and F Lippi (2016)**, 'The Real Effects of Monetary Shocks in Sticky Price Models: A Sufficient Statistic Approach', *American Economic Review*, 106(10), pp 2817–2851.
- Auclert A, R Rigato, M Rognlie and L Straub (2024)**, 'New Pricing Models, Same Old Phillips Curves?', *Quarterly Journal of Economics*, 139(1), pp 121–186.
- Beaudry P, C Hou and F Portier (2025)**, 'On the Fragility of the Nonlinear Phillips Curve View of Recent Inflation', NBER Working Paper No 33522.
- Benigno P and G Eggertsson (2023)**, 'It's Baaack: The Surge in Inflation in the 2020s and the Return of the Non-Linear Phillips Curve', NBER Working Paper No 31197.
- Benigno P and GB Eggertsson (2024)**, 'Revisiting the Phillips and Beveridge Curves: Insights from the 2020s Inflation Surge', NBER Working Paper No 33095.
- Bilyk O, M Khan and O Kostyshyna (2024)**, 'Pricing Behaviour and Inflation during the COVID-19 Pandemic: Insights from Consumer Prices Microdata', Bank of Canada Staff Analytical Note No 2024-6.
- Bernanke BS and O Blanchard (2025)**, 'What Caused the US Pandemic-era Inflation?', *American Economic Journal: Macroeconomics*.
- Bishop J and E Greenland (2021)**, 'Is the Phillips Curve Still a Curve? Evidence from the Regions', *RBA Research Discussion Paper* No 2021-09.
- Blanco A, C Boar, CJ Jones and V Midrigan (2025)**, 'The Inflation accelerator', *NBER Working Paper* No 32531.
- Blanco A, C Boar, CJ Jones and V Midrigan (2024)**, 'Non-Linear Inflation Dynamics in Menu Cost Economies', *NBER Working Paper* No 32094.
- Brassil A and C Ryan (2025)**, 'A New Keynesian "Plucking" Model of Unemployment and Inflation', *paper presented at the RBA Quantitative Macroeconomics Research Workshop*, Sydney, 11–12 December.
- Cassidy N, E Rankin, M Read and C Seibold (2019)**, 'Explaining Low Inflation Using Models', *RBA Bulletin*, June.
- Cavallo A, F Lippi and K Miyahara (2024)**, 'Large Shocks Travel Fast', *American Economic Review: Insights*, 6(4), pp 558–574.
- Chodorow-Reich G (2024)**, 'Comment on "The Dominant Role of Expectations and Broad-Based Supply Shocks in Driving Inflation"', *NBER Macroeconomics Annual*, 39, pp 291–301.
- Comin DA, RD Johnson and CJ Jones (2024)**, 'Supply Chain Constraints and Inflation', *NBER Working Paper* No 31179.
- Dedola L, E Gautier, A Nakov, S Santoro, E De Veirman, L Henkel and B Fagandini (2023)**, 'Some Implications of Micro Price-setting Evidence for Inflation Dynamics and Monetary Transmission', *European Central Bank Occasional Paper Series* No 321.

Daly MC and B Hobijn (2014), 'Downward Nominal Wage Rigidities Bend the Phillips Curve', *Journal of Money, Credit and Banking*, 46(S2), pp 51–93.

Debelle G and J Vickery (1997), 'Is the Phillips Curve a Curve? Some Evidence and Implications for Australia', *RBA Research Discussion Paper No 9706*.

Doser A, R Nunes, N Rao and V Sheremirov (2023), 'Inflation Expectations and Nonlinearities in the Phillips Curve', *Journal of Applied Econometrics*, 38(4), pp 453–471. <https://doi.org/10.1002/jae.2963>

Dupraz S, E Nakamura and J Steinsson (2025), 'A Plucking Model of Business Cycles', *Journal of Monetary Economics*, 152, Article 103766. <https://doi.org/10.1016/j.jmoneco.2025.103766>

Erceg CJ, J Lindé and M Trabandt (2024), 'Monetary Policy and Inflation Scares', *IMF Working Paper No 24/260*.

Figura A and C Waller (2024), 'What Does the Beveridge Curve Tell Us about the Likelihood of Soft Landings?', *Journal of Economic Dynamics and Control*, 169, Article 104957. <https://doi.org/10.1016/j.jedc.2024.104957>

Fink M and J Hambur (2026), 'Shifts in Australian Price-setting Behaviour Around Large Shocks', *RBA Research Discussion Paper No 2026-02*. <https://www.rba.gov.au/publications/rdp/2026/2026-02/>

Gitti G (2024), 'Nonlinearities in the Regional Phillips Curve with Labor Market Tightness', *Federal Reserve Bank of Cleveland Working Paper No 24-12*.

Harding M, J Lindé and M Trabandt (2022), 'Resolving the Missing Deflation Puzzle', *Journal of Monetary Economics*, 126, pp 15–34. <https://doi.org/10.1016/j.jmoneco.2021.09.003>

Henkel L, E Wieland, A Błażejowska, C Conflitti, B Fabo, L Fadejeva, J Jonckheere, P Karadi, P Macias, J-O Menz, P Seiler and K Szafranek (2023), 'Price Setting during the Coronavirus (COVID-19) Pandemic', *European Central Bank Occasional Paper Series No 324*.

Hooper P, F Mishkin and A Sufi (2020), 'Prospects for Inflation in a High Pressure Economy: Is the Phillips Curve Dead or Is It Just Hibernating?', *Research in Economics*, 74(1), pp 26–62. <https://doi.org/10.1016/j.rie.2019.11.004>

Karadi P, A Nakov, G Nuño Barrau, E Pasten and D Thaler (2024), 'Strike while the iron is hot: optimal monetary policy with a nonlinear Phillips curve', *BIS Working Paper No 1203*. <https://doi.org/10.2139/ssrn.4897769>

Klein M, K Stromberg O Tysklind (2024), 'Price Changes on Goods and Services during the High Inflation Period: Insights from Microdata', *Sveriges Riksbank Economic Commentary No 14*.

Kumar A and PM Orrenius (2016), 'A Closer Look at the Phillips Curve Using State-level Data', *Journal of Macroeconomics*, 47(Part A), pp 84–102. <https://doi.org/10.1016/j.jmacro.2015.08.003>

Mineyama T (2022), 'Downward Nominal Wage Rigidity and Inflation Dynamics during and after the Great Recession', *Journal of Money, Credit and Banking*, 55(5), pp 1213–1244. <https://doi.org/10.1111/jmcb.12982>

Montag H and D Villar (2025), 'Post-Pandemic Price Flexibility in the U.S.: Evidence and Implications for Price Setting Models', *Federal Reserve Board Finance and Economics Discussion Series* No 2025-024. <https://doi.org/10.17016/FEDS.2025.024>

Petrosky-Nadeau N and L Zhang (2017), 'Solving the Diamond–Mortensen–Pissarides Model Accurately', *Quantitative Economics*, 8(2), pp 611–650. <https://doi.org/10.3982/QE452>

Rudolf B and P Seiler (2022), 'Price Setting before and during the Pandemic: Evidence from Swiss Consumer Prices', *Swiss National Bank Working Paper* No 2022-12.

Schmitt-Grohé S and M Uribe (2022), 'Heterogeneous Downward Nominal Wage Rigidity: Foundations of a Nonlinear Phillips Curve', *NBER Working Paper* No 30774, revised October 2025. <https://doi.org/10.3386/w30774>