INTERNATIONAL MONETARY FUND

IMF Country Report No. 17/43

AUSTRALIA

SELECTED ISSUES

February 2017

This Selected Issues paper on Australia was prepared by a staff team of the International Monetary Fund as background documentation for the periodic consultation with the member country. It is based on the information available at the time it was completed on January 23, 2017.

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International Monetary Fund
Washington, D.C.

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January 23, 2017

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Asia and Pacific Department

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BOXES

FIGURES

TABLES

APPENDIX

LABOR MARKET ADJUSTMENT TO SHOCKS IN AUSTRALIA[1]

Australia's labor markets were not severely impacted by the global financial crisis, and are adjusting smoothly to the sizeable commodity prices bust and mining investment downturn. However, some labor market indicators suggest persistent weaknesses.

- For instance, long-term unemployment rates have risen, and prevail above long-term averages. Underemployment rates are also elevated. Much of the employment growth since the end of the mining investment boom has been driven by part-time employment, and wage growth remains weak.

In this context, we examine in detail the adjustment of Australian labor markets to the recent adverse shocks, and address, in particular, the following questions:

- Has the mining investment downturn led to an increase in structural unemployment?
- How have cyclical labor market adjustment dynamics changed, and what are the implications for labor market slack and wage growth?
- What do recent changes in sectoral allocation of labor imply for aggregate labor productivity growth?
- How did States' labor markets adjust to the commodity boom-bust cycle?

The main findings are:

- There does not appear to be a significant increase in structural employment in the wake of the commodity prices bust and mining investment decline.
- Increased flexibility in average hours per worker has likely moderated employment reduction in downturns and prevented a larger increase in unemployment in the wake of the mining investment downturn. At the same time, elevated underemployment signals additional slack, and is likely weighing down wage growth.
- Reallocation of labor to expanding sectors has proceeded smoothly. Labor productivity growth has slowed, partly as a result of the expansion of services.
- States' labor markets have transitioned smoothly, aided in particular by the response of migration to the commodity boom-bust cycle.

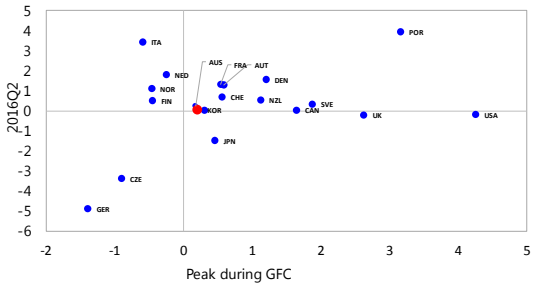
[1] Prepared by Adil Mohommad (APD).

A. Introduction

1. The Australian economy has faced two major shocks in recent years, namely the global financial crisis, followed by the shock to commodity prices. On the latter, commodity prices doubled between 2005Q1 and 2011Q3 driving the terms of trade to an all-time high. With the rapid rise in commodity prices, mining investment rose from an average of around 2 percent of GDP before 2005 to a peak exceeding 7 percent of GDP in 2013. Since 2011Q3, a 40 percent decline in commodity prices has led to an equivalent decline in the terms of trade by 36 percent from the 2011Q3 peak. Mining investment has fallen dramatically as major construction projects have come to an end, falling to 5½ percent of GDP by end-2015, and declining further since.

2. Such large external shocks have often been considered to be catalysts for major displacement in labor markets. Indeed, labor markets in some advanced economies were badly impacted by the global financial crisis, and in some cases the damage has yet to be reversed. Measured against unemployment performance, Australian labor market appears to have avoided major dislocation.

Selected OECD: Deviation of Unemployment Rate in 2016Q2 from 2000-07 average
(Percent)



Sources: OECD harmonized unemployment series and IMF staff calculations.

3. In Australia, the deterioration in labor market outcomes has been moderate. Figure 1 summarizes key real sector and labor market developments at the aggregate level. Following the global financial crisis, collapse in the terms of trade and the decline in mining investment, real GDP growth has fallen from average rates of around 3¼ percent pre-GFC to around 2½ percent post-GFC. Driven by slower growth, unemployment has risen, reversing the steady decline that started in the early 1990s. Having reached a trough of 4 percent prior to the global financial crisis, unemployment rose to an average of 5½ percent between 2009Q1 and 2016Q2, and peaked at around 6¼ percent in mid-2015 in the wake of the severe terms-of-trade bust and mining investment decline. Since then, unemployment has declined to below 5¾ percent as of August 2016. The relatively mild unemployment fluctuations – within ¾ of percent of the 2000-16 average of 5½ percent – are attributed to the flexible labor market, which has helped with the ongoing successful rebalancing of the economy.

4. The unemployment gap appears to be consistent with the size of the output gap. As a benchmark for assessing the extent to which current labor markets exhibit slackness or tightness, we have estimated an equilibrium long-term value of unemployment (known as the NAIRU: Non-Accelerating Inflation Rate of Unemployment). Based on a multivariate-filtering approach, estimates of the NAIRU point to an unemployment gap of around 0.6 percent.[2] Estimates of potential output indicate a negative output gap (excess capacity) in the range of 1.25 to 1.75 percent of potential GDP. The unemployment rate varies relative to the NAIRU in the short term according to an Okun's

[2] The unemployment gap is jointly estimated with the output gap using a small Bayesian-estimated model in tandem with a Kalman filter. See Blagrave and others (2015) for detail regarding the methodology used.

law relationship based on the output gap. Given the output and labor market gaps estimated for Australia, we deduce that the unemployment gap is in line with what would have been suggested by estimates of the Okun coefficients for Australia (see Ball and others (2013) who estimate the coefficient at -0.4 in a post-1995 sample, and Tulip and Lancaster (2015) who estimate the coefficient between -0.27 and -0.35).

5. Despite the benign cyclical labor market fluctuations, some labor market indicators seem to suggest persistent weaknesses. For instance, Figure 1 shows that both long-term unemployment and underemployment have been elevated since the global financial crisis, prevailing above their long-term (2000-16) averages since end 2012-early 2013. Elevated long term unemployment may indicate a worsening in labor market efficiency and a skills mismatch since the terms-of-trade bust and mining investment decline. Elevated underemployment suggests there is more slack than indicated by the unemployment gap alone, and may have implications for wage growth. In this context, we conduct a detailed assessment of the labor market impact of and adjustment to the adverse shocks, focusing on the following key questions:

- Has the commodity price and mining investment decline led to a worsening in skills mismatch and other frictions, such as those related to location?
- Have cyclical labor market adjustment dynamics changed over time? And what are the implications for assessment of labor market slack, and relatedly for wage growth?
- Has sectoral composition of labor changed much since the end of the mining boom, and what impact has this had on labor productivity?
- How have labor markets at the state level adjusted to the commodity boom-bust cycle, and how important a role has migration played in this adjustment?

6. The main findings of the paper are as follows. While labor markets have adjusted smoothly overall, structural unemployment appears to have increased slightly following the commodity price shock; flexible labor markets have moderated reductions in employment in the 2000s relative to previous downturns, likely due in part to labor market reforms in the early 1990s; but falling average hours per worker and rising part-time employment may have led to elevated underemployment, seen as a contributing factor to weaker wage growth. At the state level, we find that migration has played a key role in labor market adjustment to demand shocks, likely an important contributing factor to the relatively smooth adjustment both during the boom and after. Finally, we find that reallocation of labor to expanding sectors has proceeded smoothly, although aggregate labor productivity growth has slowed partly as a result of expansion in services.

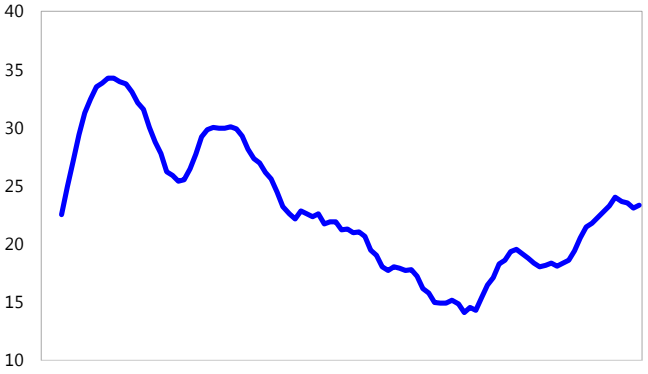
7. The paper is structured as follows. Section B examines the impact of the global financial crisis and the terms-of-trade bust and mining investment decline on structural unemployment. Section C discusses changes in cyclical labor market adjustment dynamics over time, and the implications for assessing labor market slack and relatedly for wage growth. Section D assesses the impact of the reallocation of labor following the mining investment decline on labor productivity.

Section E focuses on labor market adjustment at the state level and the role of migration and Section F provides some final conclusions. Detailed descriptions of the methodology and data are provided in Appendices I to III.

B. Has Structural Unemployment Increased?

8. Long-term unemployment has risen since the global financial crisis and again following the mining investment decline. Following the crisis, the share of long-term unemployed in total unemployed persons rose from a trough of around 15 percent in mid-2009 to around 20 percent by 2011, and then to around 25 percent since the mining investment decline. Duration of unemployment on average has increased from the pre-GFC trough of 27 weeks to nearly 46 weeks in mid-2016. The long-term unemployment rate has risen to levels seen in the early 2000s preceding the mining boom, though well below the much higher rates observed in the 1990s (Figure 1-panel 4).

Long-term Unemployment Ratio
(Unemployed in excess of 1 year as share of total unemployed, 4QMA)

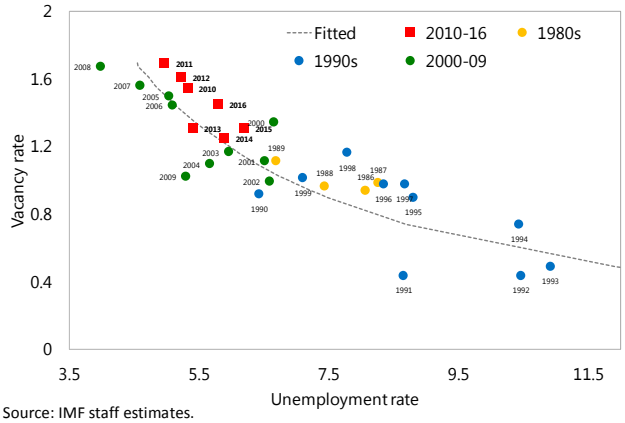


Sources: Haver Analytics database and IMF staff calculations.

- To the extent that long-term unemployment reflects skill mismatches, it provides evidence of increased structural unemployment.
- Consistent with rising structural unemployment, a multivariate filter estimate of the NAIRU in Australia indicates an increase, albeit small, beginning in 2011 (Figure 2).
- Structural unemployment is often illustrated in terms of shifts in a Beveridge curve. For Australia, the Beveridge curve suggests outward shifts in the 1980s, and again in the mid-1990s. Since then, the curve appears fairly stable, despite what appears to be a small outward shift following the terms-of-trade bust and mining investment downturn, compared to the period over 2000s before the global financial crisis.

9. A fitted Beveridge Curve for Australia suggests unemployment is higher than consistent with labor market equilibrium. To examine whether the Beveridge curve has shifted, we construct a fitted Beveridge curve for Australia following Hobijn and Sahin (2012) (see Appendix I for details), which traces labor market equilibrium unemployment values. We note that observations following the terms-of-trade

Fitted Beveridge Curve



Source: IMF staff estimates.

bust and mining investment decline appear to the right of the curve. For instance, in 2016, unemployment was around ¾ of a percent higher than the rate consistent with the labor market (turnover) equilibrium implied by the fitted Beveridge curve.

10. However, this does not necessarily signal an increase in structural unemployment. While a moderate outward shift of the curve would be consistent with the observed increase in long-term unemployment following the recent shocks, the increase is much smaller than in previous downturns, and should recede as slack in the economy is eliminated. Moreover, the divergence of the latest unemployment-vacancy rate observations from the Beveridge curve are relatively small and in line with historical divergences. Compared with other countries, the divergence from the Beveridge curve in the post-GFC period is also much smaller. Indeed, the deviation of the observations after the terms-of-trade bust are within the range of deviations of the in-sample points. Other advanced economies such as Portugal, Spain, Sweden, U.K. and U.S. have experienced much larger outwards shifts of their Beveridge curves.

C. How Have Cyclical Adjustment Dynamics Changed? And What Are the Implications for Labor Market Slack and Wage Growth?

11. Average hours worked per worker have become more flexible and since the early 2000s seem to have contributed importantly to cyclical labor adjustment. A feature of cyclical labor input (total hours worked) adjustment in Australia since the late 1990s is the relatively greater share of adjustment borne by average hours worked per worker relative to total employment. Figure 3-Panel 1 shows peak-to-trough decline in quarterly detrended total hours worked decomposed into employment and average hours. In the early 1990s, most of the cyclical decline in total hours worked was through reductions in employment, whereas starting from the early 2000s (and through to the present) the adjustment during downturns has been almost equally attributed to reductions in average hours and in employment. It can also be seen that the amplitude of peak-to-trough declines in total hours worked has moderated.

12. The employment response to output shocks seems to have moderated. To illustrate the change in adjustment dynamics in response to aggregate output shocks over time, Figure 3-Panel 2 shows the impulse response functions (IRFs) from a VAR estimation in log detrended values of GDP, average hours, and employment using quarterly data run over two samples, 1984Q4–1997Q4, and 1998Q1–2016Q1. Following Bishop and Plumb (2016), the ordering of the VAR reflects the assumption that output responds only with a lag to labor input shocks, and the assumption about the relative speed of adjustment of the components of aggregate hours worked; i.e., firms would first adjust hours worked in response to these GDP shocks than to employment. The IRFs suggest that the response of employment to a 1 percent GDP shock has indeed moderated in the second sample period (see Appendix II for details).

13. In relation to labor market features, the following factors may also help explain the moderation in the employment response to output shocks. To begin with, Australia embarked on labor market reforms in the early 1990s that made it easier for firms to bargain directly with employees, which may have allowed greater scope for firms to adjust hours worked in response to

cyclical conditions.[3] Following that, and just before the global financial crisis, tight labor markets may have increased costs related to firms' decisions on hiring and firing. During the crisis, increased uncertainty among workers regarding employment prospects may have increased their willingness to accept lower hours of work in return for employment security (though there is also evidence that the crisis witnessed destruction of jobs with longer hours and their replacement with jobs with shorter hours rather than adjustment within existing jobs). Furthermore, rising skill requirements along with economic development are likely to have increased the cost of screening and training workers, rendering decisions related to hiring and firing costlier to make. One measure of the increase in skill requirements is the level of educational qualifications of the workforce – for instance, the share of workers in the workforce with educational qualifications up to a Bachelor degree or higher rose from 18 percent in 1993 to 26 percent in 2009 (ABS Survey of Education and Training data). Evidence also suggests that the largest increases in demand for labor have occurred in cognitive, non-routine tasks management and professional activities, and non-cognitive non-routine tasks of personal care, and the largest declines in non-cognitive routine tasks of machinery and plant operation, and cognitive routine tasks such as clerical and secretarial functions (Borland, 2011).

