

Statement 7: Forecasting Performance and Sensitivity Analysis

The economic and fiscal forecasts and projections presented in the 2022-23 Budget incorporate a range of assumptions taken, and judgments made, at the time of preparation. While these figures reflect the best available information at the time, the economic and fiscal circumstances that eventuate may be different from those forecast.

The large forecast errors in 2019-20 and 2020-21 due to the COVID-19 pandemic show that there is heightened uncertainty in the forecasts. In addition to the uncertainties of living with COVID-19, Russia's invasion of Ukraine could increase the extent to which ultimate outcomes vary from the current forecasts.

This Statement assesses the performance of previous forecasts as well as the inherent risk around the current forecasts using confidence interval analysis. The Statement also presents sensitivity analyses that illustrate the impacts of alternative underlying assumptions on economic and fiscal forecasts.

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Statement 7: Forecasting Performance and Sensitivity Analysis

Overview

Economic and fiscal forecasts and projections are important for government decision making. Understanding how economic and fiscal outcomes might vary from these forecasts contributes to better decision making and better government policy.

This Statement assesses the performance of previous budget forecasts by looking at the forecast errors over the past 2 decades. This is achieved by analysing the variance between historical forecasts and outcomes in each year.

Forecast errors are also used to assess the likely degree of uncertainty around the current forecasts. This analysis, referred to as confidence interval analysis, assesses the degree of uncertainty surrounding current forecasts. There are a number of ways to measure uncertainty. Confidence intervals in this Statement are based on historical forecast errors. However, the continuing uncertainty surrounding the pandemic and Russia's invasion of Ukraine means that forecast errors could potentially be larger than previously.

Finally, this Statement assesses the sensitivity of the 2022-23 Budget forecasts to movements in 2 underlying assumptions that are consistently pertinent to the economic and fiscal forecasts: the iron ore price and yields. The sensitivity of economic forecasts to other key assumptions, including those particularly relevant to the impact of the Russian invasion of Ukraine, is considered in *Budget Statement 2: Economic Outlook*.

Assessing historical forecasting performance

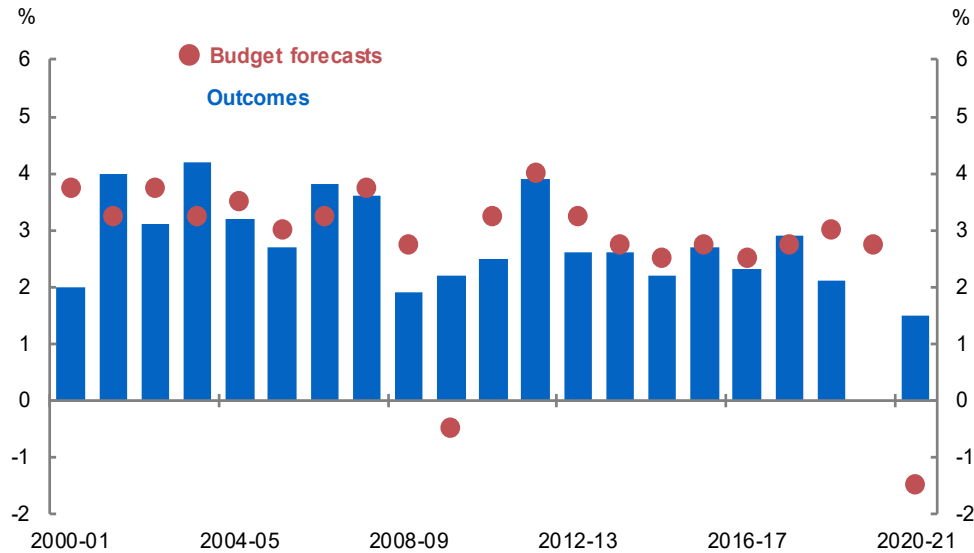
This section assesses the variance between historical forecasts and outcomes in each year for real and nominal GDP growth as well as for tax receipts. Economic forecasts are prepared using a range of modelling techniques, including macroeconomic models, spreadsheet analysis and accounting frameworks. Tax receipts forecasts are generally prepared using a ‘base plus growth’ methodology. The last outcome for each head of revenue is the base to which growth rates are applied, using appropriate economic parameters.

Forecasts incorporate a number of assumptions and judgments. The accuracy of the forecasts is influenced by the extent to which the assumptions and judgments underpinning them prove to be correct, and the reliability of the economic and fiscal relationships embodied in the models used to produce them. For example, tax receipts forecasts for a number of income taxes involves assessing whether this tax will be paid in the year the income is earned, such as for pay-as-you-go withholding tax, or in future years, such as tax on capital gains for companies and individuals.

