Macro Musing

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Dr Jonathan Kearns

Estimating the probability of a recession

There has been endless debate about whether we will have a recession. Increasing commentary suggests that the United States may be able to avoid a recession. But Bloomberg's latest economist survey still puts the probability of a US recession at 60%. Outgoing RBA Governor, Phil Lowe has remained optimistic hoping the economy can remain "on an even keel" but stating that "the path to achieving a soft landing remains a narrow one"[1] which sounds a little like we've already run aground. Should we expect recessions in Australia and the United States?

This article first discusses how we define and measure recessions, their coincidence across countries and then estimates the modelled probability of recessions in the United States and Australia.

There's nothing 'technical' about a 'technical recession'

A recession refers to a significant decline in economic activity that lasts more than a few months. Recessions have significant costs for the economy and society. Business failures increase sharply, incomes fall, unemployment jumps (which can lead to lower lifetime earnings for those made unemployed) and there is even a deterioration in health outcomes. While some point to the 'creative destruction' from wiping out less efficient businesses, it's hard to argue that recessions have a substantial cost to wellbeing.

The most used shorthand is that two consecutive quarters of falls in GDP is a '**technical** recession'. But this arbitrary shorthand definition misses many downturns in the economy. It understates the frequency and length of recessions. Notably, unlike the 'technical' recession definition, more realistic definitions show Australia did not go 29 years until 2020 without a recession.

In the United States recessions are dated by the impressively titled National Bureau of Economic Research's 'Business Cycle Dating Committee'. The committee makes a judgement on the timing of recessions based on range of monthly data measuring real economic activity (income, employment, consumption, retail sales and industrial production). Two of the eight eminent economists on the committee have been members since it was formed in 1978, so they've certainly seen a few business cycles.

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Dating recessions in Australia

Even without a panel of esteemed academics we can still do better than the crude rule of two negative quarters of growth.

- A first improvement is to use GDP **per capita**, which more accurately records declines in living standards. Using a recession definition of successive quarters of falling per capita GDP there were two recessions in the 2000s that were not 'technical' recessions.

- A second improvement is to identify peaks and troughs in the **business cycle** using an algorithm applied to the level of per capita GDP. This can more intuitively identify a recession when several quarters of falling GDP are separated by low positive growth. This 'Bry-Boschan' algorithm also provides more intuitive recession lengths. Notably, as Figure 1 shows, this method dates the early 1990s recession as lasting 9 quarters, a full year longer than even the technical 'per capita' method.

- A third alternative method is to date reces sions with the **unemployment rate**. We care about recessions for their impact on people, and unemployment is a good metric for that. A widely used option is the Sahm rule, which identifies a recession as being when the (three month average) of the unemployment rate is half a percentage point higher than the lowest rate in the previous 12 months. An advantage of this method is that it is timelier in identifying the start of a recession, even accounting for the fact that unemployment recessions tend to lag GDP-based recessions because employment growth tends to lag GDP growth.
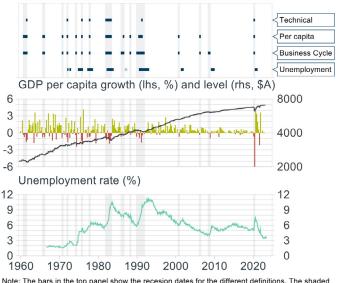
Recessions across countries

Historically countries often experience recessions at the same time as seen in Figure 2. This can be because of common shocks, such as the 1970s oil price shock or the 2008 financial crisis, and that downturns in large economies spill over to others through trade and investment flows or confidence effects.