14. At the sectoral level, adjustments of employment to output shocks appear inversely related to education levels. To provide further evidence regarding the role of skills requirements in moderating the impact of cyclical output fluctuations on employment, for selected 2-digit sectors we estimate VARs similar to those implemented at the aggregate level (on log detrended sectoral gross value added, average hours, and employment at quarterly frequency, over a sample period from 1990Q1 to 2016Q1 (see Appendix II for details). We then compare the magnitude of the cumulative 8 quarter change in employment in response to a 1 percent gross value added shock in each sector, to the share of workers with educational qualifications at least up to a Bachelor degree (as measured in 2009) in the sector. We find that the size of employment adjustment in response to an output shock varies across sectors (Figure 4). For instance, in transportation and storage industries, and in miscellaneous services, the peak employment impact of a 1 percent shock to gross value added is larger and more sustained than a similar shock in manufacturing or in health services industries. Further, there appears to be a fairly strong negative relationship in the size of cumulative employment adjustment at eight quarters in a sector and the share of workers with educational attainments at least up to a Bachelor degree in that sector. We do not observe such an association between adjustment in average hours and education levels, however.

15. The level of unemployment alone may understate the extent of labor market slack if employed workers are working fewer hours than desired. Figure 5 shows that, while employment growth has strengthened since 2014, much of the growth pickup has been driven by part-time workers. Even as average hours worked appear to have recovered up to trend levels after the terms-of-trade bust, full time hours worked are on a steadily declining trend. Likely due to rising

[3] Australia transitioned from a system of centralized wage determination to individual and enterprise level wage-setting following the reforms in the mid-1990s. At present, 80 percent of employees are covered by individual contracts and enterprise agreements, while 20 percent are set by "awards" mainly determined by the Fair Work Commission – which also influence a significant proportion of employees covered by enterprise agreements and individual contracts by establishing minimum standards (RBA, 2016).

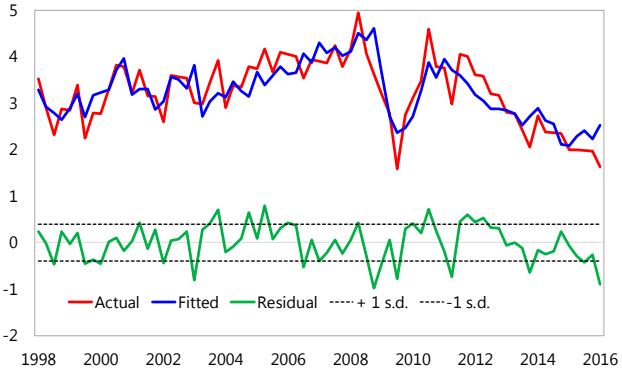
part-time work and declining full-time hours following the bust, the underemployment rate has risen to around 8¾ percent in 2016Q3, well above the historical average of around 7 percent, indicating there may be more slack in the economy than indicated by the unemployment rate alone.

16. Elevated underemployment has likely contributed to weaker wage growth since the terms-of-trade bust. Indeed, aggregate private sector wage growth appears to be weaker than would be implied by the historical relationship with the unemployment gap, indicating that the wage Phillips curve may have shifted downward since the terms-of-trade bust (Figure 6). It may be analogous to the case of the United States, as found in Blanchflower and Levin (2015), who provide empirical support for the negative impact of underemployment (in addition to unemployment) on wage levels.

17. A wage Phillips curve model for Australia suggests underemployment has a negative impact on wage growth. Building on Jacobs and Rush (2015), we estimate Phillips curves regressing private wage growth on measures of labor market slack that include underemployment and unemployment gap measures, expected inflation inferred from inflation indexed bonds, and the GDP deflator to proxy for output prices, building on Jacobs and Rush (2015) (see Appendix II for details).[4] These models provide a fairly close fit to wage growth data, and a somewhat better fit as measured by the adjusted R-squared when underemployment measures are included along with the unemployment gap. Moreover, the coefficients on the underemployment gap and lagged change in the underemployment rate terms are negative and significant, and where included, the coefficient on the lagged change in the underutilization rate is also significant (Model 2, 3 and 5 in Table A2, Appendix II). This suggests that in addition to unemployment, underemployment gaps may also have a negative impact on wage growth, and higher underemployment since the terms-of-trade bust may therefore be partly responsible for the weakness in wage growth since then.

18. The results also show that actual wage growth has been somewhat weaker than predicted by the model in recent quarters. Some explanations for the unexpected weakness in wage growth may be offered. In the 2000s, wage growth tended to often prevail above predicted levels, including the period just before the terms-of-trade bust. Part of the weakness in wage growth may thus reflect adjustment of wage levels to correct for previous high growth. Increased flexibility in labor markets, particularly among sectors exposed to commodity prices such as mining and business services, may have also added to

Wage Growth: Actual vs. Fitted Values
(Percent q/q annualized)



Source: IMF staff estimates.

[4] Caution should be taken when inferring a decline in inflation expectations from inflation-indexed bonds, as these measures are also affected by changes in the inflation risk premium. Other measures of longer-term inflation expectations in Australia, such as survey-based measures, have remained around the midpoint of Australia's inflation target.

downward wage pressure. Finally, low public sector wage outcomes, to which some private sector wages such as in health and education are benchmarked, may have also contributed to the weakness in private wage growth (Jacobs and Rush, 2015). More recently however, public sector wage growth has exceeded private sector wage growth, even though wage caps remain in effect in some state governments.

19. Broader measures of slack in labor markets and increased flexibility in labor markets are therefore central to interpreting labor market dynamics. The increased flexibility of average hours per worker may have helped moderate the rise in unemployment, but the growing share of part time workers and trend decline in full time hours may indicate more slack in labor markets than unemployment gaps alone would, and may well have been an important source of weakness in wage growth.

D. Have Sectoral Shifts in Labor Impacted Labor Productivity?

20. Aggregate labor productivity can be impacted by shifts in the sectoral allocation of labor. For instance, in the United States, the recent decline in manufacturing and mining share of aggregate hours and the rise in the services share is estimated to have reduced labor productivity growth by ¼ and ½ percentage point respectively relative to a counterfactual (of no change), given known higher productivity levels in the mining and manufacturing sectors relative to services. Moreover, the slower pace of labor productivity growth in services could exert a drag on aggregate productivity growth going forward (Van Zandweghe, 2016).

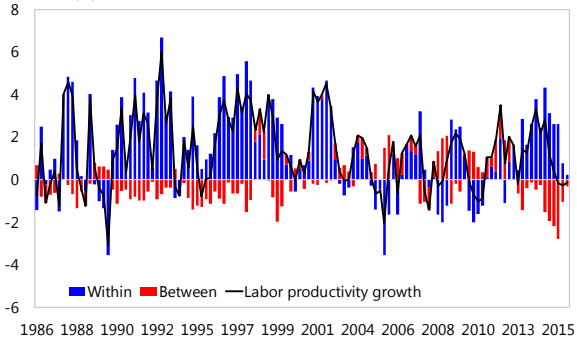
21. In Australia, changes in the share of aggregate hours worked across sectors reflect long-term trends, changes since the global financial crisis, and more recently since the terms-of-trade bust and mining investment decline. Figure 7 shows trends in the share in aggregate hours across sectors. Among goods producing sectors, manufacturing has shown a steady decline in the share of hours worked over time. The small share of mining in aggregate hours relative to other sectors rose sharply over the boom period but has dropped sharply since the end of the boom. In construction, the share rose steadily during the mining boom and has stabilized at that higher level since. With respect to services, a noticeable increase in the share of healthcare services has been observed, following the global financial crisis, with further acceleration more recently. Retail trade and communication shares declined post-GFC, likely due to increasing adoption of internet enabled retail services and expanded use of ICT technology.

22. Since the terms-of-trade bust, the most noticeable changes in the share of total hours worked have occurred in mining and healthcare services. Since 2011Q3, average hours worked have declined across most sectors, and about equally in healthcare and mining sectors. The change in shares in aggregate hours in the mining and healthcare sectors thus reflects changes in employment – mining was a major contributor to job growth during the boom period, but mining sector employment has fallen since the terms-of-trade peak, whereas healthcare services have contributed a third of the jobs added since the terms-of-trade bust, higher than quarter of the jobs added over the boom (Figure 8).

23. Trends in labor allocation and labor productivity in key sectors have changed post-GFC and following the mining investment downturn. The share in hours worked of goods related sectors (mining, manufacturing, utilities, construction, and domestic trade) has declined by nearly 5 percentage points since the global financial crisis and following the mining investment downturn, while the share of business services (finance, real estate services, professional services, and administrative services) and particularly household services (food and accommodation, education, healthcare, recreational, and other personal services) has risen correspondingly. The level of labor productivity (in real gross value added per hour) is markedly higher in the goods-related sector and in business services compared to household services. Moreover, the growth rate of labor productivity in household services is on average much lower (about 0.7 percent compared to 2 percent in goods and 1.9 percent in business services, over 1986 – 2016).

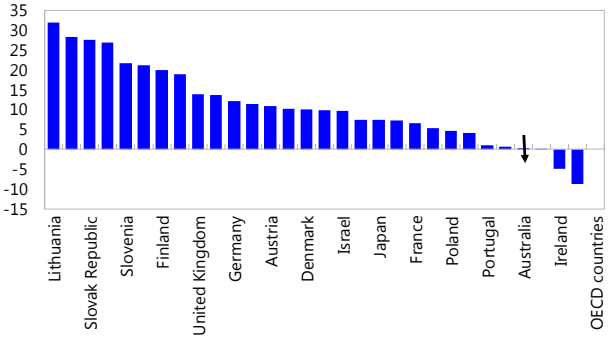
24. The decline in labor productivity growth in recent quarters is partly due to shifts in allocation of total hours worked – a "between" effect. Labor productivity growth has also slowed within both household and business service sectors in recent periods. On average though, post-GFC aggregate labor productivity growth has sustained its pre-GFC growth rate of around 1½ percent (in terms of GDP per hour worked), and unlike many other advanced economies still exhibiting large labor productivity level gaps relative to their pre-GFC trend, no such gap can be discerned in Australia. However, it remains to be seen whether lower labor productivity growth in services will drag aggregate labor productivity growth down to a lower average rate, beyond the peak of mining output at full capacity.

Decomposition of Labor Productivity Growth
(Percent y/y)



Sources: Haver Analytics database and IMF staff estimates.

Hourly Labour Productivity Gap
(Percent)

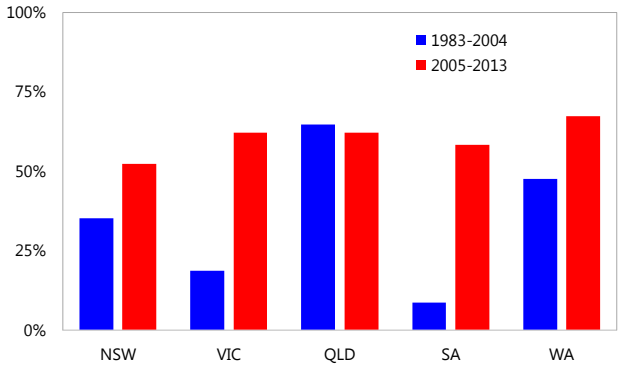


Source: OECD.
Note: Percentage shortfall of the Q4 2015 value with respect to a counterfactual value calculated assuming the pre-crisis growth rate (Q1 2000 to Q4 2007a) had continued after Q4 2007.

E. How Did States' Labor Markets Adjust to the Mining Boom-Bust Cycle?

25. The mining boom produced a strong labor supply response at the state level. The boom led to a strong pickup in private investment growth in the mining states, namely Western Australia (WA) and Queensland (QLD), accompanied by a strong pickup in labor demand (as measured by vacancies as per Figure 10) . In New South Wales (NSW), Victoria (VIC), and South Australia (SA), investment growth and the states' shares in total investment fell quite markedly, but there was strong labor demand growth particularly in NSW, likely linked indirectly to the mining boom. There was a marked supply response – participation rates rose, and unemployment rate declined. Working age population rose above long-term average growth rates, particularly in WA and in QLD. Following the terms-of-trade bust, labor demand in mining states fell sharply, and was accompanied by sharp declines in working age population growth, reflecting migration flows.

Share of Net Migration in Working Age Population Growth
(Percent)



Sources: ABS migration statistics and IMF staff calculations.

26. Migration has played a key role in driving working age population growth in Australia. On aggregate, about 50-60 percent of the increase in population is due to international migration. In terms of the supply response to the mining boom-bust cycle, migration has helped avoid labor shortages on the upswing, and big increases in unemployment on the downswing. At the state level, migration has been a key supply side factor especially over the mining boom period, contributing a larger share of population growth over 2005-11 in all states than in the previous two decades.

27. Econometric evidence suggests that the population (migration) response to demand shocks is a key component of states' labor market adjustment. In order to illustrate the labor market adjustment dynamics at the state level, in particular how migration behaves in response to state-specific demand shocks, we implement a set of state level VARs in (log changes in) employment, unemployment rate, and labor force participation rate (following Bayoumi and others 2006, and Blanchard and Katz 1992) for six states (NSW, VIC, QLD, SA, WA, and Tasmania (TAS)) over 1979-2015. Following the Blanchard-Katz interpretation, shocks to employment within the year are assumed to be demand shocks. Supply side effects occur through the employment rate and participation rates. The ordering of variables reflects the assumption that employment is impacted by shocks to the unemployment rate and participation rate impacts only with a lag. To focus on state-specific shocks, the aggregate cycle component is removed from each variable (details of the estimation procedure are provided in Appendix III). Based on the IRFs of this system, it is possible to trace out the evolution of the unemployment rate, participation rate, and population growth in response to the state-specific or acyclic employment shocks.

- In Figure 11A, we show the IRFs from a 1 percent shock to employment. As employment adjusts over 10 years to its long-term growth rate:

- In QLD and VIC, employment and participation rates account for around half of the increase in employment over 10 years. Thus, about half the increase in employment in the long term is supported by rising population (migration). In QLD, the employment rate has a smaller role in adjustment relative to participation compared to VIC. In all states, participation rates seem to do more of the adjusting than employment rates.

- In NSW and WA, migration seems to play a somewhat smaller role in response to employment shocks, accounting for between 30-40 percent of the long-term increase in employment over 10 years.

- One would expect WA to show a larger migration component given the sizeable swings in working age population growth over the past decade. This likely reflects our focus on state-specific employment shocks that remove the influence of aggregate shocks. It is plausible that there are larger population inflows into WA in response to aggregate shocks such as the commodity price boom rather than in response to state-specific shocks. Indeed, IRFs from VARs that do not remove the aggregate cycle from the data show WA has the largest migration response among all states in the sample (Figure 11B).

- In SA and TAS, the role of migration appears to be the smallest, accounting for only about 10-15 percent of the increase in employment in the long term.

- Further, conducting an historical shock decomposition exercise, we ask what would employment growth in states have looked like had it been driven by shocks to the employment rate and participation rate (Figure 12). The results show variation over time within states as to how closely observed employment growth is driven by these two shocks. By and large in the four bigger states (NSW, VIC, QLD, and WA), the sum of employment rate and participation rate shocks correspond reasonably well with actual changes in employment, with some exceptions. For instance, in QLD the decline in employment after 2006 exceeded what would be caused by unemployment rate and participation rate shocks alone. Conversely, the increase in employment growth in VIC and NSW in the mid-to-late 2000s is larger than the impact of the two shocks alone. In WA, instances over the mining boom period also point to positive employment shocks not caused by employment rate and participation shocks alone. This is further evidence on the historical role of migration in adjusting to employment shocks, particularly in the mining boom-bust cycle.

