

### FORECAST UNCERTAINTIES, SENSITIVITIES AND SCENARIOS

#### Overview

The macroeconomic and fiscal forecasts presented in the 2017-18 MYEFO incorporate assumptions and judgments based on information available at the time of preparation.

Macroeconomic and fiscal forecasts are important for Government policy and decision making. The budget estimates provide a fiscal baseline against which policy decisions are taken by the Government. Better forecasting and a better understanding of the uncertainties around the forecasts contribute to better policy and decision making.

This Attachment presents an assessment of the historical performance of Budget forecasts and estimates of uncertainty around these forecasts. This assessment is consistent with the practice of many other international fiscal agencies to improve forecasting performance and, more importantly, to raise awareness of the uncertainties inherent in forecasting.

This Attachment also presents an analysis of the sensitivity of 2017-18 MYEFO estimates to changes in key assumptions as required under the *Charter of Budget Honesty Act 1998*. An analysis of how alternative assumptions over the medium term can affect the fiscal projections is also included.

### CONFIDENCE INTERVALS AROUND ECONOMIC AND FISCAL FORECASTS

#### Measures of uncertainty around economic forecasts

The Government's macroeconomic forecasts are prepared using a range of modelling techniques including macro-econometric models, spreadsheet analysis and accounting frameworks. These are supplemented by survey data, business liaison, professional opinion and judgment.

Forecasts are subject to inherent uncertainties. Generally, these uncertainties tend to increase as the forecast horizon lengthens. Forecast errors (the differences between forecasts and outcomes) can arise for a range of reasons — for example, differences between the assumed path of key variables and outcomes as well as changes in the relationships between different parts of the economy.

Confidence intervals seek to illustrate that there is a range of plausible outcomes around any forecast. Confidence intervals are based on observed historical patterns of forecast errors. They are a guide to the degree of uncertainty around a forecast and can span a wide range of outcomes.

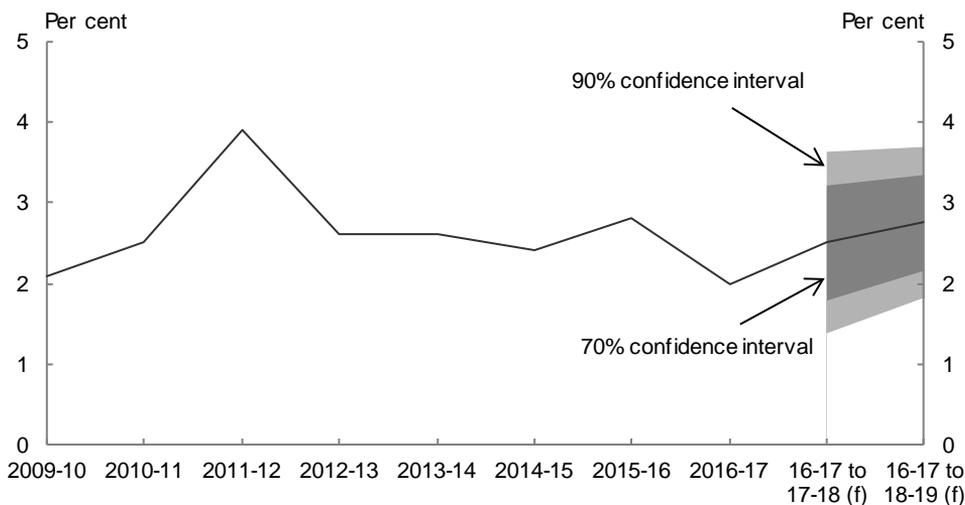
### Real GDP forecasts

Real GDP forecasts in the MYEFO are based on a number of key assumptions including exchange rates, interest rates and commodity prices. The forecasts also incorporate judgments about how developments in one part of the Australian economy affect other parts and how the domestic economy is affected by events in the international economy.

The accuracy of the forecasts depends on the extent to which the assumptions and judgments underpinning them prove to be correct – and also the reliability of the economic relationships embodied in the macroeconomic models used to produce them. Forecast errors for real GDP can also be caused by unexpected shifts in the pace and nature of economic activity during the forecast period.