Since the 1980s, every unemployment recession in Australia has occurred when half or more other advanced OECD economies are also experiencing a recession. The cross-country correlation of recessions also shows up for other recession definitions (see Appendix).
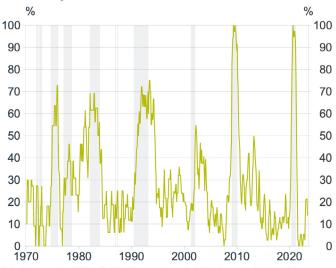
Figure 1

Australian Recessions

Recession dates for different recession definitions

Note: The bars in the top panel show the recession dates for the different definitions. The shaded regions across the panels show the business cycle recessions.
Sources: Challenger, Macrobond, ABS

Figure 2

Share of Countries in an Unemployment Recession
Shaded regions are Australian recessions

Note: Sahm recession definition (3m MA of the unemployment rate 0.5ppts or more above the minimum during the previous year). Sample starts with 10 countries in 1970 and with data availability increases to 38 OECD countries.
Sources: Challenger, Macrobond, national sources, OECD

Estimating the probability of recessions in the United States

The slope of the yield curve (a long-bond rate minus a short-term interest rate) has historically been shown to be a good predictor of recessions in the United States (an early prominent paper is Estrella and Mishkin (1996) and a more recent update is Pike and Vazquez-Grande (2019)).
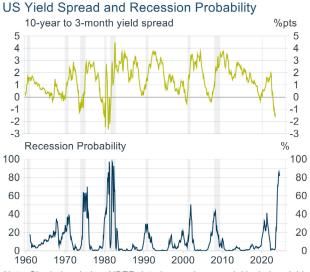
Recessions are often preceded by a significant increase in the Fed's policy interest rate (trying to contain high inflation or excess growth). In addition, when market participants expect there may be a recession lower expected growth and so expected interest rate cuts result in lower long term interest rates. Indeed, we see that US recessions have all been preceded by a yield curve that is flat or inverted (short-term interest rates exceed long-term interest rates).

Statistical models predicting recessions are also motivated by 'business cycles', noting that recessions are often preceded by an 'overheating' economy with low unemployment and high inflation. Other research points to 'leading indicators' falling sharply prior to a recession (see Kiley (2023)). Leading indicators combine forward looking economic and financial series, such as orders for goods, building permits and equity prices and bond yields.

Currently the US yield curve (10-year minus 3-month Government interest rates) is deeply inverted. A regression (Probit) model with only the yield spread estimates that at the end of July the probability of the United States being in recession in one year to be 66%, down slightly from 71% two months earlier, as seen in Figure 3. Adding the Conference Board's leading indicator to the yield spread model increases the estimated probability of a US recession to a very high 81%.
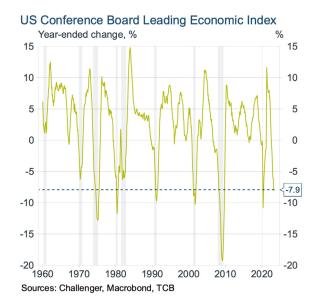
Indeed, as seen in Figure 4 this leading indicator is currently at a level only previously seen at the onset of recessions. Models that also include inflation and the unemployment rate also produce high probabilities of a recession. While recent commentary is that the likelihood of a US recession is receding, a broad range of data with an accurate predictive track record indicates that a recession in the US is still quite likely.

Figure 3

US Yield Spread and Recession Probability

Note: Shaded periods = NBER dated recessions, model includes yield spread and leading indicator
Sources: Challenger, Macrobond, NY Fed, TCB

Figure 4

US Conference Board Leading Economic Index

Sources: Challenger, Macrobond, TCB

Estimating the probability of recessions in Australia

Here, the probability of a recession is estimated as depending on

- the interest rate spread (either 10-year government bond to 3-month bank bill or 10-year to overnight interest rate spread);
- inflation and unemployment rates (deviations from a rolling average to account for structural changes over the long sample); and
- the OECD leading indicator for Australia (which comprises dwelling construction approvals, manufacturing surveys, share price index, terms of trade and 10-year bond yield).