Overall, the results indicate that migration is among the key aspects of labor market flexibility that helped moderate the impact of the recent shocks. Over the boom period, migration likely prevented labor shortages and additional wage cost pressures. Over the bust period, the decline of migration into mining states has likely helped prevent unemployment from rising higher, and likely also prevented wage growth from weakening further.

F. Summary and Conclusion

28. Overall, Australia's labor markets have coped well with the adverse shocks as of late, adjusting smoothly in response to the terms-of-trade bust and mining investment decline, but not without some lingering concerns. Unemployment rose modestly following the global financial crisis and during the bust phase of the commodity prices and mining investment cycle. However, there may have been a slight increase in structural unemployment. The employment impact of cyclical downturns has moderated since the early 2000s and more of the cyclical adjustment in total hours worked has occurred in average hours per worker, likely due to increased labor market flexibility following reforms in the early 1990s, and other events including the global financial crisis. The slowdown in growth since the crisis and commodity price bust and mining investment decline produced significantly smaller reductions in employment than in prior downturns, and unemployment deteriorated only modestly.

29. Underemployment has played a key role in labor market slack and recent wage growth weakness. The trend decline in average hours worked per worker and increased part-time work are likely reflected in elevated underemployment and suggest more slack in labor markets than the unemployment gap alone would indicate. Elevated underemployment may also explain some of the weaknesses in wage growth in recent periods. Though wage growth appears to be unexpectedly low in recent periods, wages are expected to strengthen gradually as non-mining investment picks up and the drag from declining mining investment comes to an end.

30. Finally, migration has played a key role in labor market adjustment at the state level. This is the case particularly in response to state-specific demand shocks. Migration has likely helped avoid labor shortages during the boom phase and a worse unemployment outturn in the bust phase of the commodity price cycle. This has likely contributed to the overall moderate impact on labor markets over the boom-bust cycle.

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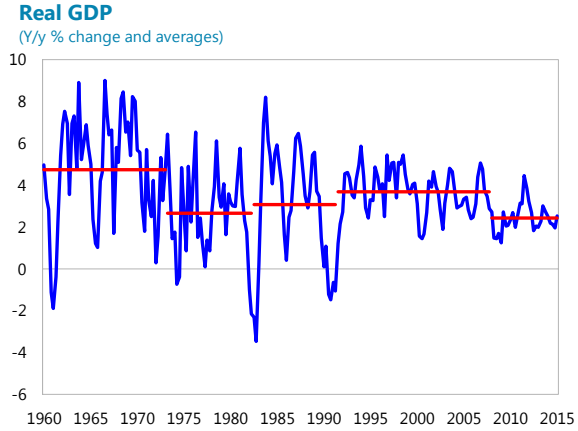
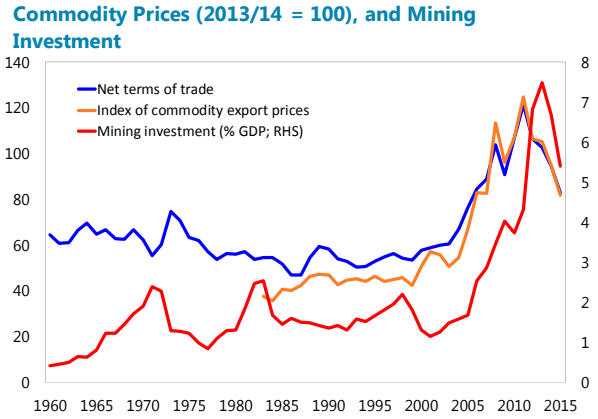
Figure 1. Key Real Sector and Labor Market Developments

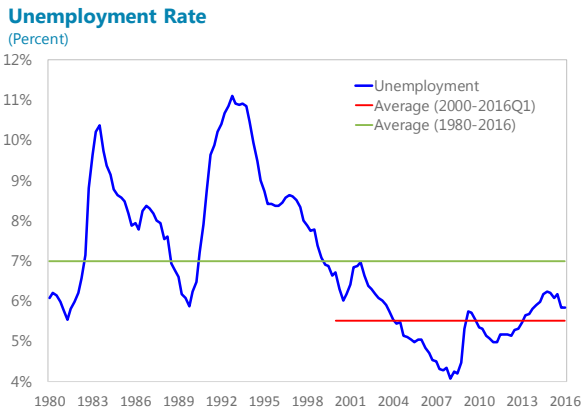
Growth has slowed since the global financial crisis by 0.75 percent on average…



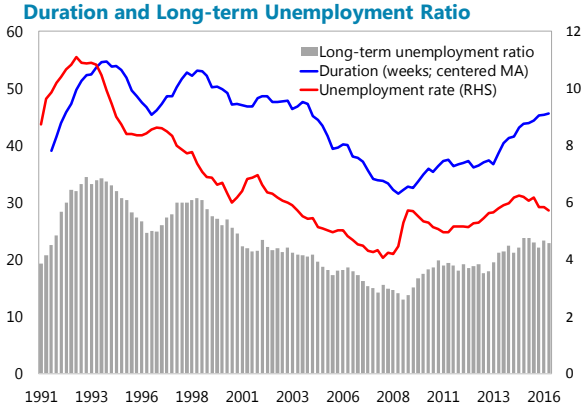
… and terms of trade and mining investment have reversed sharply.



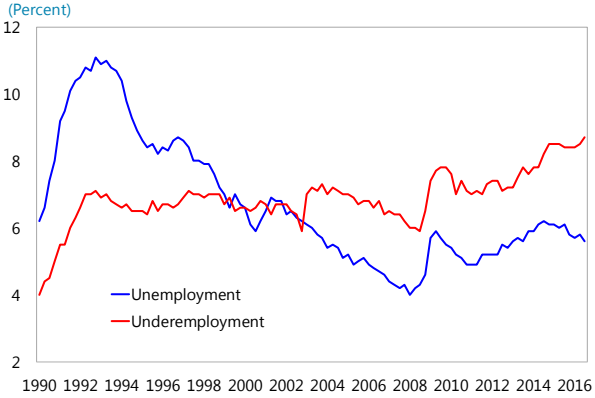
Unemployment increased modestly …



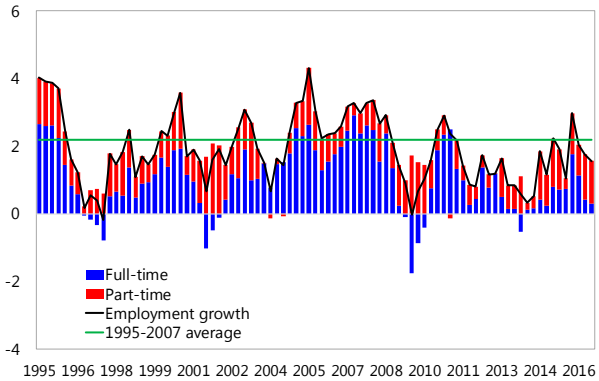
…but long term unemployment has risen…



…underemployment rates are above historical averages…



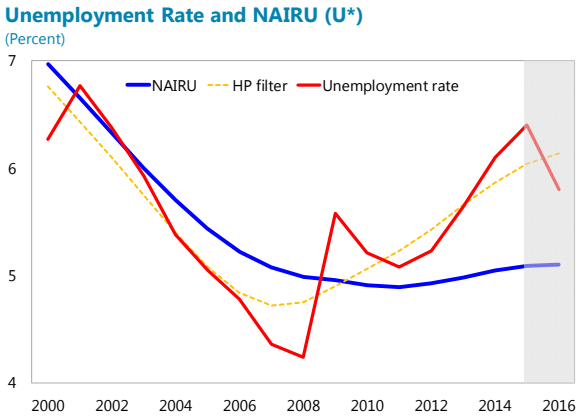
…and employment growth, while strong, has been driven by part-time workers.



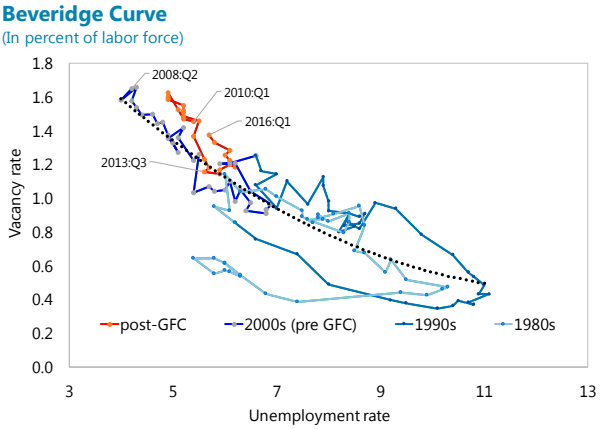
Sources: Haver Analytics database, and IMF staff calculations.

Figure 2. Structural Unemployment

NAIRU has increased somewhat since 2011...



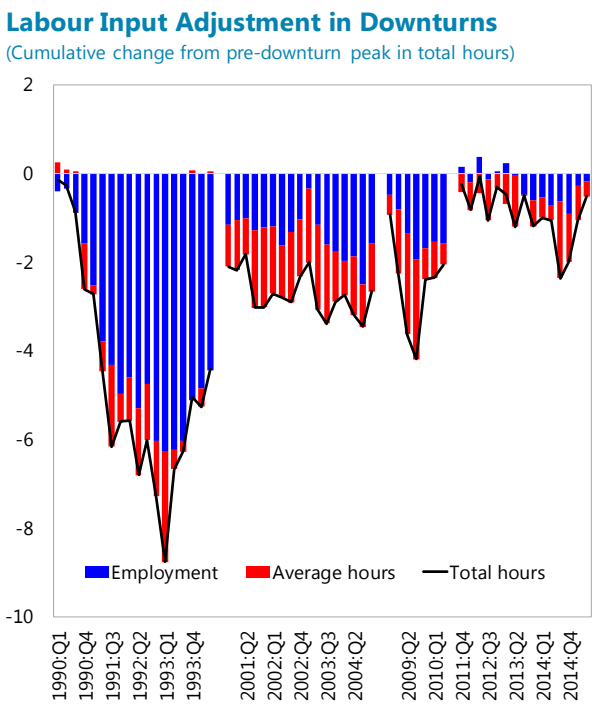
... and the Beveridge curve indicates some outward shifting after the global financial crisis and terms-of-trade bust.



Sources: Haver Analytics database, and IMF staff calculations.

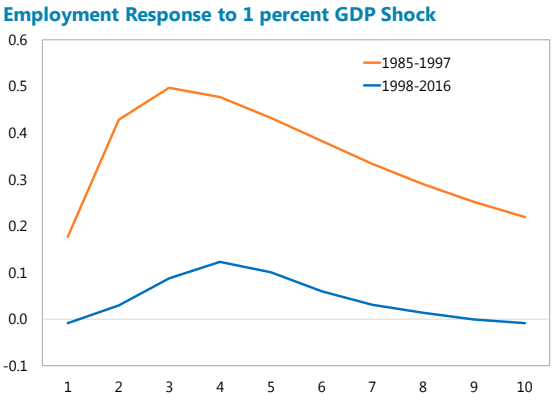
Figure 3. Cyclical Adjustment in Labor Input

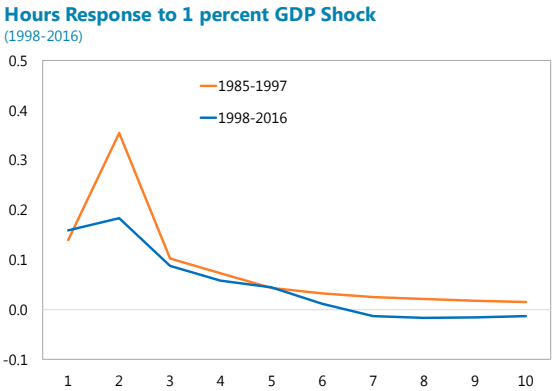
Panel 1. Peak-to-trough decline in aggregate hours worked



Note: Figure shows log differences from peak multiplied by 100. All variables are detrended using an HP filter (lambda = 1600). Peaks are dated 1989Q4, 2000Q3, 2008Q3, and 2011Q3.

Panel 2. Employment and Hours Worked Response to Output Shocks



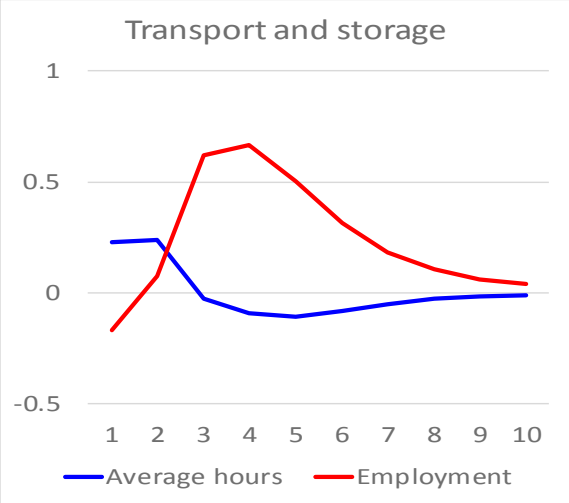


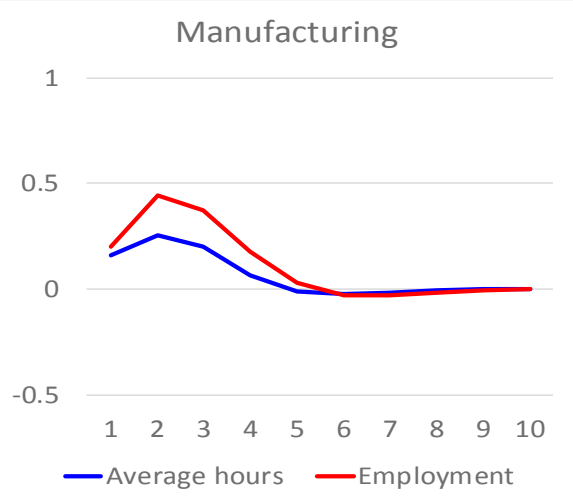
Sources: Haver Analytics database, and IMF staff calculations.

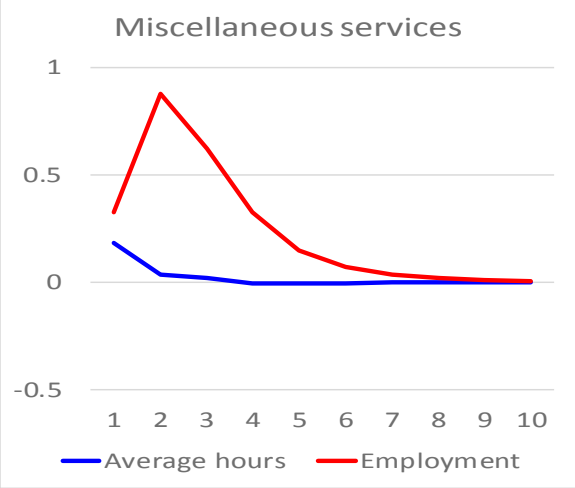
Figure 4. Differences in Sectoral Cyclical Adjustment in Labor Input

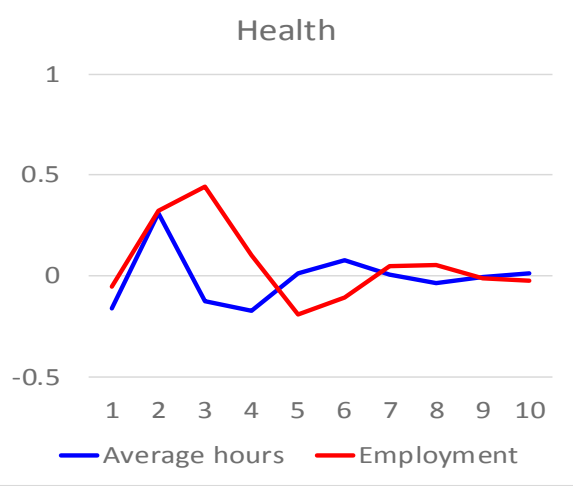
In some sectors, employment response is bigger, and more persistent…

…and lower and less persistent in others.