Chart 3.6 shows that the average annualised growth rate in real GDP in the two years to 2018-19 is expected to be around 2¾ per cent, with the 70 per cent confidence interval ranging from 2¼ to 3¼ per cent. In other words, if forecast errors are similar to those made over recent years, there is a 70 per cent probability that the growth rate will lie in this range.

**Chart 3.6: Confidence intervals around real GDP growth rate forecasts**



Note: The central line shows the outcomes and the 2017-18 MYEFO forecasts. Annual growth rates are reported for the outcomes. Average annualised growth rates from 2016-17 are reported for 2017-18 onwards. (f) are forecasts. Confidence intervals are based on the root mean squared errors (RMSEs) of MYEFO forecasts from 1998-99 onwards, with outcomes based on September quarter 2017 National Accounts data.

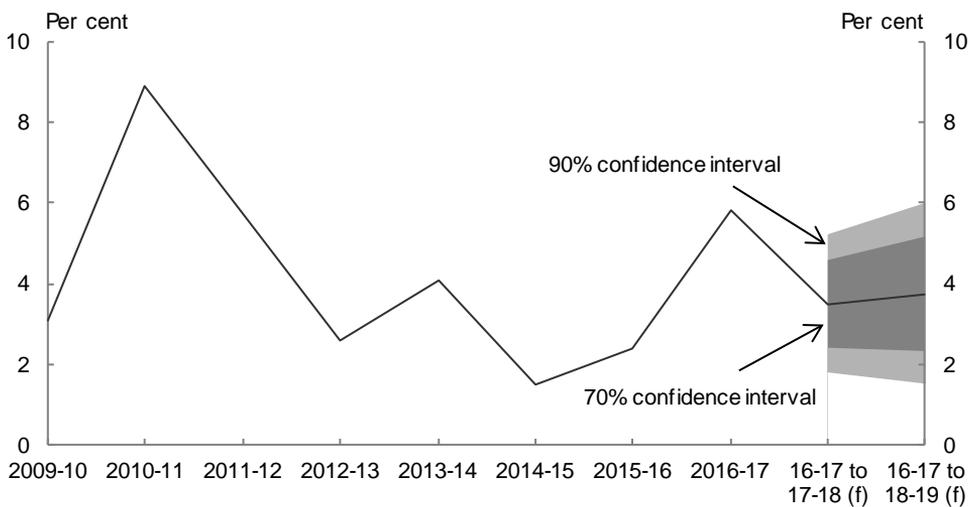
Source: ABS cat. no. 5206.0, Budget papers and Treasury.

## Nominal GDP forecasts

Compared with real GDP forecasts, nominal GDP forecasts are subject to additional sources of uncertainty from the evolution of domestic prices and wages, and world prices for commodities. Difficulty in predicting their movements, particularly global commodity prices, has been the primary driver of nominal GDP forecast errors over the past decade. This additional uncertainty is reflected in the wider confidence intervals around nominal GDP forecasts.

Chart 3.7 shows average annualised growth in nominal GDP in the two years to 2018-19 is expected to be around  $3\frac{3}{4}$  per cent, with the 70 per cent confidence interval ranging from  $2\frac{1}{4}$  to  $5\frac{1}{4}$  per cent.

**Chart 3.7: Confidence intervals around nominal GDP growth rate forecasts**



Note: See note to Chart 3.6.

Source: ABS cat. no. 5206.0, Budget papers and Treasury.

## Measures of uncertainty around fiscal forecasts

The fiscal estimates contained in the 2017-18 MYEFO are based on economic and demographic forecasts and projections as well as estimates of the impact of Government spending and revenue measures. Changes to the economic or demographic forecasts and projections underlying the estimates will affect forecasts for receipts and payments. As such, this will have a direct impact on the profile of the underlying cash balance and government debt. Even small movements in these economic forecasts and projections can result in large changes to the budget estimates.