Economic forecasting performance

Real GDP forecasts incorporate a number of assumptions, including those regarding exchange rates, interest rates, commodity prices and population growth. The forecasts also incorporate judgments about how developments in one part of the economy affect other parts and how the domestic economy is affected by events in the international economy.

The large forecast error in 2019-20 was due to the onset of the COVID-19 pandemic. The 2020-21 forecasting error illustrates how the economic recovery was significantly stronger than anticipated. This economic recovery was underpinned by Australia’s success in containing the health crisis. In addition, the broad-based economic support measures introduced by the Government were critical during the emergency phase of the COVID-19 pandemic to limit the economic cost and longer-term labour market scarring from the crisis (Chart 7.1).

Chart 7.1: Comparison of forecasts and outcomes for real GDP growth

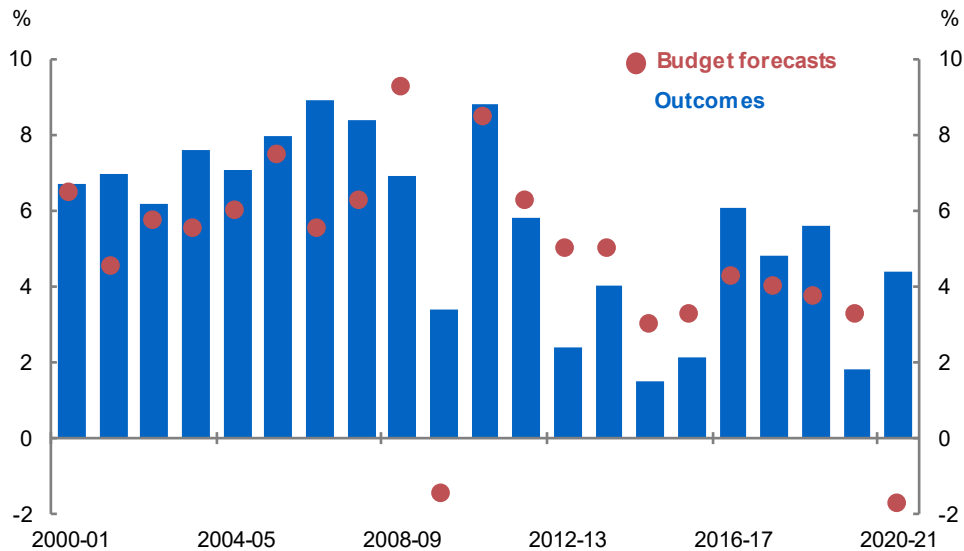
Note: Outcome is as published in the December quarter 2021 National Accounts. Forecast is that published in the Budget for that year.

Source: ABS Australian National Accounts: National Income, Expenditure and Product and Budget papers.

Compared with real GDP forecasts, nominal GDP forecasts include a prices component which is an additional source of uncertainty. This uncertainty stems from the evolution of domestic prices and wages, prices of imported goods and world prices for Australia's exports, including commodities.

Since the early 2000s, nominal GDP forecast errors have largely reflected the difficulties in predicting movements in global commodity prices (Chart 7.2). From 2011-12 to 2015-16, as key commodity prices were falling from their record highs, larger than expected falls in the terms of trade meant that nominal GDP growth was overestimated. The outcomes for nominal GDP growth from 2016-17 to 2018-19 were higher than forecast in the Budgets for those years, primarily reflecting stronger than expected commodity prices. Forecast errors have been smaller in recent years with the notable exception of 2020-21, reflecting the stronger than expected recovery from the COVID-19 pandemic, and stronger than expected commodity prices.