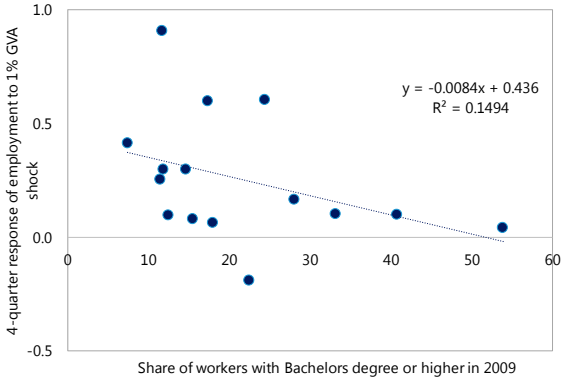




Employment appears to adjust relatively less in sectors with high educational qualifications…

…but no relationship is observed with respect to adjustment in hours worked.

Impact of 1% GVA Shock at 8 Quarters: Employment



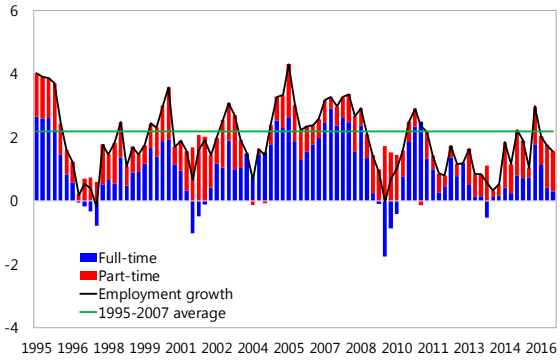
Impact of 1% GVA Shock at 8 Quarters: Average Hours

Sources: ABS Survey of Education and Training data; and IMF staff estimates.

Figure 5. Part-time Work, Hours Worked, and Underemployment

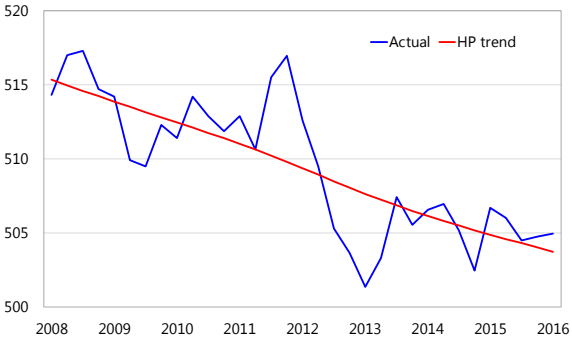
The share of part-time employment has increased…

Full-time and Part-time Job Growth
(Contribution to employment growth, percent)



…even though hours worked gaps have closed the commodity price bust for part time …

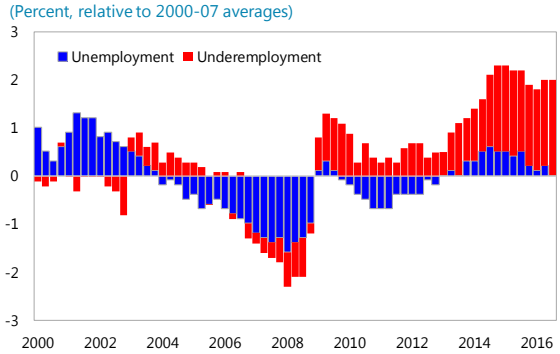
Average Hours per Quarter: Full-time Workers



Note: Average quarterly hours worked estimated from monthly hours worked and employment status.

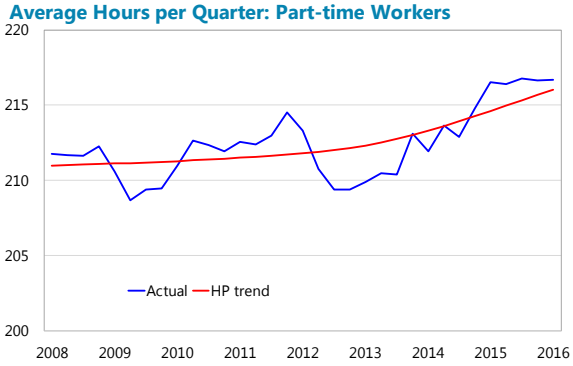
…and underemployment gaps remain quite high…

Deviation of Unemployment and Underemployment from Long-run Averages
(Percent, relative to 2000-07 averages)



… and full time workers.

Average Hours per Quarter: Part-time Workers

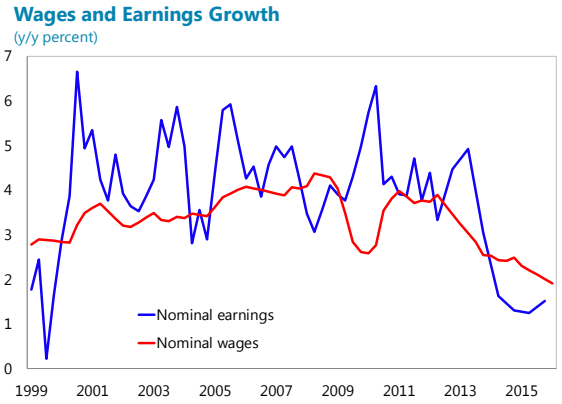


Note: Average quarterly hours worked estimated from monthly hours worked and employment status.

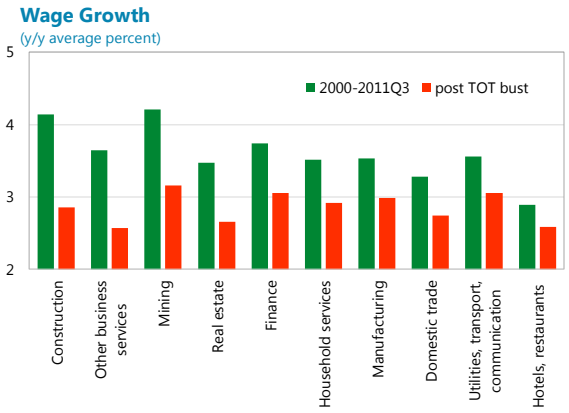
Sources: Haver Analytics database; and IMF staff calculations and estimates.

Figure 6. Wages and Labor Market Slack

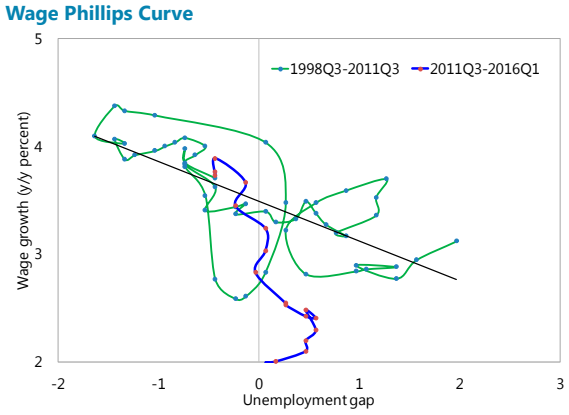
Wages and earnings growth declined sharply



… across all sectors, especially commodity related sectors.



The Phillips curve appears to have shifted lower since the terms-of-trade bust.



Sources: Haver Analytics; and IMF staff calculations

Figure 7. Share in Aggregate Hours Worked (percent)

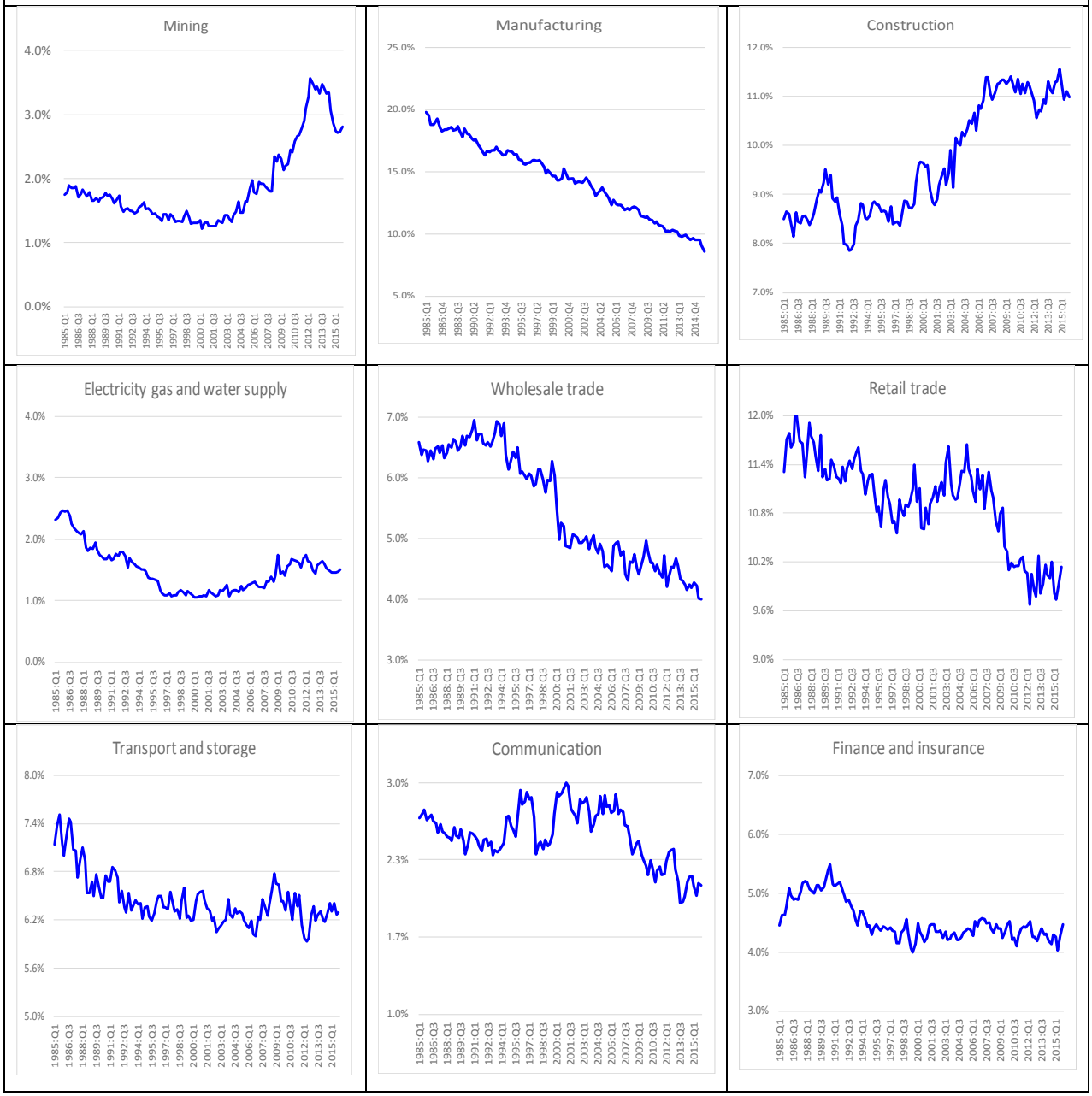
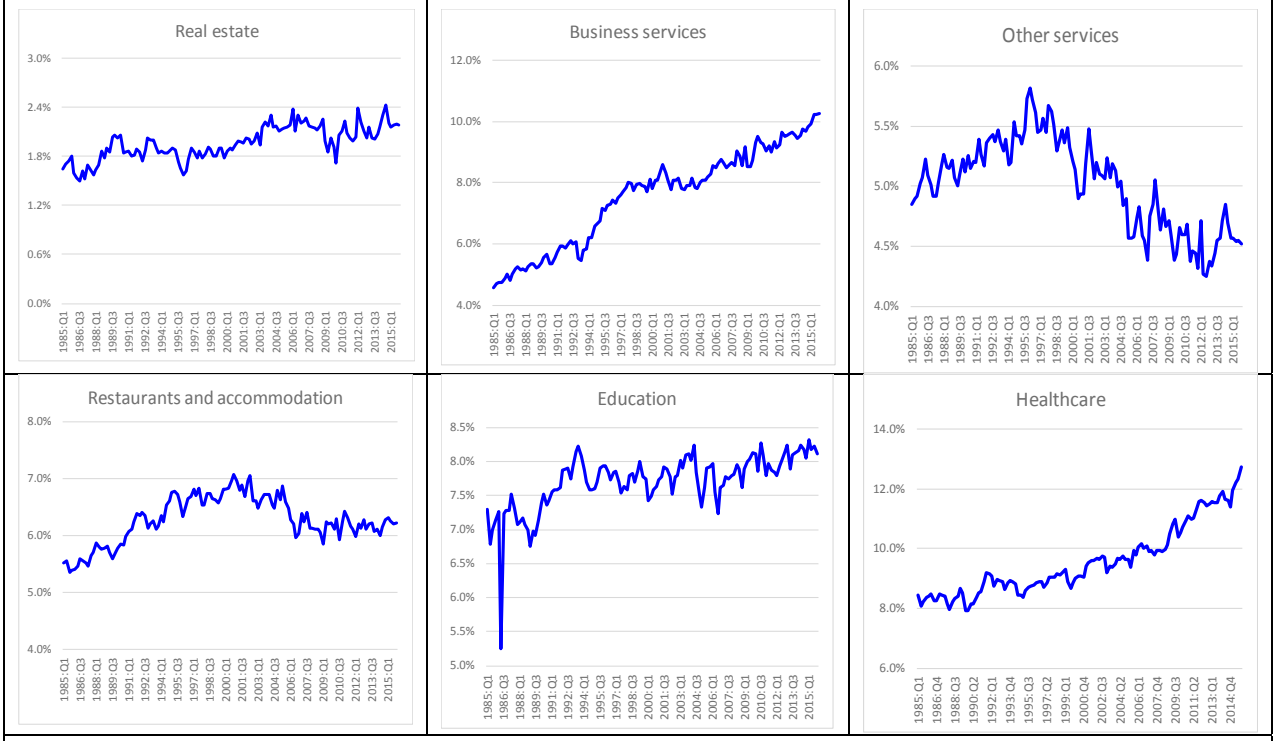


Figure 7. Share in Aggregate Hours Worked (percent) (concluded)



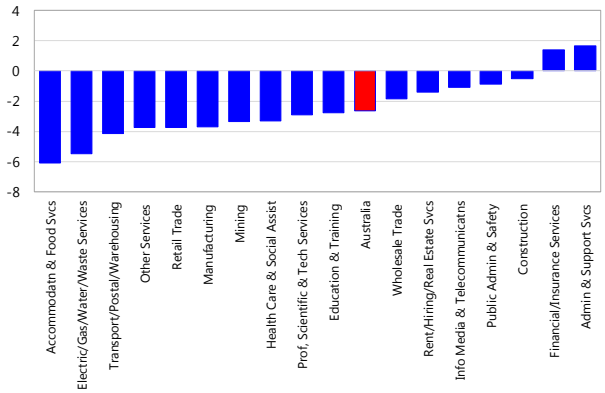
Sources: Haver Analytics database; and IMF staff calculations.