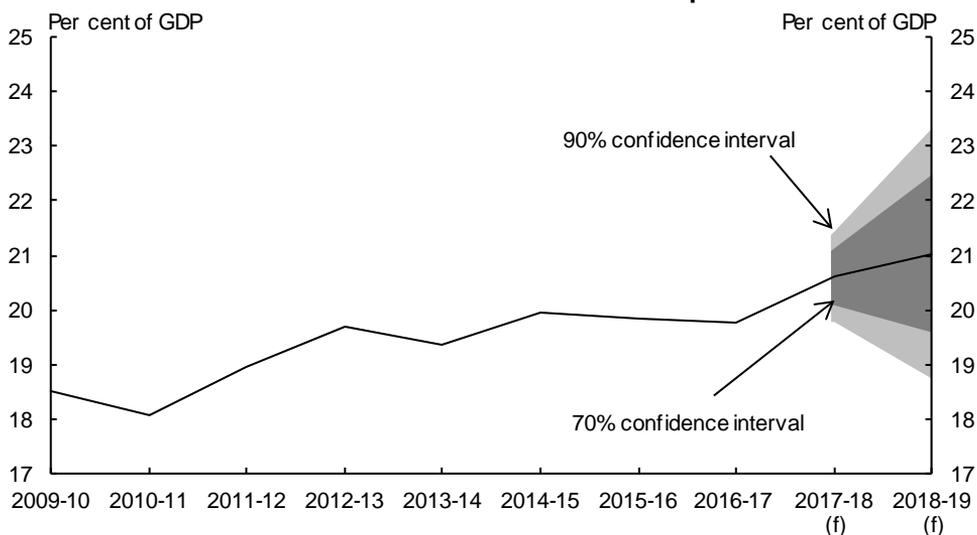
## Receipts

The Government’s tax receipts estimates are generally prepared using a ‘base plus growth’ methodology. The last known outcome (2016-17 for the 2017-18 MYEFO) is used as the base to which estimated growth rates are applied, resulting in tax receipts estimates for the current and future years. Estimates for the current year also incorporate recent trends in tax collections.

Chart 3.8 shows confidence intervals around the forecasts for receipts (excluding GST<sup>1</sup> and including Future Fund earnings). Confidence intervals constructed around the receipts forecasts exclude historical variations caused by subsequent policy decisions. These intervals take into account errors caused by parameter and other variations in isolation.

The chart shows that there is always considerable uncertainty around receipts forecasts and that this uncertainty increases as the forecast horizon lengthens. It suggests that in 2017-18, the width of the 70 per cent confidence interval for the 2017-18 MYEFO receipts forecast is approximately 1.0 per cent of GDP (\$20 billion) and the 90 per cent confidence interval is approximately 1.6 per cent of GDP (\$30 billion).

**Chart 3.8: Confidence intervals around receipts forecasts**



Note: The central line shows the outcomes and the 2017-18 MYEFO point estimate forecasts. Confidence intervals use RMSEs for MYEFO forecasts from the 1998-99 MYEFO onwards. (f) are forecasts.

Source: Treasury.

1 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.

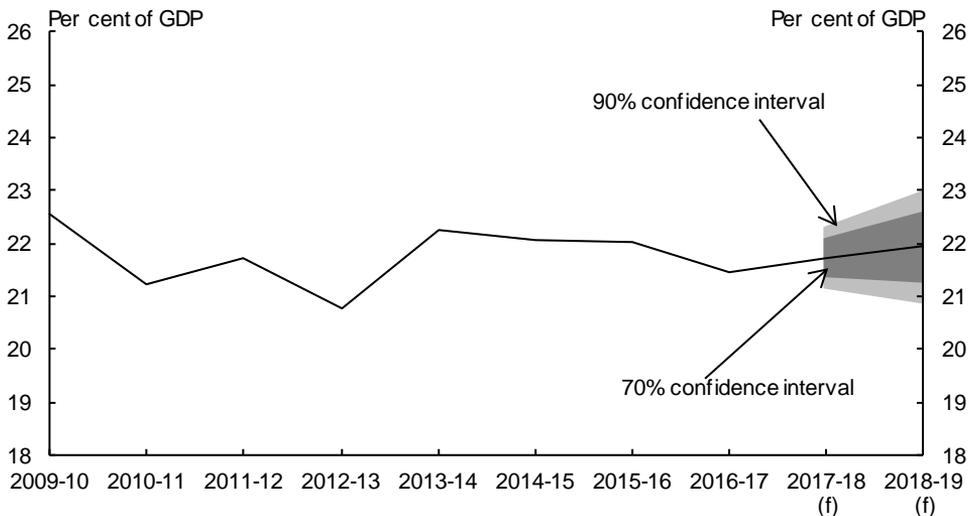
## Payments

Payments outcomes can differ from forecasts for a number of reasons. Demand-driven programs, such as payments to individuals and some social services, form the bulk of Government expenditure. Forecasts of payments associated with many of these government programs depend on forecasts of economic conditions. For example, higher than forecast unemployment levels will mean that expenditure on related services, including allowances, will be higher than forecast.