Chart 7.2: Comparison of forecasts and outcomes for nominal GDP growth



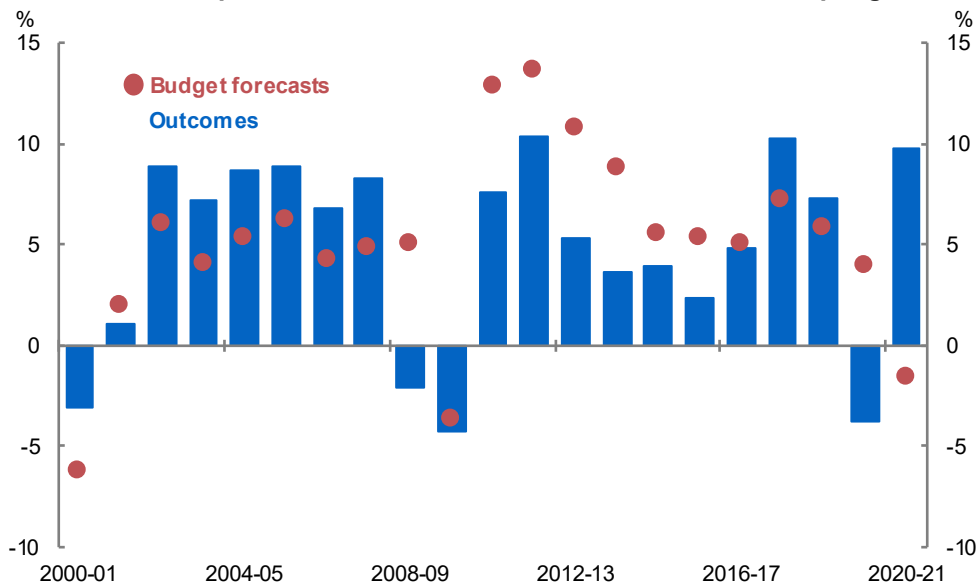
Note: Outcome is as published in the December quarter 2021 National Accounts. Forecast is that published in the Budget for that year.

Source: ABS Australian National Accounts: National Income, Expenditure and Product and Budget papers.

Tax receipts forecasting performance

Over the past 2 decades, tax receipts forecasts have both under-predicted and over-predicted outcomes (see Chart 7.3).

Chart 7.3: Comparison of forecasts and outcomes for tax receipts growth

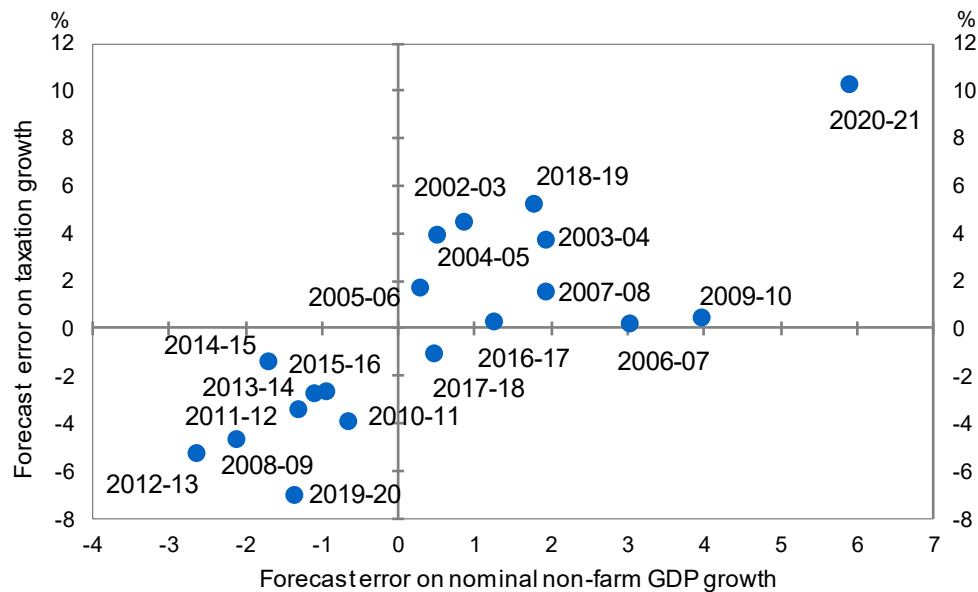


Source: Budget papers and Treasury.

Total tax receipts were \$49.2 billion higher in 2020-21 than the estimate at the 2020-21 Budget. This outcome reflects the strength in tax collections across almost all revenue heads, driven by stronger-than-expected economic outcomes and higher-than-expected commodity prices. Further information on this variation can be found in the *2020-21 Final Budget Outcome*.

Generally, there is a strong correlation between the accuracy of the forecasts of nominal GDP and its components and the forecasts for tax receipts. On average, economic forecast errors will be magnified in receipts forecast errors, owing to the progressive nature of the personal income tax system. Chart 7.4 plots the forecast errors for nominal non-farm GDP growth against the errors for tax receipts growth excluding capital gains tax (CGT). It shows that where there has been an underestimate of nominal non-farm GDP growth, tax receipts tend to be underestimated and vice versa.

Chart 7.4: Forecast errors for nominal non-farm GDP growth and taxation receipts growth^(a)



(a) Excludes CGT.

Source: ABS Australian National Accounts: National Income, Expenditure and Product, Budget papers and Treasury.