Figure 8. Sectoral Average Hours and Employment Changes

Average hours have declined across most sectors …

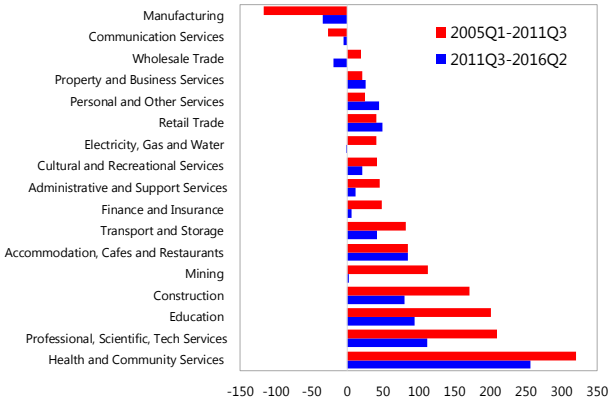
Change in average weekly hours since 2011Q3

(Percent)



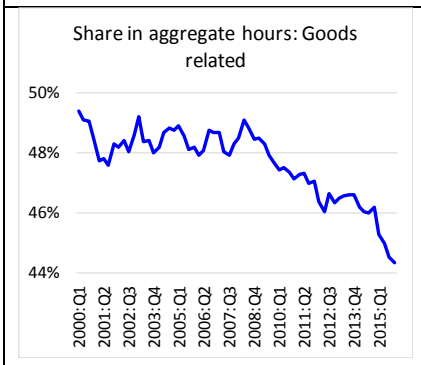
… and the contribution of mining to employment has shrunk following the bust.

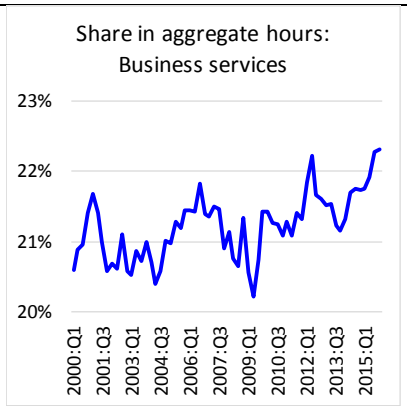
Changes in Employment ('000 persons)

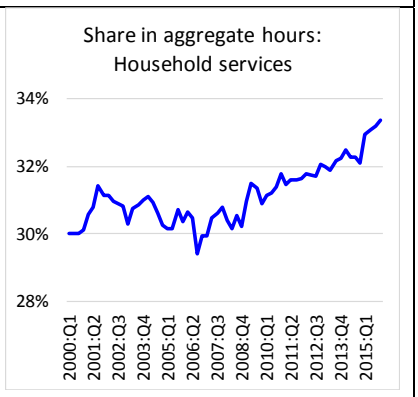


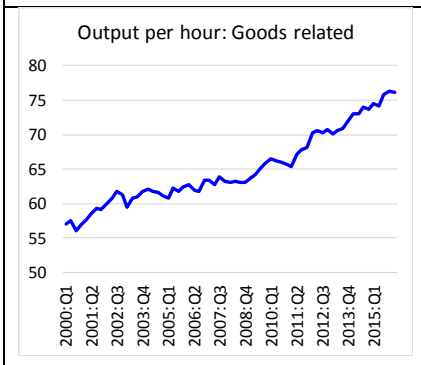
Sources: Haver Analytics; and IMF staff calculations.

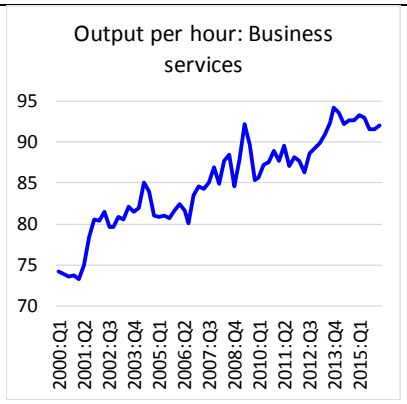
Figure 9. Share in Aggregate Hours and Labor Productivity ($ output per hour worked)

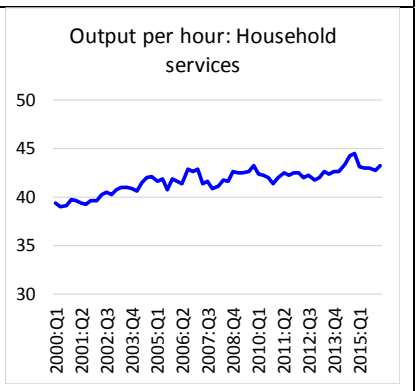










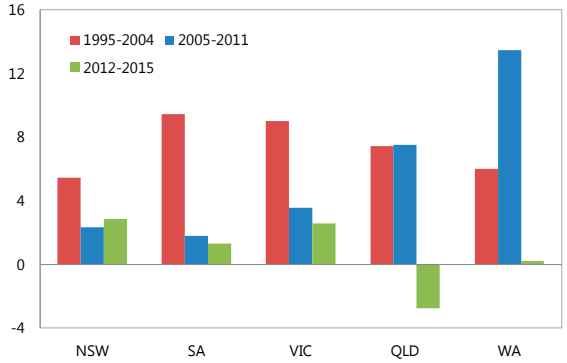


Sources: Haver Analytics; and IMF staff calculations.

Figure 10. Labor Market Developments in States

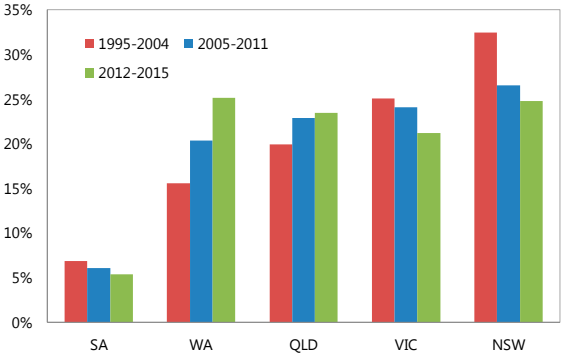
Private investment growth was much stronger in mining states during the boom…

Private Investment Growth
(Percent)



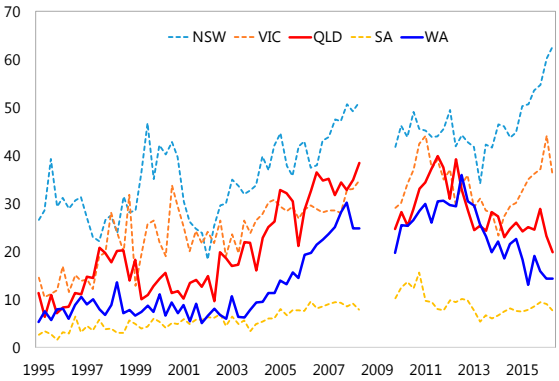
…increasing their share in aggregate private investment.

Share in private investment
(Percent)



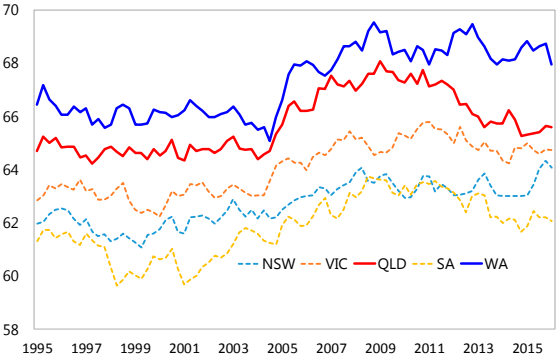
Labor demand increased more sharply in mining states…

Vacancies ('000, EOP)



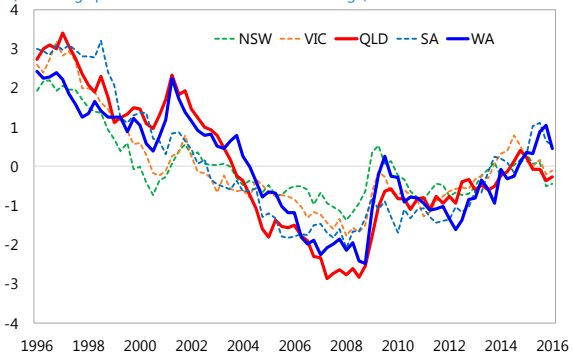
…producing a stronger response in participation rates…

Labor Force Participation Rate
(Percent)



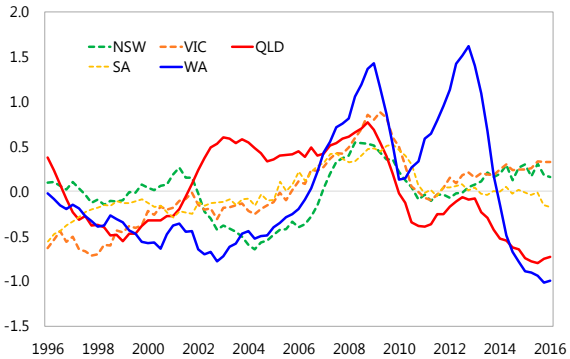
… steeper declines in unemployment …

Unemployment
(Percentage point deviation from 1996-2016 average)



… and stronger working age population growth.

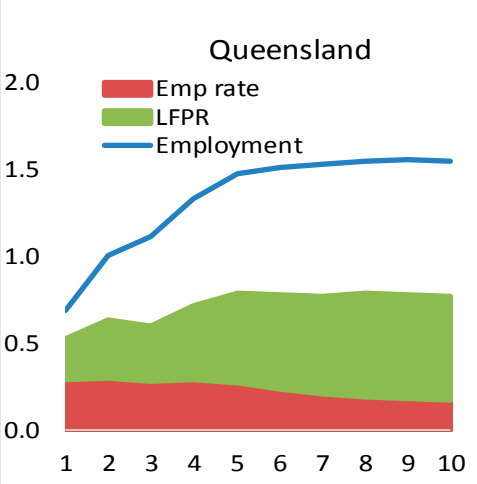
Working Age Population Growth
(Percentage point deviation from 1996-2016 average)



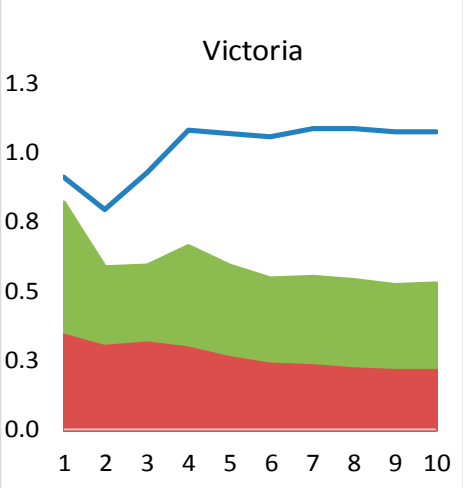
Sources: Haver Analytics; and IMF staff calculations.

Figure 11A. Impulse Responses to 1% State-Specific Employment Shock

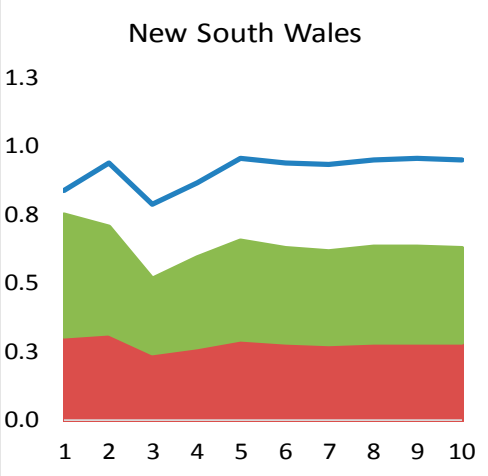
Migration plays a bigger role in Queensland…



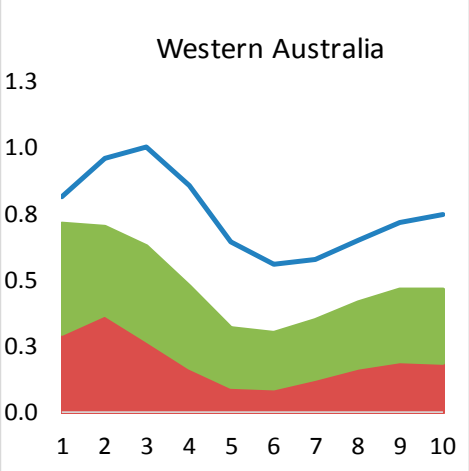
…and Victoria…



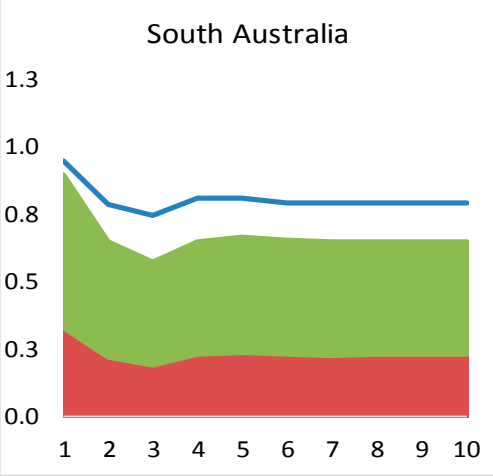
… but a smaller role in New South Wales…



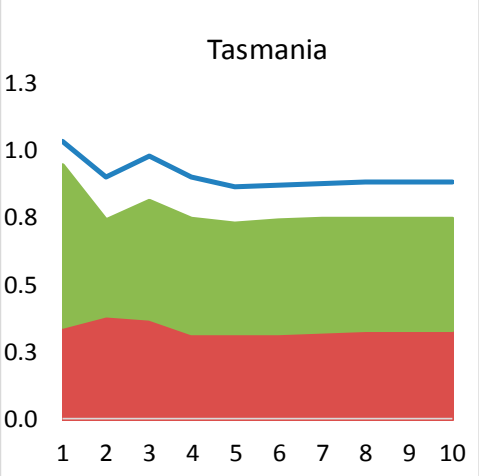
…and Western Australia…



…with the least in South Australia…



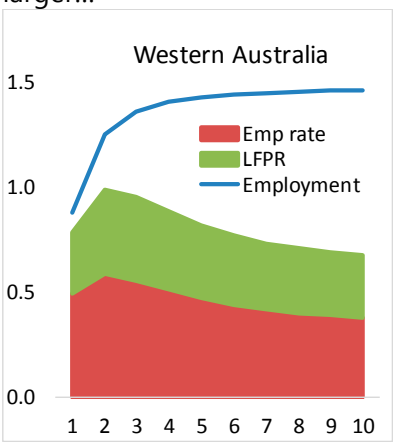
…and Tasmania.



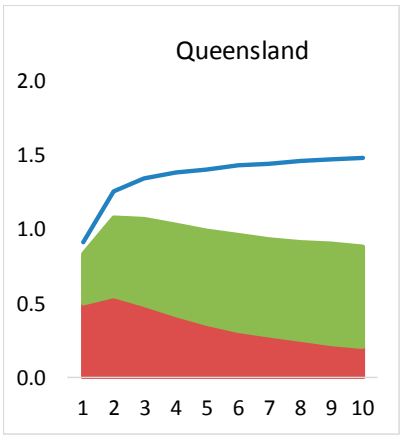
Source: Haver Analytics; and IMF staff estimates.