Chart 3.9 shows confidence intervals around payments forecasts (excluding GST). As with receipts estimates, historical policy decisions are excluded<sup>2</sup>, and future policy decisions are out of scope. Payments estimates include the public debt interest impact of policy decisions.<sup>3</sup>

The chart shows that there is moderate uncertainty around payments forecasts. In 2017-18, the width of the 70 per cent confidence interval for the 2017-18 MYEFO payments forecast is approximately 0.8 per cent of GDP (\$15 billion) and the 90 per cent confidence interval is approximately 1.2 per cent of GDP (\$20 billion).

**Chart 3.9: Confidence intervals around payments forecasts**



Note: See note to Chart 3.8.

Source: Treasury.

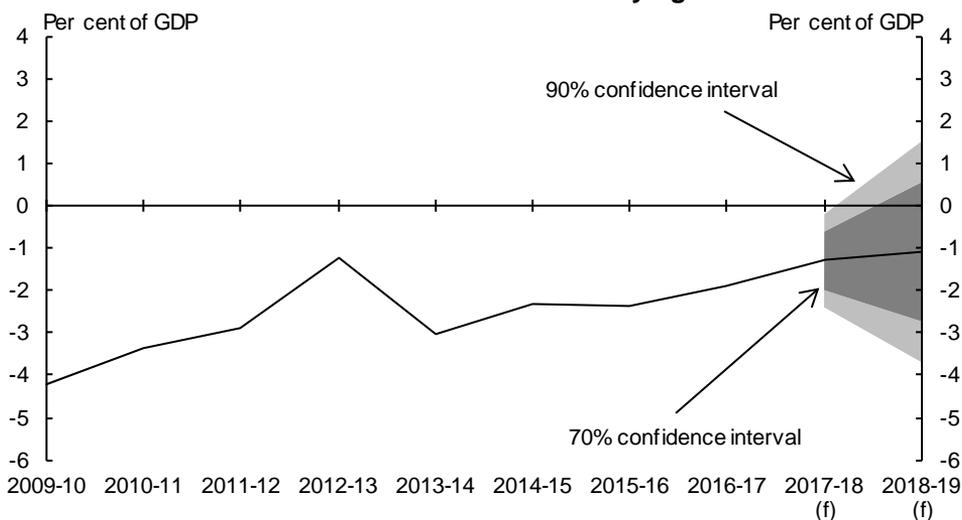
- 2 The allowance for historical policy includes only new policy decisions made at each update. No allowance is made for other decisions, such as assistance for the impact of natural disasters or changes to the timing of projects announced in previous updates. These decisions will contribute to historical forecast errors and therefore increase the size of the confidence intervals around payments.
- 3 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 analysis.

## Underlying cash balance

The underlying cash balance estimates are sensitive to the same forecast errors that affect estimates of receipts and payments. Confidence interval analysis shows that there is considerable uncertainty around the underlying cash balance forecasts (Chart 3.10).

In 2017-18, the width of the 70 per cent confidence interval for the 2017-18 MYEFO underlying cash balance forecast is approximately 1.4 per cent of GDP (\$25 billion) and the 90 per cent confidence interval is approximately 2.2 per cent of GDP (\$40 billion). In line with receipts forecasts, uncertainty increases over the estimates period.

**Chart 3.10: Confidence intervals around the underlying cash balance forecasts**



Note: See note to Chart 3.8.

Source: Treasury.

## SENSITIVITY AND SCENARIO ANALYSIS

Chart 3.10 demonstrates that fiscal estimates reflect assumptions and judgments made about the economy as much as they do Government policy. Small changes in the economic forecasts and projections – or to the assumptions and judgments that underpin them – can have a significant impact on fiscal estimates.