Assessing current forecasts through confidence interval analysis

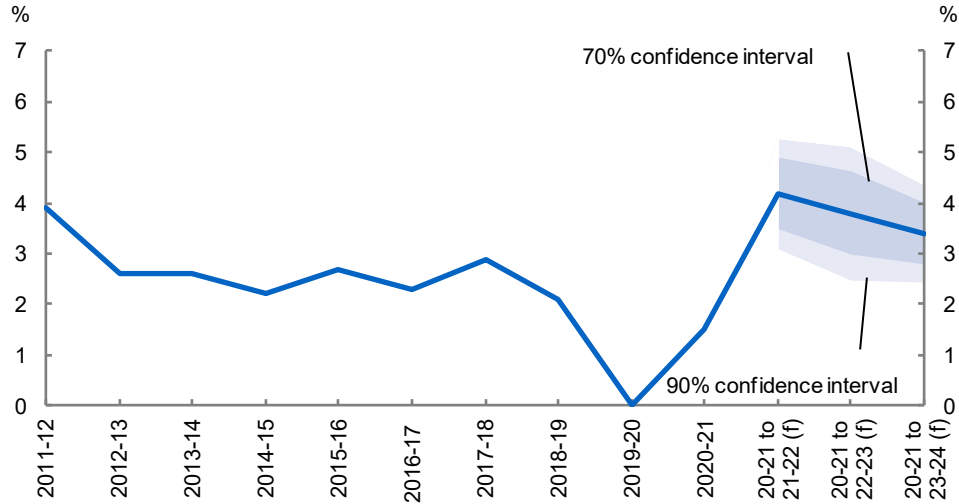
This section presents confidence intervals consistent with practice in previous budget updates. The confidence intervals provide a guide to the degree of uncertainty around current forecasts if it is assumed that forecast errors are consistent with the distribution of forecast errors since 1998-99.¹

Forecast errors in the future will not necessarily be consistent with the distribution of historical forecast errors. Forecast errors driven by unusual developments can be larger than experienced during the historical sample period. During such periods, the range of outcomes for economic and fiscal estimates can be considerably wider than normal. The large forecast errors in 2019-20 and 2020-21, due to the unforeseen nature of the COVID-19 pandemic, are an example of the type of event not previously captured in the historical sample. While the estimated confidence intervals now include the large errors in these years, they are still based predominantly on more normal periods of time and are therefore likely to understate the true uncertainty during the pandemic.

Economic uncertainty based on historical forecast errors

Based on forecast errors for real GDP in the past, Chart 7.5 shows the degree of variance around the current forecasts if similar magnitude errors were made again. The chart suggests that the average annualised growth rate of real GDP in the 3 years to 2023-24 is expected to be around 3½ per cent, with the 70 per cent confidence interval ranging from 2¾ per cent to 4 per cent. The 90 per cent confidence interval ranges from 2½ per cent to 4¼ per cent. In other words, if forecast errors are similar to those made over recent years, there is a 90 per cent probability that the average annualised growth rate of the economy over the 3 years to 2023-24 will lie in this range.

1 The assumptions behind the confidence intervals presented are based on the methodology presented in the Treasury Working Paper *Estimates of Uncertainty around Budget Forecasts*. As in the paper, it is assumed that forecast errors are normally distributed with zero mean and the past errors are representative of the future errors.

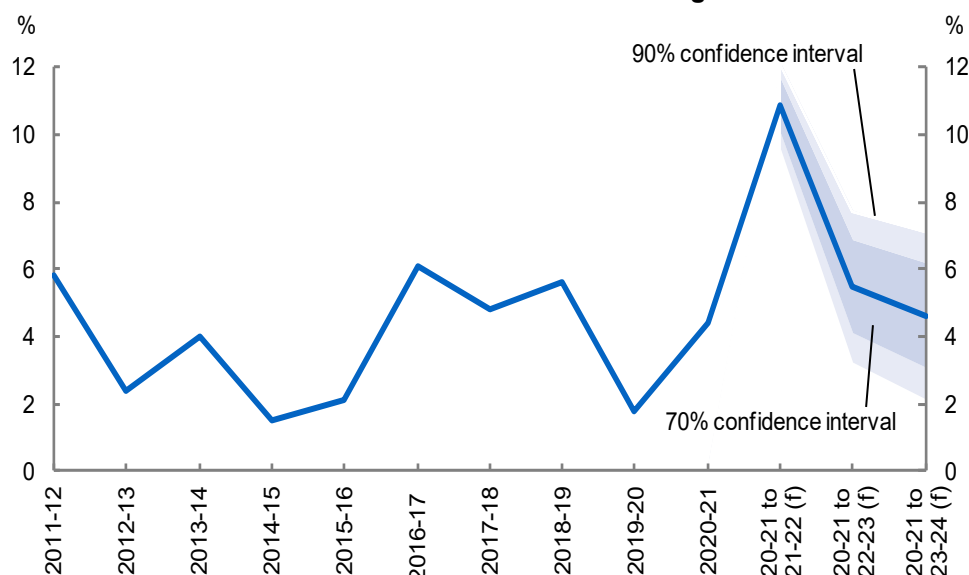
Chart 7.5: Confidence intervals around real GDP growth rate forecasts

Note: The central line shows the outcomes and the 2022-23 Budget forecasts. Annual growth rates are reported for the outcomes. Average annualised growth rates from 2020-21 are reported for 2021-22 onwards. Confidence intervals are based on the root mean squared errors (RMSEs) of Budget forecasts from 1998-99 onwards. (f) are forecasts.