Figure 11B. Impulse Responses to 1% Employment Shock

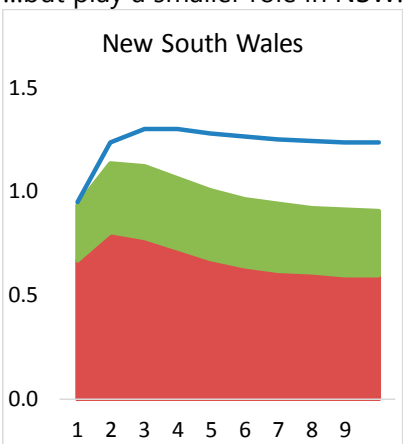
Including the aggregate cycle, migration shocks in WA are much larger…



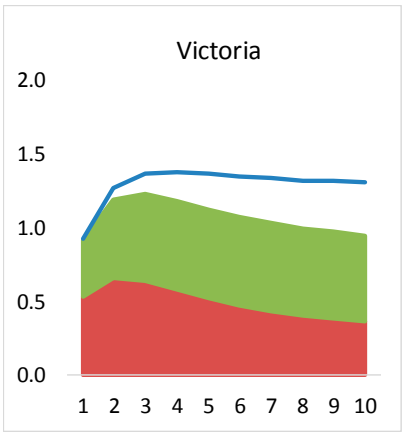
…and still sizeable in Queensland…



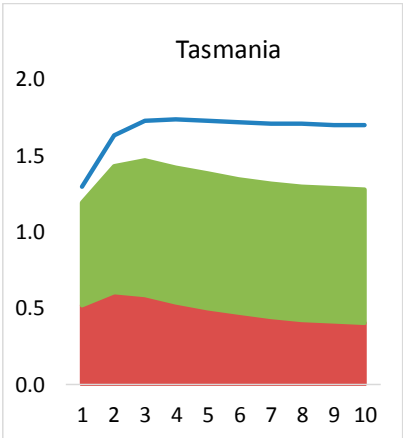
…but play a smaller role in NSW…



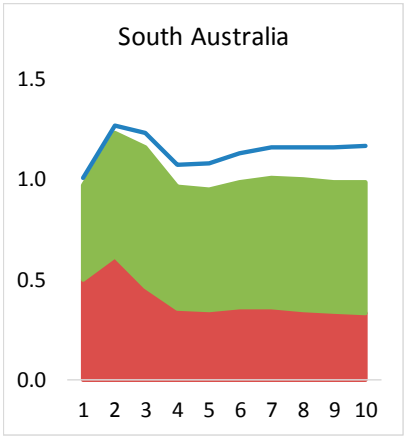
…Victoria…



…and in Tasmania…

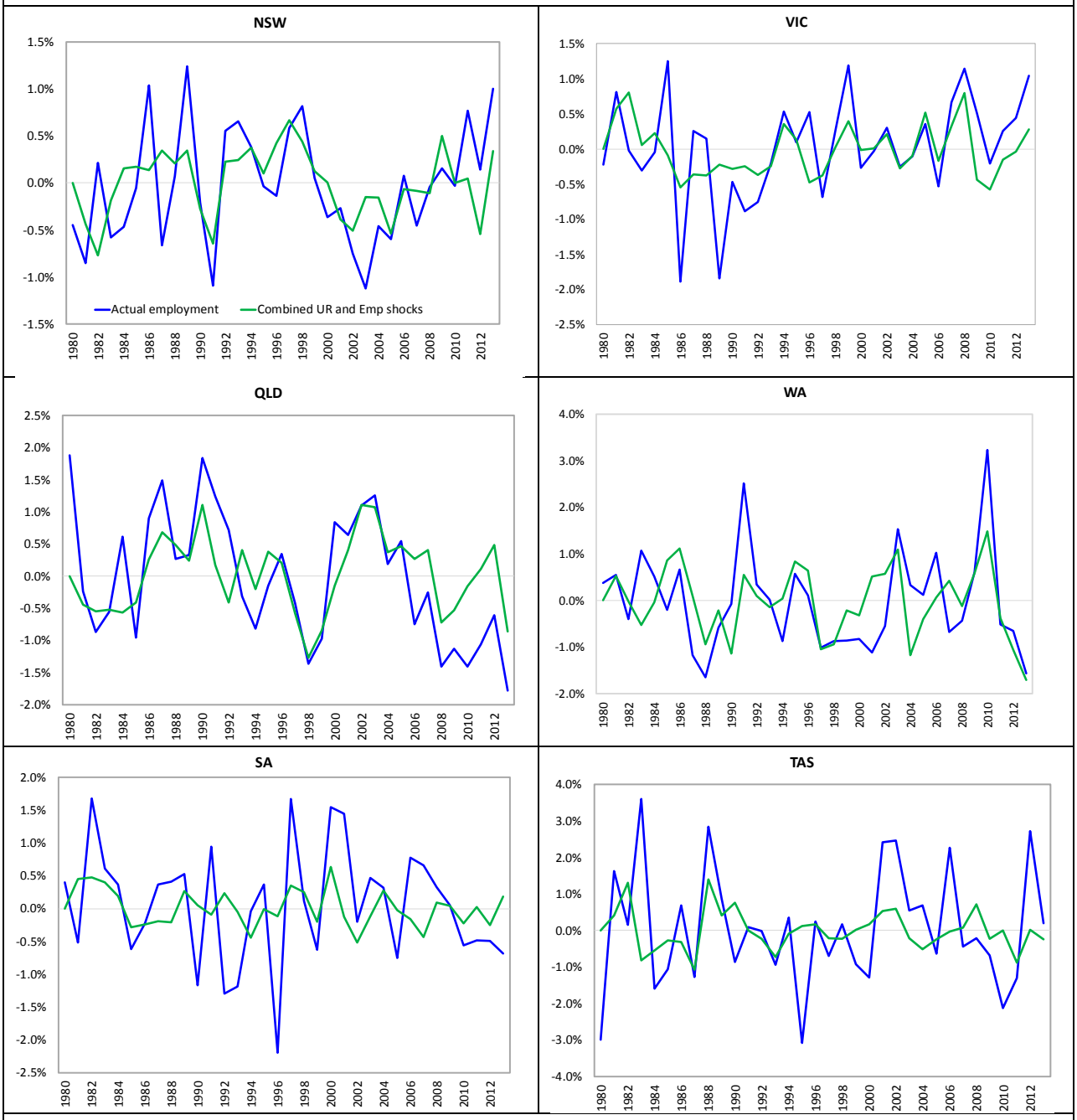


…and the least in South Australia.



Source: Haver Analytics; and IMF staff estimates.

Figure 12. Historical Decomposition of Employment Growth



Source: Haver Analytics; and IMF staff estimates.

Appendix I. Fitting a Beveridge Curve for Australia

To start with, the labor market is in its "turnover steady state" when the net hiring rate equals labor force growth. Put differently, employment growth equals labor force growth in a turnover steady state. Employment growth (RHS of equation (1) below) is the difference between hires (H_t) and separations (S_t) over $(t, t+1]$ (here a 1-year period), as a ratio of employment at the start of the period (E_t):

$$g_{t+1} = \frac{H_t - S_t}{E_t}\ , \tag{1}$$

where g_{t+1} is labor force growth over period $(t, t+1]$. To express the steady state condition (1) in terms of unemployment and vacancies, a Cobb-Douglas matching function (equation 2) and separation rate equation (equation 3) are estimated, where (U) is the level of unemployment and (V) is the number of vacancies:

$$\ln\left(H/V\right) = \mu_h + \alpha_h ln\left(U/V\right) + \epsilon_h, \tag{2}$$

and

$$\ln\left(S/E\right) = \mu_s + \alpha_s ln\left(U/V\right) + \epsilon_s \tag{3}$$

Combining (2) and (3) with (1), and noting U/E can be expressed in terms of the unemployment rate as $\left(\frac{u_t}{1-u_t}\right)$, the steady-state condition can be expressed as:

$$\mathrm{g}_{t+1} = e^{\mu_h + \epsilon_{h,t}} \left(\frac{u_t}{1-u_t}\right)^{\alpha_h} v_t^{(1-\alpha_h)} - e^{\mu_s + \epsilon_{s,t}} \left(\frac{u_t}{1-u_t}\right)^{\alpha_s} v_t^{-\alpha_s}\ , \tag{4}$$

The implicit function defined above is evaluated at errors $\epsilon_{h,t}, \epsilon_{s,t} = 0$, v_t (the vacancy rate) at observed rates, and g_{t+1} set at its pre-GFC average rate of 1.7 percent growth to solve for the equilibrium unemployment rate. Parameter values μ_h, μ_s, α_h, and α_s are obtained from the regressions of (2) and (3).

To estimate the regressions, data on hires and separations are inferred from job tenure data. The reader is referred to Hobijn and Sahin (2012) for details of the derivation; a brief description is as follows. It is assumed that hires and separations occur at a constant rate through the year t (i.e. over $(t, t+1]$), in proportion to the level of employment, i.e., the number of hires at any point in time is hE_t where h is the hiring rate, and separations are sE_t where s is the separation rate. It can be shown that given E_t, E_{t+1}, and $E_{t+1}^{\tau>1}$ which is the number of employed workers at $t+1$ who have

job tenure in excess of 1 year, the hiring rate is given by $h = \ln(E_{t+1}) - \ln(E_{t+1}^{\tau>1})$, and the separation rate is given by $s = \ln(E_t) - \ln(E_{t+1}^{\tau>1})$. Time aggregating the continuous time flows yields:

$$H_t = \left(\frac{h}{h-s}\right)\left[e^{(h-s)} - 1\right]E_t \ , \tag{5}$$

$$\text{and } S_t = \left(\frac{s}{h-s}\right)\left[e^{(h-s)} - 1\right]E_t \tag{6}$$

ABS data on employment duration in excess of a y ear (avail able for year-ended in February) are combined with data on employment in February of the year, and the year before, to obtain estimates of hires and separations over the year ended in February of a given, as outlined above. Table A1 shows the results of estimates of equations (2) and (3). The results presented in the text are based on the shorter sample up to 2008, and are in line with those obtained by Hobijn and Sahin (2012) for Australia. A longer sample up to the terms-of-trade bust after 2011 yields very similar parameter values. The results for the hiring function (2) show a relatively good fit even with the limited sample size. As expected, hires per vacancy (the vacancy yield) is positively correlated with the U-V ratio: more slack makes filling vacancies easier. In the separations equation (3), the fit is much weaker and the coefficient on the U-V ratio is insignificant in the shorter sample.

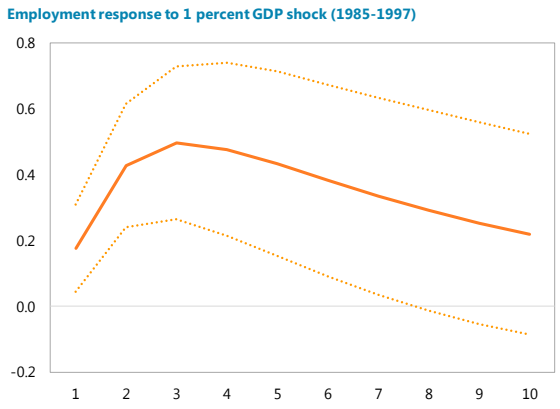
Table I.1. Regression Estimates

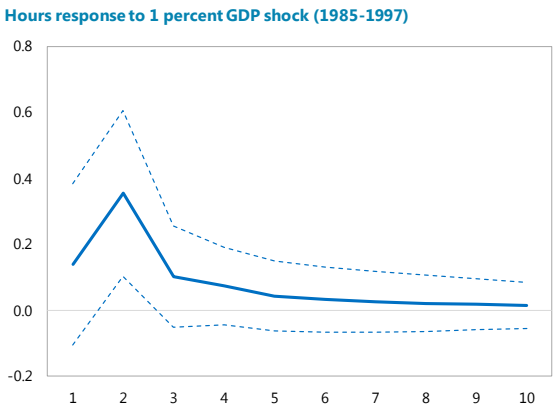
Sample: 1986-2008	log H/V	log S/V
Constant	2.1***	-1.5***
log U-V ratio	.58***	0.04
R-sq	0.89	0.09

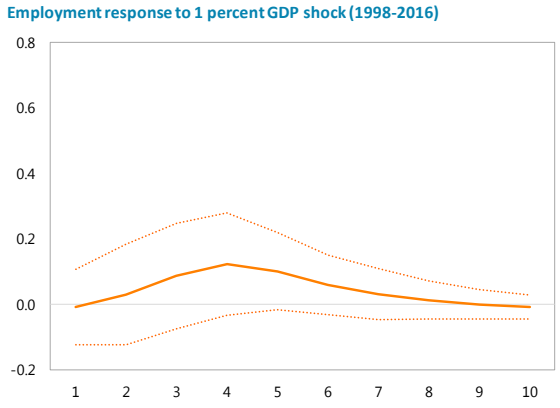
Sample: 1986 - 2011	log H/V	log S/V
Constant	2.0***	-1.6***
log U-V ratio	.6***	.06*
R-sq	0.89	0.15

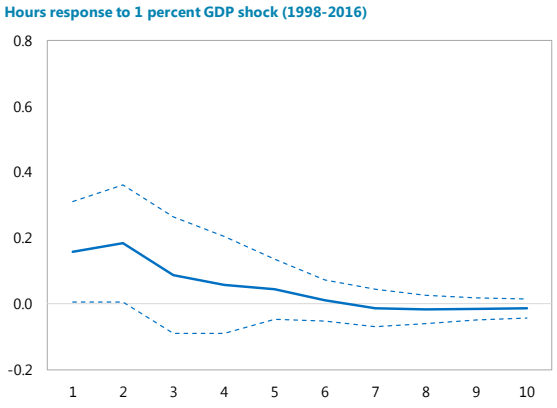
Appendix II. Cyclical Features of Labor Market Adjustment

Aggregate GDP, hours worked, and employment: The VAR results shown in Figure 3 (Section III) are derived from a three variable VAR in log detrended GDP, employment, and average hours worked, based on two quarterly samples – from 1983 to 1997, and 1998 to 2016 respectively. Variables are detrended using the H-P filter, with the smoothing parameter lambda=1600. Seasonal dummies are included since hours worked data are available in non-seasonally adjusted form. Consequently, GDP and employment data are also included in non-seasonally adjusted form. In the charts below, the left panels show the response of log employment in the two sub-periods, while the response of average hours per worker are shown in the panels on the right. Error bands show two standard errors above and below the estimate response. It seems quite evident that employment responses were larger, and distinctly above zero in the earlier period, as compared to the later period. On the other hand, the response of hours worked does not appear to differ very much across the two samples; though noise in hours worked data may be a factor as noted in Jacobs and Rush (2015).









Sectoral value added, hours worked, and employment: The VAR framework above is extended to sector level data to examine differences in the employment response across sectors. The data include detrended values of real gross value added, sectoral average hours worked, and

employment (all in logs). The sample runs quarterly from 1990 – 2016. Data on educational qualifications are taken from ABS Survey of Education and Training. In Figure 4 above, we show the relationship between the cumulative 8 quarter employment response and education attainments (share of sectoral labor with Bachelor degree or higher) for the year 2009. The survey is available every 5 years starting from 1993, but comparability over time is limited with expanded sectoral classification, with the 2009 survey having the most detailed sector classification. The surveys for 2005 and 2001 have 2 sectors fewer than the 2009 survey. In general, the sectoral rankings in terms of the share of workers with education attainments of at least Bachelor degrees are preserved, and the results shown in the text would not be altered by choosing a different year of the survey.