This is also the case for the medium-term fiscal projections, which partially reflect the projected path of the economy (particularly nominal GDP and prices growth) over the seven years following the forward estimates period. The medium-term fiscal projections also reflect a number of additional technical assumptions. Examples of technical assumptions implemented in the medium-term fiscal projections include the assumption that tax receipts will not increase beyond 23.9 per cent of GDP and the assumption that yields will rise over the medium term.

As the assumptions and judgments that underpin fiscal forecasts and projections are subject to considerable uncertainty, it is important to understand how changes to these can affect these estimates and projections. Consideration of alternative scenarios and sensitivity analysis demonstrates the potential impact of these changes and highlights the uncertainties that governments face should risks eventuate — for example, in meeting budget forecasts or fiscal targets.

The analysis presented in the 2017-18 MYEFO considers the impact of changes to the economic outlook over both the forecast years. The analysis also considers the impact of changes to technical assumptions on the medium-term fiscal projections.

Scenarios 1 and 2 explore the sensitivity of fiscal aggregates to an alternative path for the terms of trade and a delayed recovery in non-mining business investment. These risks are outlined in Part 2.

Scenario 3 illustrates the sensitivity of the medium-term fiscal projections to changes in assumed long-run yields on Government debt.

### **Sensitivity analysis over the forecast period**

The following scenario provides an indication of the sensitivity of receipts, payments and the underlying cash balance to changes in the terms of trade over the forecast period, which is 2017-18 and 2018-19.

#### **Scenario 1: Alternative path for the terms of trade**

This scenario considers the consequences of a permanent 10 per cent movement in world prices of non-rural commodity exports through 2017-18 relative to 2017-18 MYEFO forecast levels. Such a price rise (fall) is consistent with a rise (fall) in the terms of trade of  $4\frac{3}{4}$  per cent and an increase (decrease) in nominal GDP of 1 per cent by 2018-19. The sensitivity analysis shows the flow-on effects to GDP, the labour market and prices. The impacts in Table 3.19 are stylised and refer to percentage deviations from the MYEFO forecast levels due to a permanent rise in non-rural commodity prices.

**Table 3.19: Illustrative impact of a permanent 10 per cent rise in non-rural commodity prices (per cent deviation from the MYEFO level)<sup>4</sup>**

	Impact after 1 year (2017-18) per cent	Impact after 2 years (2018-19) per cent
Real GDP	0	1/4
GDP deflator	1/2	3/4
Nominal GDP	1/2	1
Employment	0	1/4
Wages	1/4	1/2
CPI	0	1/4
Company profits	1 3/4	3 1/4
Nominal household consumption	0	1/2

Source: Treasury.

Assuming no change in exchange rates or interest rates, the increase in export prices leads directly to higher overall output prices (as measured by the GDP deflator) and higher domestic incomes compared with MYEFO levels. Higher domestic incomes cause both consumption and investment to rise, resulting in higher real GDP and employment and an increase in wages. The rise in aggregate demand puts upward pressure on domestic prices.

On the receipts side, an increase in nominal GDP increases tax collections. The largest impact is on company tax receipts as the increase in export income increases company profits. The impact on company tax is larger in 2018-19, partly owing to lags in tax collections and a larger impact on company profits in the second year of the scenario period. Higher company profits are assumed to flow through to higher Australian equity prices, therefore increasing capital gains tax from individuals, companies and superannuation funds.

On the payments side, a significant proportion of government expenditure is partially indexed to movements in costs (as reflected in various price and wage indicators). Some forms of expenditure, in particular income support payments, are also driven by the number of beneficiaries.

The overall estimated expenditure on income support payments (including pensions, unemployment benefits and other allowances) decreases in both years, reflecting a lower number of unemployment benefit recipients. The fall in spending on unemployment benefits in 2018-19 is partially offset by increased expenditure on pensions and allowances reflecting stronger growth in benefit rates resulting from slightly higher inflation. At the same time other payments linked to inflation also rise in line with the stronger growth in prices.

<sup>4</sup> These results represent a partial economic analysis only and do not attempt to capture all the economic feedback and other policy responses related to changed economic conditions, and assume no change in the exchange rate, interest rates or policy over the forecast period.