The regression model is estimated for both the business cycle and unemployment recession definitions using all combinations of these explanatory variables (for each recession definition there are a total of 95 specifications estimated).
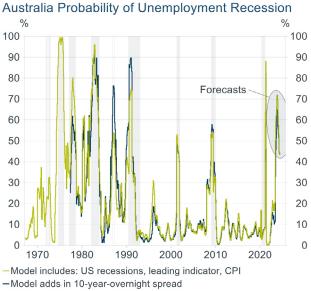
The results indicate that recessions can be predicted reasonably well using these economic data. Of the 95 different specifications, the model that best explains the timing of unemployment recessions contains an indicator for US recessions, the leading indicator, inflation and the overnight spread. As seen in Figure 5, the episodes when the model estimates there being a high probability of a recession typically accord with when a recession ultimately did occur. Only on one occasion in the late 1980s does the model estimate a greater than 40% chance of a recession when no recession occurred. On all other occasions when the model estimated a 40% or higher probability, a recession ultimately occurred. The model's probability of a recession in 2020 lags when the recession occurred, not surprisingly as economic and financial data did not predict the pandemic.

This model estimates that the probability of a recession in Australia in one year is currently 43%. The second-best fitting model, which omits the spread variable but can then be estimated over a longer historical sample period, estimates essentially the same probability of a recession in one year, at 44%.

The best fitting model for the business cycle definition of a recession contains all the explanatory variables: the spread, US recession, leading indicator, inflation and unemployment variables. It estimates that the probability of a recession in one year is currently 60% (Figure 6).
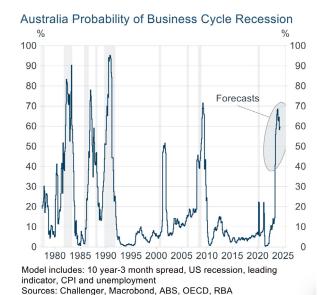
While the models predict the probability of a recession in one year based on current values for the leading indicator, inflation and spread, they also include whether the US is in recession in one year. Given we don't know if the

United States will be in recession, we use the calculated probability that it will be, currently 81%. Highlighting the importance of whether the US experiences a recession for outcomes in Australia, the probability of Australia being in a (business cycle) recession in one year if the US does experience a recession is 66% as opposed to just 33% if the United States does not have a recession.

Figure 5

Australia Probability of Unemployment Recession

— Model includes: US recessions, leading indicator, CPI
— Model adds in 10-year-overnight spread
Sources: Challenger, Macrobond, ABS, OECD, RBA

Figure 6

Australia Probability of Business Cycle Recession

Model includes: 10 year-3 month spread, US recession, leading indicator, CPI and unemployment
Sources: Challenger, Macrobond, ABS, OECD, RBA

Not all recessions are equal

Statistical models indicate there is a high probability of a recession in the US, and about a one-in-two chance in Australia. But not all recessions are equal. The early 1980s recession saw the unemployment rate rise 4% and GDP per capita fall by over 6%. The early 1990s recession was also severe. By contrast, the 2008 GFC recession was mild, with the unemployment rate rising by 'only' around 1½% and GDP per capita falling by less than 1%.

Recessions are deeper when there are amplification mechanisms. A prime candidate is the financial system, say (near) bank failures resulting from earlier bad lending decisions (such as in the early 1990s recession). Seemingly Australian banks have maintained good lending standards, and like insurers they have plenty of capital and liquidity. Risks from non-prudentially regulated financial entities also do not seem substantial as these entities are not large, nor highly integrated with leveraged institutions.