Wage Phillips curve estimates: The estimated equation is of the form:

$$\Delta \log WPI_t^{private} = \alpha + \beta_1 URgap_{t-1} + \beta_2 UERgap_{t-1} + \beta_3 \Delta UR_{t-1} + \beta_4 \Delta UER_{t-1}$$
$$+\beta_5 \text{Bondinfexp}_{t-1} + \beta_6 \text{Bondinfexp}_{t-2} + \beta_7 \text{Bondinfexp}_{t-3} + \beta_8 \Delta 4 \log GDPdefl_{t-1} + \beta_9 \Delta \log labprod_{t-1} + \varepsilon_t$$

where $\Delta \log WPI_t^{private}$ is private sector wage (log change), $URgap_{t-1}$ is the lagged deviation of unemployment from its sample average (sample runs from 1998Q1 – 2016Q1), $UERgap_{t-1}$ is the lagged underemployment rate gap similarly calculated, Bondinfexp_{t-1} is the lagged expected inflation term implied by 10-year indexed bonds, $\Delta 4 \log GDPdefl_{t-1}$ is the lagged year-on-year change in log of the GDP deflator to proxy for changes in output prices, and $\Delta \log labprod_{t-1}$ is the lagged change in log output per worker.

We impose parameter restrictions as shown in Table A2. Model 1 assumes $\beta_2 = \beta_4 = 0$, i.e. underemployment gaps are assumed to not impact wage growth. Model 2 removes this restriction, allowing the underemployment gap (and the change in the underemployment rate) to exert a distinct impact on wage growth in addition to unemployment measures. Model 3 imposes equality constraints on $\beta_1 = \beta_2$ and $\beta_3 = \beta_4$. In Model 4 and 5 we consider variants of Model 1 and 3 including a lagged dependent variable term. The results show that output prices (GDP deflator) have a positive impact on wage growth in all models and appears robustly estimated. Model 1 is closest in specification to RBA (2015) and the fit is very close to the RBA model in terms of the R-squared. While the UGap term is not significant, the change in unemployment rate has a negative and significant effect on wages. In Model 2, the coefficient on the underemployment gap variable UEGap is negative and significant, as is the lagged change in the underemployment rate. Moreover, the introduction of this variable leads to the sign on UGap to be larger (and significant at 15%) compared to Model 1. Overall, this specification has a better fit in terms of adjusted R-squared and shows that the underemployment gap has a sizeable impact on wages. In Model 3, the change in underutilization rate is significant and has a sizeable impact. The

Table II.1. Wage Phillips Curve Estimates

	Model 1	Model 2	Model 3	Model 4	Model 5
Dlog PWage				**0.317**	**0.306**
UGap	-0.010	-0.031		-0.015	
UEGap		**-0.064**			
UUGap			-0.025		-0.024
DUrate	**-0.234**	**-0.188**		**-0.198**	
DUErate		**-0.099**			
DUUrate			**-0.138**		**-0.122**
ExpInfB10	**0.001**	0.001	0.001	**0.001**	0.001
ExpInfB10 (-2)	-0.001	-0.001	0.000	-0.001	0.000
ExpInfB10 (-3)	**0.001**	**0.001**	**0.001**	0.001	0.001
D4log GDPdef	**0.030**	**0.023**	**0.027**	**0.021**	**0.017**
Constant	**0.003**	**0.005**	**0.004**	**0.002**	**0.003**
R-sq (adjusted)	0.60	0.64	0.65	0.65	0.72

Notes: dependent variable is quarterly log difference in private wage. Sample 1997:1 - 2016:1. PWage = private wage, U = unemployment, UE = underemployment, UU = underutilization, ExpinfB10 = inflation expectations inferred from 10 year inflation indexed bonds, GDPdef = GDP deflator. All RHS variables are included at first lag unless otherwise noted. Bold figures are significant at 10% or higher.

R-squared is also larger than that in Model 1. In addition, we also show results from including a lagged wage inflation term in Models 4 and 5, which improves the fit noticeably in Model 5 which includes the overall underutilization rate measure. Overall, these results would suggest that underemployment gaps do matter for wage growth and may be having some impact in relatively weak wage growth outcomes observed since the terms-of-trade bust.

Appendix III. Role of Migration in States' Labor Market Adjustment

The exercise follows the methodology in Bayoumi and others (2006), building on Blanchard and Katz (1992). Noting that $E_t = (1-UR_t) * LFPR_t * WAP_t$, where E is employment, $(1-UR)$ is the employment rate, $LFPR$ is the participation rate, and WAP is the working age population, taking logs and rearranging we observe that $e - emp - p = wap$ where e is log employment, emp is log employment rate, and p is log participation rate. Thus, from the impulse-responses to employment shocks in a VAR involving employment, employment rate, and participation rate, one can infer the role played by wap in adjustment to employment shocks (as the identity must hold), essentially capturing the migration response of potential workers in working age groups.

In Blanchard-Katz, the VAR on data for the United States is implemented as $y_t^{'} = (\Delta e_t, emp_t, p_t)$ and $\varepsilon_t^{'} = (\varepsilon_{\Delta et}, \varepsilon_{empt}, \varepsilon_{pt})$, i.e. employment rate and participation rate are level stationary. However, as in the case of the application to Canada in Bayoumi and others, Australian data cast doubt on the stationarity in levels of the unemployment rate and participation rate, and these are thus entered in first differences. Table A3 summarizes the unit root test results, which show that in individual states' samples, unemployment rate and participation rate may be non-stationary.

Thus, the specification in this paper includes all variables in log differences: $y_t^{'} = (\Delta e_t, \Delta emp_t, \Delta p_t)$ and $\varepsilon_t^{'} = (\varepsilon_{\Delta et}, \varepsilon_{\Delta empt}, \varepsilon_{\Delta pt})$. An implication of this specification is that unemployment rate and participation rate thus have a role in long term adjustment to employment shocks. The shocks to employment are interpreted as labor demand shocks, and supply responses occur through shocks to the unemployment rate and to participation. Employment shocks are ordered first, and supply responses feed through to employment with a lag. As in Bayoumi and others, two lags of each variable are included in the equations.

Data on employment, unemployment rate, and participation rate at the state level are taken from ABS. The sample runs from 1979 to 2015 at annual frequency. Each variable entering the VAR is "acyclic" to the aggregate economy, i.e., the influence of aggregate shocks is removed to consider only state-specific demand shocks. This is done by obtaining the residuals of a regression of the state level variable on the national variable and a constant. This allows us to focus on labor market responses to local level disturbances.

Table III.1. Individual Unit Root Test: ADF Test with AIC

	Change in employment	Employment rate	Change in employment rate	LFPR	Change in LFPR
NSW	X	Y	Y	Y	
VIC	X	Y	Y	Y	
QLD	X	Y	X	Y	
SA	X	Y	X	Y	
WA	X	Y	X	Y	
TAS	Y	X	X	Y	

Rejection of null: unit root at 5%
Sample: 1979 - 2015 (annual)

INFLATION TARGETING IN AUSTRALIA: PERFORMANCE, CHALLENGES AND STRATEGY GOING FORWARD[1]

The Australian model of flexible inflation targeting has been a success, as evidenced by average inflation consistent with the target, and a substantial moderation in inflation and output volatility.

Belatedly, monetary policy in Australia has also faced some of the challenges that other central banks have faced after the global financial crisis, albeit not to the same extent.

- A slower-than-expected recovery, economic slack, and inflation declining below target in a difficult global economic environment.
- An increased probability of hitting the effective lower bound (ELB) on nominal policy rates, given declines in the real equilibrium interest rate (EIR) and some possibly large downside risks (e.g. China, European banks, geo-political uncertainty, etc.).
- Risk of more persistent deviations of inflation below target ("low inflation trap") and prolonged slack.

Staff estimates of the real EIR in Australia suggest that it has declined from around two percent in mid-2008 to around 1 percent over the past two years. The policy rate has been below the equilibrium throughout most of the post-GFC recovery, indicating that monetary policy has been in a 'loose' stance.

In the current situation, the prudent policy strategy would be a "low for longer" monetary policy stance while preparing for coordinated monetary and fiscal policy easing if downside risks were to materialize.

- Around the *current baseline outlook,* a 'prudent risk-management strategy' would be to respond more strongly to negative inflation and output surprises than to positive ones.
- To lower risks of *'dark corners'*, an effective policy response would call for both expansionary monetary and fiscal policies in the event that large negative shocks were to materialize (e.g., lower global growth and commodity prices).

Enhancing policy transparency

- A more forecast-oriented communication policy which could include more explicit discussion of how the RBA intends to use its policy instruments over time to bring inflation back to target, with the importance of such policies in minimizing the risk of drifting inflation expectations likely to increase, the closer policy rates come to the ELB.

[1] Prepared by Thomas Helbling, and Philippe Karam (both APD), Ondra Kamenik, Douglas Laxton, Hou Wang, and Jiaxiong Yao (all RES).

A. Introduction

1. Australia was one of the early adopters of inflation targeting (1993). The IT regime in Australia is widely considered a success, as evidenced by average inflation consistent with the target, and a substantial moderation in inflation and output volatility.

2. Belatedly, the Reserve Bank of Australia (RBA) has faced some of the policy challenges that are similar to those other central banks have faced after the Global Financial Crisis (GFC).

- A lower real 'equilibrium interest rate' (EIR), which, everything else equal, implies that the probability of hitting the effective lower bound (ELB) on nominal policy rates has increased. At the same time, monetary policy could possibly be tighter than desired if rates are set based on earlier, higher estimates of the EIR.
- An unusually long period of economic slack and inflation below target, and with important external downside risks, including a China hard landing and stagnation in advanced economy trading partners.
- A difficult international environment. Market participants have been expecting that major central banks will peg their policy rates for a longer time or, in the case of the United States, raise them more gradually. With Australia's relatively higher policy rate and bond yields, exchange rates have responded to rate differentials in these circumstances, with possible appreciation pressures interfering with the 'shock absorber' role of flexible exchange rates.

3. The paper analyzes three monetary policy issues in light of these challenges.

- How expansionary has the RBA's monetary policy stance been, given the decline in the EIR?
- What should monetary policy do under current conditions? Easier for longer? A larger reaction to contractionary shocks to avoid dark corners? Coordination with fiscal policy?
- What are implications for the conduct of monetary policy? Greater transparency to improve the efficacy of monetary policy?

4. The structure of the paper is as follows. Section B provides an overview of Australia's IT framework since the early 1990s and current policy challenges. Section C looks at how much the EIR has declined in Australia and its impact on policy. Section D provides an overview of the Inflation Forecast Targeting (IFT) framework, with a focus on how IFT works as policy rates approach the ELB. Section E presents a 'prudent risk-management strategy' to deal with issues related to anemic global growth and low levels of the real EIR and commodity prices. Section F concludes by offering main policy recommendations.

B. Current Monetary Policy Framework and Challenges

Australia's Monetary Policy Framework

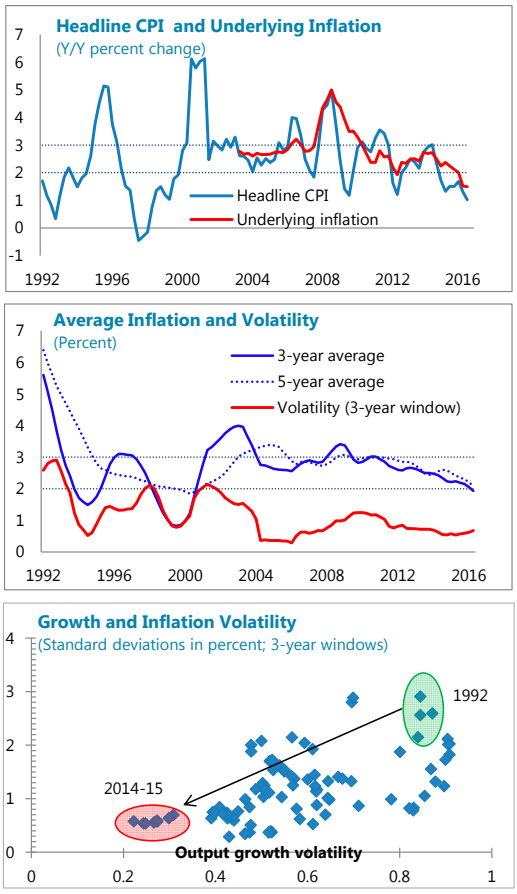
5. Australia informally moved to an Inflation Targeting (IT) regime in 1993, seeking to achieve an inflation rate of 2–3 percent, on average, over the cycle. The inflation objective was subsequently formalized in 1996 in the first *Statement on the Conduct of Monetary Policy* by the Governor of the RBA and the Treasurer of the time. More recently, the core understandings of the Act were reiterated stating that an appropriate goal is to keep consumer price inflation between 2 and 3 percent, on average, over time (RBA, 2016).

6. Australia has been among the most successful IT countries. Headline inflation has been low with inflation broadly stable around the range since about 2003 as episodes of inflation outside the band have generally been short-lived. In addition, macroeconomic volatility as measured by inflation and output volatility has moderated, including after the global financial crisis of 2008 (Figure 1).

7. From the beginning of the IT regime in the 1990s, the RBA has pursued what is now referred to as 'flexible IT', a framework where the central bank also seeks to stabilize output around potential. In fact, the Reserve Bank Act sets out that the RBA pursue policies that contribute to stability of the currency as well as full employment and the economic prosperity and welfare of the people of Australia.

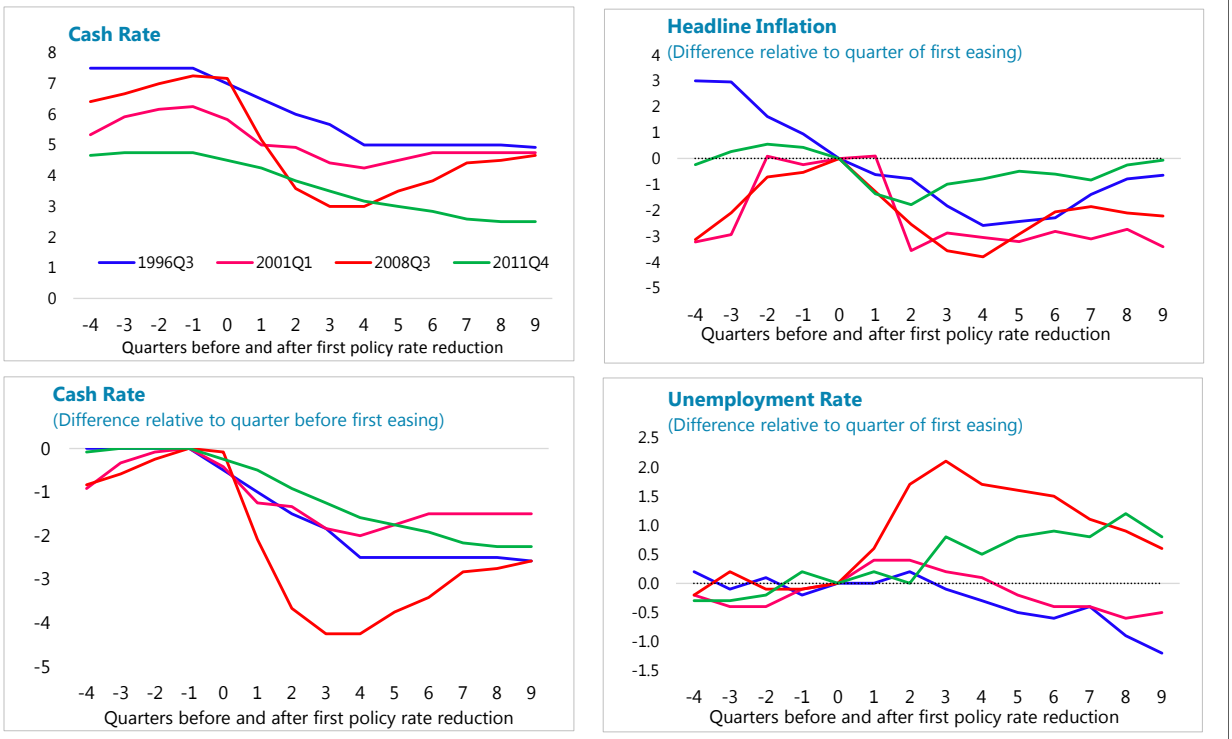
8. The tradition of 'flexible IT' in Australia is best illustrated by looking at past episodes of monetary easing (Figure 2). The cash rate—the monetary policy instrument—was lowered when subsequent declines in inflation or increases in unemployment were expected. The episode beginning in 1996Q3 (blue line) stands out; despite unemployment being broadly stable it was inflation which had been falling considerably for several quarters (as driven by global commodity price disinflation in the wake of the Asian Financial Crisis) that triggered a sustained policy easing. The 2008 episode (red line) is also notable in the decisive easing carried out over a three-quarter period, driven predominantly by concerns about higher unemployment. In other episodes, the easing was more gradual.