Source: December quarter 2021 ABS Australian National Accounts: National Income, Expenditure and Product, Budget papers and Treasury.

The confidence intervals around the nominal GDP forecasts are wider than those around the real GDP forecasts, reflecting the uncertainty around domestic prices and commodity prices. Average annualised growth in nominal GDP in the 3 years to 2023-24 is expected to be around 4½ per cent, with the 70 per cent confidence interval ranging from 3 per cent to 6¼ per cent. The 90 per cent confidence interval ranges from 2¼ per cent to 7 per cent (Chart 7.6).

Chart 7.6: Confidence intervals around nominal GDP growth rate forecasts



Note: See note to Chart 7.5.

Source: December quarter 2021 ABS Australian National Accounts: National Income, Expenditure and Product, Budget papers and Treasury.

Fiscal uncertainty based on historical forecast errors

The fiscal estimates contained in the Budget are based on, and are highly sensitive to, economic and demographic forecasts as well as estimates of the impact of spending and revenue measures. Changes to any of these factors will affect forecasts for receipts and payments. As such, this will have a direct impact on the profile of the underlying cash balance.

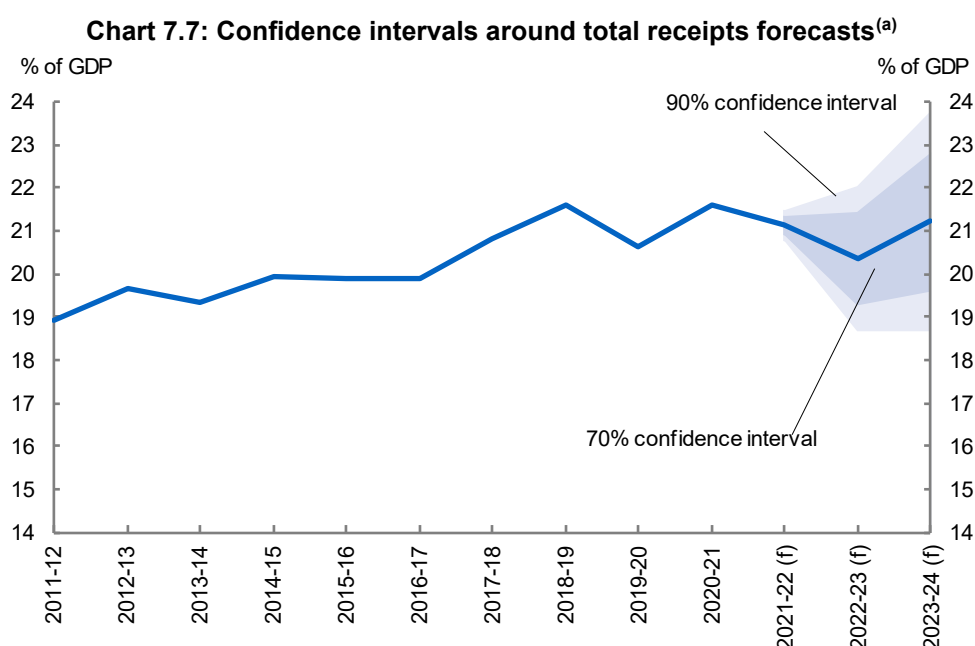
Historical variations caused by subsequent policy decisions are excluded as these do not relate to the forecasting errors presented in this section. However, payments estimates include the public debt interest impact of policy decisions and a provision for contingencies.²

² The impacts of past policy decisions on historical public debt interest through time cannot be readily identified or estimated. For this reason, no adjustment has been made to exclude these impacts from the confidence interval analysis.

Total receipts

Chart 7.7 shows confidence intervals around the forecasts for total receipts (excluding GST³). The chart shows that there is considerable uncertainty around receipts forecasts and that this uncertainty is likely to increase as the forecast horizon lengthens.

Total receipts (excluding GST) are expected to be around 20.4 per cent of GDP in 2022-23, with the 70 per cent confidence interval ranging from 19.3 per cent to 21.4 per cent of GDP. The 90 per cent confidence interval ranges from 18.7 per cent to 22.0 per cent (Chart 7.7).