One area that has been highlighted as a potential amplification is the high level of household debt. At almost 190% of income, household debt is more than two-and-a-half times as large as when Australian last had a deep recession. But available information indicates that those households that owe debt are mostly well placed to meet their payment obligations. Overall, while there is a fair chance of a recession, the best guess is that it is unlikely to be severe.
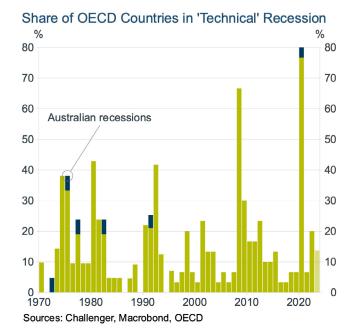
Appendix

Bry-Boschan (quarterly) algorithm

1. Identify local peaks (troughs) in the level of real GDP as quarters greater (less) than their neighbouring two quarters either side.

2. Peaks (troughs) are forced to alternate by eliminating the smaller (shallower) of any two consecutive peaks (troughs).

3. A minimum period between peaks (and troughs) of five quarters is enforced. If a peak or trough has to be removed it is done to maximise the average depth of recessions.

4. Peaks (troughs) that are lower (higher) than previous troughs (peaks) are eliminated by removing that trough-peak (or peak-trough) phase.

5. The first and last peaks (troughs) are eliminated if they are not greater (less) than the ends of the series.

Sahm Rule

This method, derived by former Fed researcher Claudia Sahm, identifies a recession as being when the three-month moving average of the unemployment rate is 0.5 percentage points or more above the minimum of this moving average during the previous 12 months.

The Sahm rule will typically identify a recession earlier than GDP-based rules. Unemployment data are published monthly with a three-week lag while GDP data are only published quarterly and with a two-month lag. Further, GDP methods require at least two quarters of GDP data to identify the start of a recession. Offsetting this employment tends to lag output (by on average 4.5 months for recession definitions).

Cross-country recession timing

Share of OECD Countries in 'Technical' Recession

Sources: Challenger, Macrobond, OECD

Share of OECD Countries in 'Technical' Recession

Sources: Challenger, Macrobond, OECD

United States Recession Probit Model Estimation

The probability of a recession is estimated using a Probit regression:

$$P\left[\,Recession_{(t+4)}\,|\,X_t\,\right] = \Phi\left(\alpha + \beta_1 spread_t + \beta_2\,LEI_t\right) + \varepsilon_t$$

where $Recession_{(t+4)}$ is a binary variable equal to 1 if there is a recession at time $t+4$ and 0 otherwise, $\Phi(.)$ is the cumulative normal distribution, $spread_t$ is the 10-year minus 3-month interest rate spread at time t and LEI_t is the Conference Board Leading Economic Indicator at time t.

US Recession Probability Probit Estimation Results

	Estimate	Standard Error	Estimate	Standard Error
Intercept	-0.60	0.08***	-0.64	0.08***
10-year to 3-month spread	-0.68	0.07***	-0.68	0.07***
CB Leading Indicator			-0.06	0.02***
AIC	426.42		382.83	
Significance codes: '***' <0.001 '**' <0.01 '*' <0.05 '.' <0.1				

Australian Recession Estimation

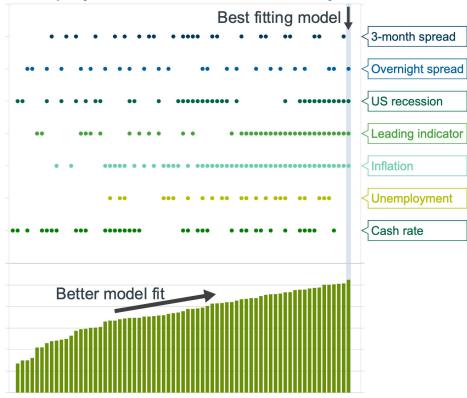The recession probability model for Australia has the same form as for the United States.

There are data constraints that affect estimation for Australia. Bond interest rates prior to 1982 were not fully market determined, reducing the information content of bond yields. For most of the sample period there have not been 3-month Treasury Bills and so 3-month bank bills are used instead (which introduces a credit premium that could vary with recession likelihood, again introducing noise). The other short-term interest rate used is the overnight cash rate, a market which has also experienced considerable structural change over time, becoming the target of monetary policy in 1990.