Given these assumptions, the overall impact of the increase in the terms of trade is an improvement in the underlying cash balance of around \$1.8 billion in 2017-18 and around \$5.6 billion in 2018-19 (see Table 3.20). The opposite impacts would be broadly expected for a fall in the terms of trade of the same magnitude.

**Table 3.20: Illustrative sensitivity of the budget balance to a permanent 10 per cent rise in non-rural commodity prices**

	2017-18	2018-19
	\$b	\$b
<b>Receipts</b>		
Individuals and other withholding taxes	0.5	1.8
Superannuation fund taxes	0.1	0.2
Company tax	1.2	3.0
Goods and services tax	0.0	0.3
Excise and customs duty	0.0	0.2
Other taxes	0.1	0.2
<b>Total receipts</b>	<b>1.8</b>	<b>5.6</b>
<b>Payments</b>		
Income support	0.0	0.2
Other payments	0.0	0.0
Goods and services tax	0.0	-0.3
<b>Total payments</b>	<b>0.0</b>	<b>-0.1</b>
Public debt interest	0.0	0.1
<b>Underlying cash balance impact(a)</b>	<b>1.8</b>	<b>5.6</b>

(a) Estimated impacts fall within the 70 per cent confidence intervals for years 2017-18 and 2018-19, as shown in Charts 3.8 to 3.10.

Note: Data may not sum due to rounding.

The impacts of a US\$10 per tonne free-on-board (FOB) movement in iron ore prices alone are contained in Box B.

**Box B: Sensitivity analysis of iron ore price movements**

The impacts of a **US\$10 per tonne FOB movement in iron ore prices** over the course of a year, based on the sensitivity analysis presented in Scenario 1, is set out in Table B. A US\$10 per tonne FOB movement in the iron ore price results in a movement in nominal GDP of around \$6.5 billion in 2017-18 and just over \$14 billion in 2018-19.

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

	US\$10/tonne FOB <sup>(a)</sup> fall		US\$10/tonne FOB increase	
	2017-18	2018-19	2017-18	2018-19
Nominal GDP (\$billion)	-6.5	-14.1	6.5	14.1
Tax receipts (\$billion)	-1.3	-4.2	1.3	4.2

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

Source: Treasury.

**Scenario 2: Delayed recovery in non-mining business investment**

This scenario considers the consequences of a weaker outlook for business investment than forecast in the 2017-18 MYEFO. The scenario involves a 3 and 6 per cent reduction in new business investment in 2017-18 and 2018-19 respectively, compared with MYEFO levels, as a result of a delayed recovery in non-mining business investment. Under this scenario, the level of non-mining business investment would be broadly flat over this two-year period.

Once again, the sensitivity analysis evaluates the flow-on effects to GDP, the labour market and prices. The impacts in Table 3.21 are stylised and refer to percentage deviations from the MYEFO forecast levels.

**Table 3.21: Illustrative impact of a delayed recovery in non-mining business investment (per cent deviation from the 2017-18 MYEFO level)<sup>5</sup>**

	Impact after 1 year (2017-18)	Impact after 2 years (2018-19)
	per cent	per cent
Real GDP	- 1/4	- 1/2
GDP deflator	0	- 1/4
Nominal GDP	- 1/4	- 3/4
Employment	- 1/4	- 1/2
Wages	0	- 1/4
CPI	0	- 1/4
Company profits	-1	-1 3/4
Nominal household consumption	0	- 1/2

Source: Treasury.

<sup>5</sup> These results represent a partial economic analysis only and do not attempt to capture all the economic feedback and other policy responses related to changed economic conditions, and assume no change in the exchange rate, interest rates or policy over the forecast period.

Assuming no change in exchange rates or interest rates, the delayed recovery in non-mining business investment leads directly to lower real GDP compared with MYEFO levels and also lower imports. This fall in output depresses employment and, in turn, wages. This results in lower levels of consumption. The fall in aggregate demand puts downward pressure on domestic prices.

On the receipts side, lower nominal GDP results in lower tax collections. The initial impact is largest on corporate profits and company tax. In the second year, the larger impact on wages and consumption is expected to result in a larger reduction to tax receipts from individuals and the goods and services tax.