(a) Excludes GST and includes Future Fund earnings.

Note: The central line shows the outcomes and the 2022-23 Budget forecasts. Confidence intervals use RMSEs for Budget forecasts from the 1998-99 Budget onwards. (f) are forecasts.

Source: Budget papers and Treasury.

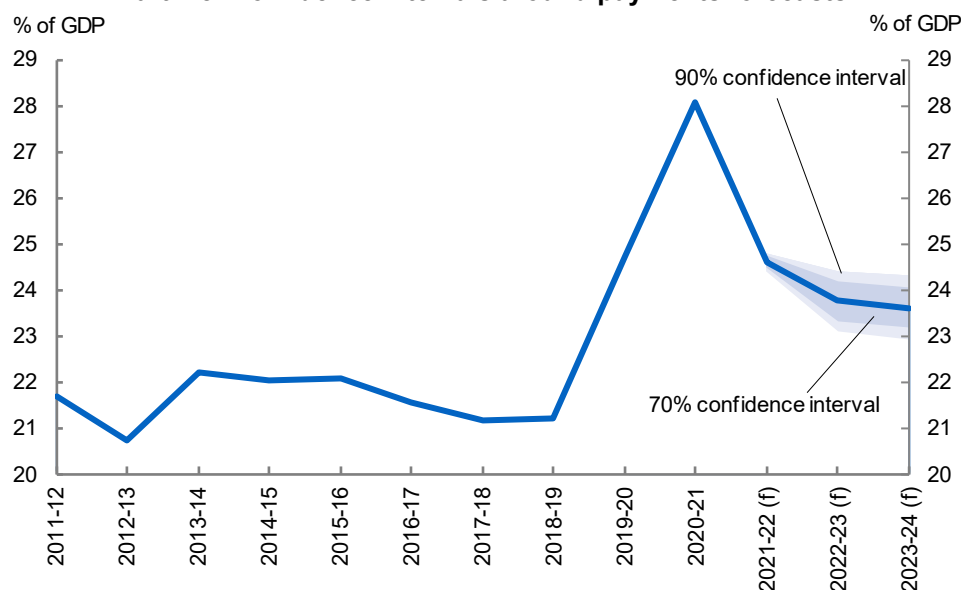
Payments

Chart 7.8 shows confidence intervals around payments forecasts (excluding GST). Payments (excluding GST) are expected to be around 23.7 per cent of GDP in 2022-23, with the 70 per cent confidence interval ranging from 23.3 per cent to 24.2 per cent of GDP. The 90 per cent confidence interval ranges from 23.1 per cent to 24.4 per cent (Chart 7.8).

³ GST was not reported as a Commonwealth tax in budget documents prior to the 2008-09 Budget. As a result, GST data have been removed from historical receipts and payments data to abstract from any error associated with this change in accounting treatment.

Automatic stabilisers have operated to provide support during the pandemic. Demand-driven programs, such as payments to individuals for social welfare, form the bulk of government expenditure. Forecasts of payments associated with a number of these government programs depend on forecasts of economic conditions.

Chart 7.8: Confidence intervals around payments forecasts^(a)



(a) Excludes GST payments.

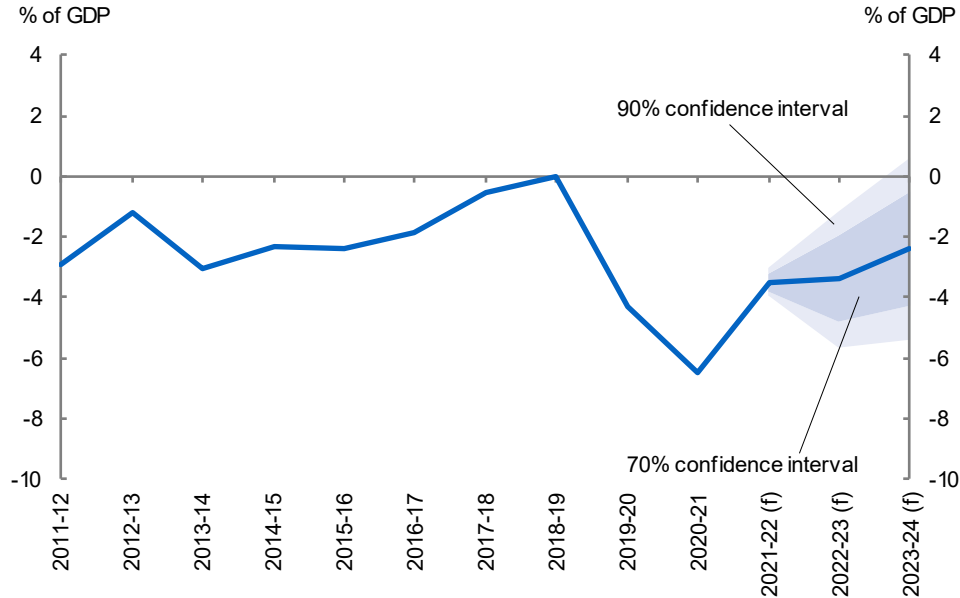
Note: See note to Chart 7.7.