From 1993 inflation targeting in Australia has resulted in much lower and more stable inflation, changing the relationship of the level of inflation with the economic cycle. Similarly, the changes in the labour market over time mean that a given unemployment rate at one point in time might have been 'tight' but at another indicate there was 'slack' (i.e. the NAIRU has changed over time). For this reason, deviations of inflation and unemployment are taken from three-year rolling averages.

All series are available from June 1976, while some data start in 1968 allowing longer estimation windows. The results are broadly consistent for those regression structures that can be estimated for the longer windows. Of the 95 specifications estimated (for each of the recession definitions) any coefficient signs that differ from the economic relationship outlined earlier are discarded (e.g. if a negative yield spread reduced the likelihood of a recession). The remaining models are ordered according to their fit with the results shown in the following graphs.
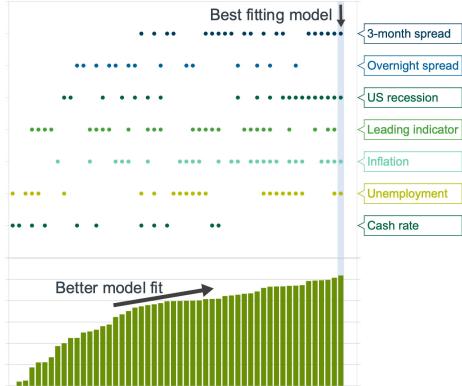
The best fitting model for unemployment recessions contains the leading indicator, inflation and unemployment, as well as the 10-year–overnight spread. The first three of these variables are consistently in all the best fitting models, while a spread (either the 3-month or overnight) is in many. For the business cycle definition of recessions, the best fitting model is similar but has the 3-month spread, and the unemployment rate rather than the leading indicator. The spread and US recession variable are consistently in the best models, along with some combination of inflation, unemployment and the leading indicator. Overall, all of these variables have some power for predicting recession. The only variable not in any of the best fitting models is the cash rate, potentially because it had a lesser role in determining financial conditions in the earlier part of the sample.

Unemployment Recession Probability Models

Note: models ordered from worst to best fit, top panel show the variables in each model; bottom panel plots the measure of fit = minus (BIC of model minus BIC of worst model)
Sources: Challenger, Macrobond

Business Cycle Recession Probability Models

Note: models ordered from worst to best fit, top panel show the variables in each model; bottom panel plots the measure of fit = minus (BIC of model minus BIC of worst model)
Sources: Challenger, Macrobond

Australian Recession Probability Probit Estimation Results

Recession definition	Unemployment		Unemployment		Business Cycle	
	Estimate	Std. Error	Estimate	Std. Error	Estimate	Std. Error
Intercept	-1.71	0.14***	-1.82	0.13***	-0.71	0.27**
10-year to overnight spread	-0.14	0.04***				
10-year to 3-month spread					-0.23	0.06***
US recession	0.86	0.20***	0.93	0.19***	0.84	0.20***
Leading indicator	-1.10	0.21***	-1.20	0.21***	-0.44	0.22*
Inflation	0.14	0.02***	0.15	0.02***	0.14	0.04***
Unemployment					-1.03	0.35**
AIC	397.43		406.48		383.39	
Significance codes: '***' <0.001 '**' <0.01 '*' <0.05 '.' <0.1						

References

Tyler Pike and Francisco Vazquez-Grande (2019) "Out-of-Sample Performance of Recession Probability Models"
Fed Notes

Arturo Estrella and Frederic S. Mishkin (1996) "The Yield Curve as a Predictor of U.S. Recessions"
Current Issues in Economics and Finance

Michael T. Kiley (2023) "Recession Signals and Business Cycle Dynamics: Tying the Pieces Together"
Fed Discussion paper

The NY Fed has an 8 page list of papers estimating economic activity with the term structure here.

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