On the payments side, overall estimated expenditure on income support payments increases in both years due to a higher number of unemployment benefit recipients. The increase in spending on unemployment benefits in 2018-19 is partially offset by reduced expenditure on pensions and allowances reflecting slightly lower inflation. In addition, other payments linked to inflation fall in line with the reduced growth in prices.

The overall impact of the delayed recovery in non-mining business investment is a decrease in the underlying cash balance of around \$1.6 billion in 2017-18 and around \$4.4 billion in 2018-19 (see Table 3.22).

**Table 3.22: Illustrative sensitivity of the budget balance to a delayed recovery in non-mining business investment**

	2017-18	2018-19
	\$b	\$b
<b>Receipts</b>		
Individuals and other withholding taxes	-0.5	-1.9
Superannuation fund taxes	-0.1	-0.1
Company tax	-0.8	-1.7
Goods and services tax	-0.1	-0.3
Excise and customs duty	-0.1	-0.2
Other taxes	0.0	0.0
<b>Total receipts</b>	<b>-1.5</b>	<b>-4.2</b>
<b>Payments</b>		
Income support	-0.1	-0.4
Other payments	0.0	0.0
Goods and services tax	0.1	0.3
<b>Total payments</b>	<b>-0.1</b>	<b>-0.1</b>
<b>Underlying cash balance impact(a)</b>	<b>-1.6</b>	<b>-4.4</b>

(a) Estimated impacts fall within the 70 per cent confidence intervals for years 2017-18 and 2018-19, as shown in Charts 3.8 to 3.10.

Note: Data may not sum due to rounding.

## **Sensitivity analysis over the medium term**

Over the budget's forward years, economic and fiscal forecasts are extended by economic and fiscal projections. The economic forecasts span two financial years, while the economic projections cover the last two financial years. The economic and fiscal projections also span seven additional years after the budget's forward years. The projections are prepared using a medium-term projection methodology, which means that they are sensitive to the underlying assumptions. For example, an important assumption is that Government policy does not change over the projection period.

For further information on the economic and fiscal projection frameworks, please refer to *Budget Paper 1, Statement 8: Forecasting Performance and Scenario Analysis* in the 2017-18 Budget.

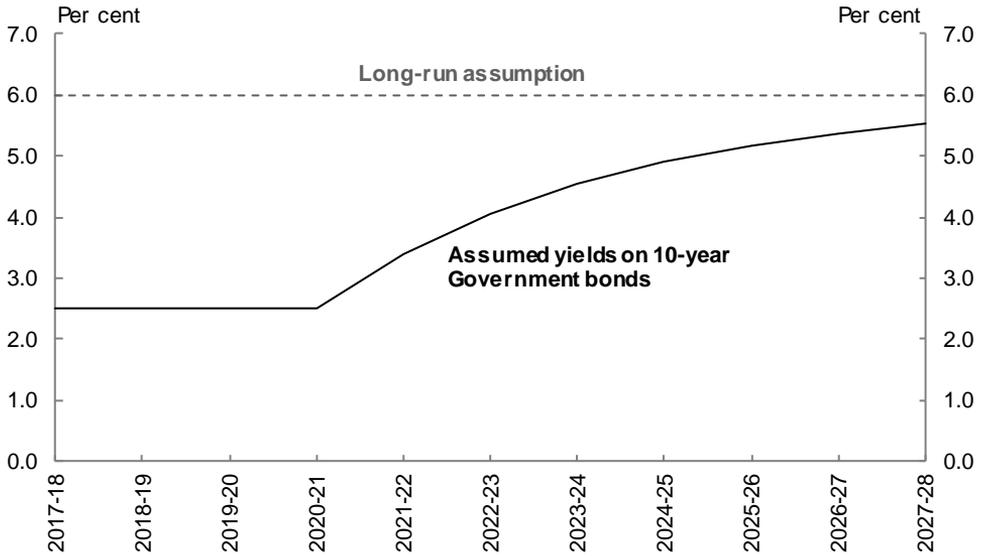
### **Scenario 3: Alternative long-term yield assumptions**

The following scenario demonstrates the sensitivity of the medium-term fiscal projections to changes in technical modelling assumptions about yields on Government debt.