Source: Budget papers and Treasury.

Underlying cash balance

The underlying cash balance estimates are sensitive to the same forecast errors that affect estimates of receipts and payments. Chart 7.9 shows that there is considerable uncertainty around underlying cash balance forecasts and that this uncertainty is likely to increase as the forecast horizon lengthens. The underlying cash deficit in 2022-23 is expected to be 3.4 per cent of GDP, with the 70 per cent confidence interval ranging from a deficit of 4.8 per cent to 2.0 per cent of GDP. The 90 per cent confidence interval ranges from a deficit of 5.6 per cent to 1.1 per cent (Chart 7.9).

Chart 7.9: Confidence intervals around the underlying cash balance forecasts



Note: See note to Chart 7.7.
Source: Budget papers and Treasury.

Assessing current forecasts through sensitivity analysis

Sensitivity analysis provides an alternative way to examine the uncertainty surrounding current forecasts. Sensitivity analysis assesses the degree of uncertainty by considering alternative assumptions for key variables. In doing so, sensitivity analysis can illustrate the impact of small changes in assumptions on economic and fiscal aggregates.

There are a range of variables that could have different outcomes from those assumed in the forecasting process. The iron ore price and yields have been chosen for the following sensitivity analysis as they are fundamental to Australia's economic and fiscal outcomes and have varied considerably over time. The economic impact of other key variables, including the recent significant increase in oil prices due to Russia's invasion of Ukraine, is considered in *Budget Statement 2: Economic Outlook*.

Movements in the iron ore price

The forecasts for nominal GDP and tax receipts are sensitive to assumptions about commodity prices, particularly iron ore which represented around a third of the value of goods and services exports in 2020-21. Iron ore prices are affected by many factors, are volatile and are uncertain. Refer to *Budget Statement 2: Economic Outlook* for more information on recent developments in commodity prices. The results of both an increase and a decrease in the iron ore price are presented in Table 7.1 below.

This analysis considers the impact that a permanent US\$10 per tonne increase in the iron ore price has on nominal GDP and tax receipts relative to baseline levels in the 2022-23 Budget forecasts. The effects of a US\$10 per tonne decrease in the iron ore price are broadly symmetrical with the effects of a US\$10 per tonne increase.

The US\$10 per tonne increase in the assumed price for iron ore exports is expected to result in an increase in nominal GDP of around \$4.4 billion in 2022-23 and around \$2.3 billion in 2023-24. The economic response to a permanent change in the price of iron ore is derived from a generic terms of trade shock in Treasury's Macroeconometric Model of Australia (EMMA). The model incorporates forward-looking financial markets, which are able to anticipate the permanent increase in commodity prices.

Under this analysis, an increase in iron ore export prices leads directly to higher export prices and a higher terms of trade. However, this is moderated somewhat by an appreciation in the exchange rate, which partially offsets the increase in export prices. The appreciation also reduces import prices across all industries which flows through to lower consumer price inflation. Output, investment and export volumes in the mining sector increase in response to higher iron ore prices, although this is limited over the short term due to adjustment costs in increasing the capital stock.

A US\$10 per tonne increase in the assumed price for iron ore exports is expected to result in an increase in tax receipts of around \$0.2 billion in 2022-23 and \$0.6 billion in 2023-24. An increase in iron ore export prices increases mining company profits and, as a result, increases company tax receipts. Lower domestic prices result in lower individuals and other withholding taxes and indirect tax receipts, partially offsetting the increase in company tax. The impact on tax receipts is larger in 2023-24, largely owing to lags in tax collections.

Table 7.1: Sensitivity analysis of a US\$10 per tonne movement in iron ore prices

	US\$10/tonne FOB ^(a) fall		US\$10/tonne FOB increase	
	2022-23	2023-24	2022-23	2023-24
Nominal GDP (\$billion)	-4.4	-2.3	4.4	2.3
Tax receipts (\$billion)	-0.2	-0.6	0.2	0.6

(a) Prices are presented in free-on-board (FOB) terms which exclude the cost of freight.

Source: Treasury.

Alternative pathways for yields

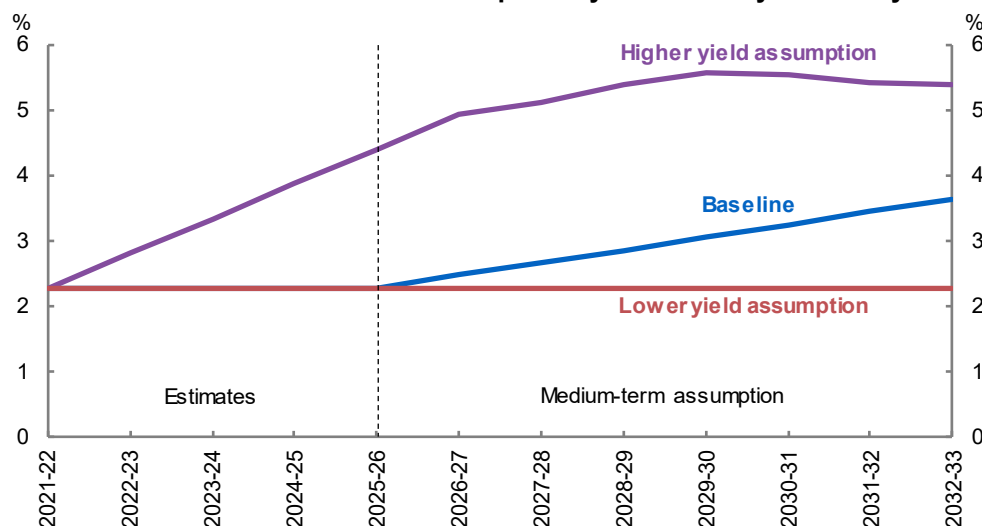
Yields on Australian Government bonds reflect the cost of government borrowing. Despite the recent increase, Australia continues to experience low yields on government debt. The following analysis illustrates sensitivity of the underlying cash balance and gross debt over the next 10 years using different assumptions surrounding yields.

This analysis illustrates the impact of changes in the yield assumption in isolation. Other economic projections, including nominal GDP, are the same as those used in the baseline projections. While it is likely that yields would not move in isolation, isolating the yield effect shows how changes in yields may impact fiscal aggregates, above and beyond other changes. From a fiscal sustainability perspective, it is the difference between nominal yields and nominal economic growth that matters. If higher yields are accompanied by an economy growing at a faster rate than the rate on government borrowing, this may be sufficient to improve debt as a share of the economy over time, all else being equal.

There are a multitude of factors, often impacting in opposite directions, that could affect current and future yields. Given this uncertainty, a technical assumption for baseline yields is employed. Nominal yields are assumed to remain fixed over the budget year and the following 3 years at the levels observed immediately prior to the Budget update. The 10-year bond yield then converges to a long-run yield of around 5 per cent, consistent with long-run nominal GDP growth. The timeframe for this transition is 15 years (Chart 7.10). This section examines the consequences of different yield assumptions.

The lower yield assumption has the 10-year bond yield remaining at current levels over the next 10 years rather than beginning to rise after 4 years, as is assumed in the baseline assumption. Notwithstanding the recent increase in yields, a lower yield assumption is supported by the observation that yields on Australian Government debt have generally been trending downwards for several decades. The higher yield assumption has yields converging immediately from current levels over 5 years to the long-run yield of around 5 per cent. While the medium and long-term effects on yields of the pandemic are unclear, a further increase in inflation expectations, among other factors, could drive yields to increase more quickly than assumed under the baseline assumption.

Chart 7.10: Baseline and alternative pathways for the 10-year bond yield



Source: Treasury.

Yields affect both government receipts and payments. Yields affect the amount of public debt interest that the Government has to pay on its borrowings, but also have an impact on the receipts that the Government earns on its investments.

Compared with the baseline Budget projections, the lower yield assumption results in a slight improvement to the underlying cash balance over the medium term. Cumulative improvements to the underlying cash balance are projected to reduce gross debt by 1.3 percentage points of GDP at 30 June 2033 (Chart 7.11).

Conversely, the higher yield assumption results in a deterioration in the underlying cash balance of around 0.6 percentage points of GDP by 2032-33. This has flow on effects for debt with gross debt projected to be 5.2 percentage points of GDP higher compared to the Budget baseline at 30 June 2033.

Even under the higher yield assumption, gross debt as a share of GDP declines towards the end of the medium term and remains lower than the baseline projections in the 2021-22 MYEFO (Chart 7.11). Projected Commonwealth gross debt as a share of GDP under the higher yield assumption is almost a third of the average general government gross debt as a share of GDP in G7 economies today.

Chart 7.11: Gross debt, impact of alternative yield assumptions