Technical assumptions are generally used where explicit policy guidance is not available or where replicating recent outcomes produces misleading results or results that are out of line with historical experience. Technical assumptions can affect the level of payments and receipts projections over the medium term and therefore projections of fiscal aggregates such as the underlying cash balance or gross debt. *Chart 3.1: Underlying cash balance projected to 2027-28* shows the sensitivity of the medium-term underlying cash balance to changes in the technical assumption relating to the level of tax receipts.

The medium-term fiscal projections assume yields on Government debt converge to a fixed long-term yield curve. The long-term yield curve is based on an assumption that the long-term yield on 10-year Government bonds is 6 per cent. This is consistent with the Long-Term Cost Reports prepared by the Australian Government Actuary. The gap between the current yield curve and the long-term yield curve is closed by a quarter in each year over the medium term (Chart 3.11). This technical assumption is intended for preparing medium-term fiscal projections only, and is not equivalent to a forecast. For further information on the long-term yield assumption refer to *Appendix C: Methodology* of the 2015 Intergenerational Report.

**Chart 3.11: Assumed yields over the medium term**



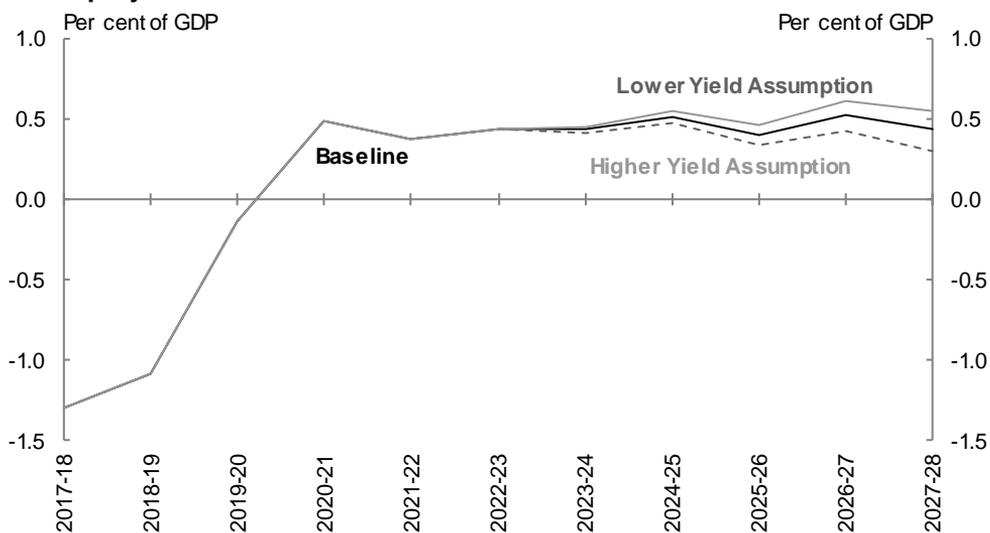
Note: The chart shows the assumed yield on 10-year Government bonds in each year through the forward estimates to the end of the medium term. These are technical assumptions intended for modelling purposes only. They are not forecasts of yields.

Source: Treasury

Yields affect the amount of public debt interest (PDI) the Government has to pay on its borrowings. They can also have an impact on projections of the non-tax receipts the Government earns on its investments, as some government investment funds hold financial assets whose returns can be benchmarked against the yield curve for Government bonds.

Chart 3.12 outlines the impact on the fiscal projections of an assumed long-term yield curve 100 basis points lower and 100 basis points higher than the current assumed long-term yield curve.

**Chart 3.12: Impact of alternative long-run yield assumptions on underlying cash balance projections**



Source: Treasury projections.

A lower assumed long-term yield curve would result in lower PDI expense projections, partially offset by lower non-tax receipts projections. Compared to the baseline, this would lead to a net improvement in the projected underlying cash balance of around 0.1 per cent of GDP by 2027-28.

Conversely, a higher assumed long-term yield curve would result in higher PDI expense projections, partially offset by higher non-tax receipts projections. Compared to the baseline, this would lead to a net deterioration in the projected underlying cash balance of around 0.1 per cent of GDP by 2027-28.