Figure 1. Australia: Inflation and Macroeconomic Volatility



Sources: Haver Analytics; and IMF staff calculations.

Figure 2. Australia: Episodes of Monetary Policy Easing

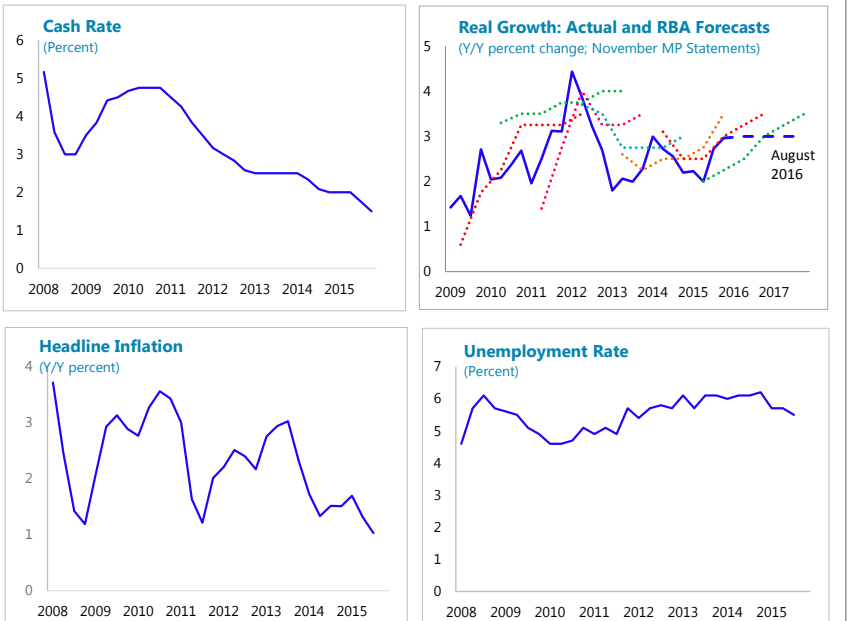


Sources: Haver Analytics; and IMF staff calculations.

Monetary Policy in the Wake of the Global Financial Crisis

9. With decisive macroeconomic policy responses, Australia only experienced a short, moderate growth slowdown during the global financial crisis. Growth had already recovered strongly in early 2009 as commodity prices rebounded mid-year. The mining investment boom was still accelerating at the time, with inflation within the target range by the end of 2009. Against this backdrop, the RBA started tightening in the last quarter of 2009 (Figure 3).

Figure 3. Monetary Policy After the Global Financial Crisis



Sources: Reserve Bank of Australia; Haver Analytics; and IMF staff calculations.

10. In the third quarter of 2011, Australia's terms of trade peaked and started falling thereafter, prompting a strong reaction by the RBA. The policy rate was lowered but less so than during the global financial crisis as the increase in unemployment that followed the commodity price bust was small compared to previous economic downturns. The inflation decline was short-lived. In early 2013, the easing cycle ended. In its *Statements on Monetary Policy*, the RBA noted that it expected robust growth going forward (Figure 3-upper right panel) and that it projected inflation to remain in the target range.

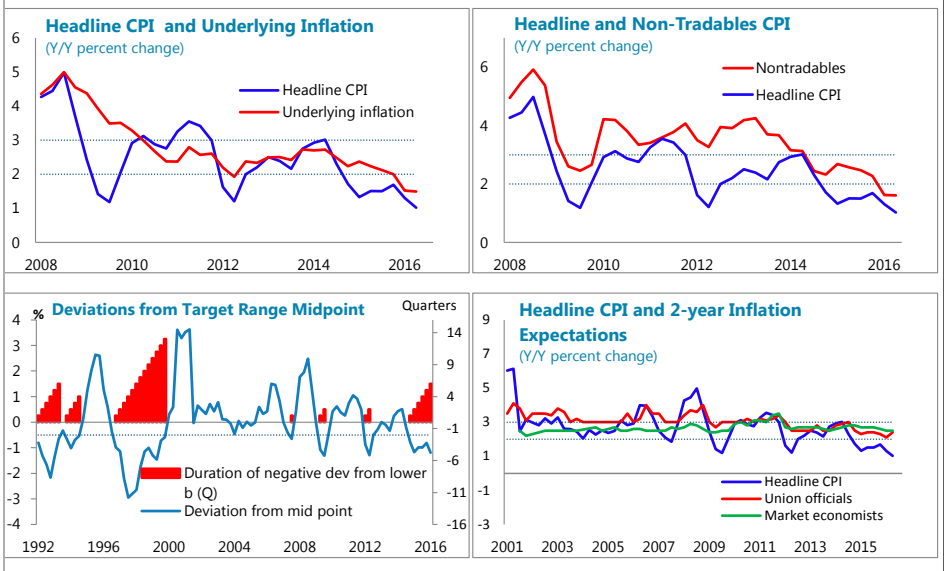
11. But during 2014, Australia experienced its own version of a delayed, weaker recovery. Unemployment, while still lower than in earlier downturns, remained above 6 percent, and inflation declined during the year. Initially, most of the disinflation was due to renewed declines in global commodity prices. Over time, however, non-tradables inflation also weakened.

12. The RBA adopted a wait-and-see attitude and only lowered rates in early 2015. In its *Statements,* the RBA indicated throughout 2014 that it projected inflation to remain in the target range. At the same time, it also signaled that it expected a further lift in growth from depreciation and further support to domestic demand from low interest rates. In February 2015, however, the RBA lowered the policy rate, noting that growth had remained below trend for longer than expected and that the expected pick up had not materialized, and followed up with another cut in May.

13. While growth picked up in the second half of 2015, inflation weakened further. After a sizeable inflation surprise on the downside in 2016Q1, the RBA lowered the policy rate in May 2016, shortly after the data had been released and then again in August 2016.

14. Headline inflation has been below the lower bound of the inflation target range before, but such deviations were typically shorter lived (Figure 4). The current episode has been longer lasting than all but one previous episode—the deviation lasted longer during the Asian Financial Crisis—and it is the first time that both non-tradables and underlying inflation are below target. These facts highlight the new challenges that the current episodes pose for monetary policy in Australia.

Figure 4. Australia: Inflation Developments after the Global Financial Crisis



Sources: Haver Analytics; and IMF staff calculations.

Current Challenges and Monetary Strategy Going Forward

15. Monetary policy in Australia faces three sets of challenges going forward—challenges that are similar to those that central banks in other advanced economies have faced. The first set relates to a different, more difficult economic environment, notably inflation undershooting the target, declining inflation expectations, persistent labor market slack, and strong external disinflationary forces and, more broadly, a less supportive international growth environment than during the 1990s and 2000s. The second set relates to the lower EIR. Finally, the third set of challenges relates to the monetary policy time horizon and policy communication.

16. These challenges raise the question of what they imply for the optimal monetary policy strategy going forward. As detailed below, the paper argues that a 'prudent risk-management strategy' in the current situation would aim to avoid 'dark corners', where the economy could get stuck in a low inflation and low growth trap. Put differently, a "low for longer" strategy would be best suited to minimize those risks. If there were to be a sizable downside shock, leading to persistent economic slack and inflation expectations ratcheting downwards, monetary policy might be less effective in responding adequately to adverse shocks, given its proximity to the ELB. Once low inflation becomes entrenched, it could be very difficult to correct, leading to economic costs that can be considerable (such as those incurred, for example, in Japan and the euro area).

17. Such strategy should entail using conventional policy instruments more effectively, and even taking unconventional measures if the situation dictates. Strengthening central bank communication could be an important contribution towards enhancing policy effectiveness. Preparatory steps in unconventional measures, such as large-scale asset purchases, funding for credit, or negative interest rates, would also help equip policymakers with the tools to deal with shocks that could drive the economy off course.

C. The Equilibrium Interest Rate (EIR) in Australia: How Much Lower Is It?

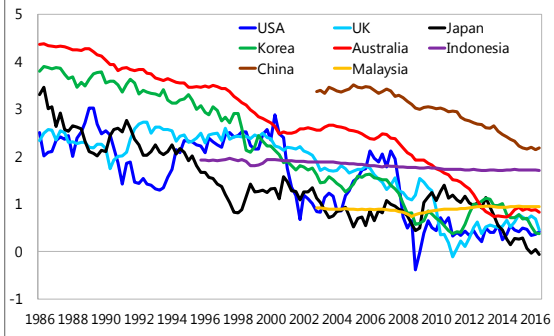
18. Defining the EIR. The EIR is a benchmark for assessing the extent to which current monetary policy settings are either contractionary or expansionary. It is defined as the policy rate consistent with inflation being at the target and output at its potential level (full employment). In a standard macroeconomic model, an IT central bank would vary the policy rate from this equilibrium level to return inflation to the target and to manage the short-term output-inflation trade-off. The EIR is unobservable and must be estimated. Given substantial model uncertainty, a good deal of judgment is also needed.[2]

[2] Such uncertainty is not a new phenomenon. Central banks continually monitor the economy for possible changes. Signs that the EIR may be changing are initially incorporated into the Bank's risk assessment when setting policy. If the economy shows clear signs of a change in the equilibrium rate, the Bank will formally change its estimate in its modeling frameworks. See for example., the Czech National Bank's *Inflation Report* (2013), Box 2 "New steady state settings in the g3 model", CNB's third generation forecasting model, and RBNZ's Structural Model for Policy Analysis and Forecasting—Kamber and others (2015).

19. Factors influencing the EIR. For open economies with high capital mobility, such as Australia, the domestic rate will be strongly driven by global interest rates, that is, the EIRs in other major economies. But the two rates may differ due to country-specific factors, notably a country risk premium. In the Australian case, the country risk premium is likely to depend in part on its net foreign liabilities and related perceptions of repayment risks.

20. Downward trend in global and regional (real) EIRs. Inflation-adjusted bond yields have seen a trend decline worldwide since the early 1980s (Rachel and Smith, 2015). A renewed drop after the onset of the global financial crisis, accompanied by low inflation and weak output growth has led to substantial downward revisions of the real EIR. The declining trends are noted in the estimated real values in selected Asian countries, and in much of the developed world, using the Lubik-Matthes (2015) methodology (Figure 5). With respect to the U.S. neutral rate, given its global importance, Summers (2015) has cited a wide variance in estimates ranging between -3 and 1.75 percent. Obstfeld and others (2016) attribute the differences in estimates to differences in the definition of shocks. Higher estimates of the EIR, at or above 1 percent, consider the serial growth disappointments to reflect a series of transitory shocks. Lower estimates, near or below zero, classify the disappointments to reflect a permanent shock to medium-term growth. Looking back, the repeated downgrades of forecasts, the persistence of below-target inflation, and the declines in actual real rates all suggest that policy makers and markets have been underestimating the headwinds to growth and recovery.

Figure 5. Estimated Real Natural Rates of Interest
(Percent)



Sources: Haver Analytics database; and IMF staff calculations.

21. Estimating the EIR in Australia. In recent years, while the level of the cash rate has remained low by historical standards, the persistence of a negative output gap has been protracted. Combined with low inflation, this suggests that equilibrium rates may have fallen, and the same level of the cash rate may not provide as much stimulus as it did historically. In Box 1, we report estimates of the EIR in Australia using a number of approaches. All of them point to a decline in the real EIR to around 1 percent.

22. Implications of low EIR for monetary policy. With a real EIR of around 1 percent, RBA faces relatively greater risks of reaching the ELB of about 1 percent than it would if the EIR were higher.[3] Hence, it could face a situation where there is little room for a monetary policy response to negative shocks with the conventional cash rate tool and it will be important to explore the scope for unconventional measures. Concerns about risks to financial stability from low interest rates can be addressed through banking supervision and prudential policies, with a view to curbing excessive leverage by financial intermediaries, firms, and households.

[3] Lowe (2012) alludes to '1% plus or minus a bit' as a threshold representing ELB, where the incremental benefit of further cuts is 'quite small' and 'other options of unconventional monetary policy become more viable'.

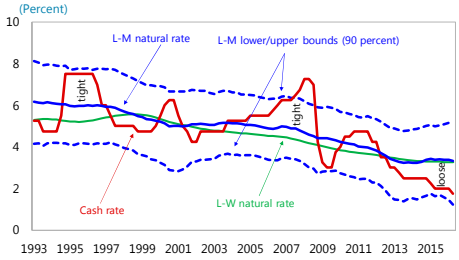
Box 1. Estimates of the Australian Equilibrium Interest Rate

Given the uncertainty in estimating the EIR, a mix of empirically, semi-structurally, and statistically-driven approaches are deployed. All three methods point to large drops in the real EIR in Australia to levels near 1 percent. This implies that monetary stimulus in the economy would be less than widely thought.

- Methodologies # 1 and # 2 are empirically-driven and are subject to large statistical uncertainty. The first one uses the Laubach and Williams (2013 and 2015) (L-W) method which has some underpinnings in theoretical models of the economy; and the second by Lubik and Matthes (2015) (L-M) follows an even less structural approach, known as the time-varying parameter vector autoregressive (TVP-VAR) approach.[1] For a fuller description of these approaches see the referenced papers. The empirical approaches do not impose interest rate linkages and are only influenced by Australian variables to draw out long term relationships, including trends in real GDP, which in turn depend on productivity growth and population.
- Methodology # 3 follows an indicative approach to estimate the EIR. It is based on a simple Hodrick-Prescott (HP) univariate filtering approach to estimate trends in real interest rates. HP-filtered trends in real 10-year, 90-day and floating (standard) mortgage interest rates are estimated.

The L-W and L-M based estimates both point to a secular decline in the nominal natural rate. Expressed in real terms, this rate has fallen from an average of about 3 percent in the early 1990s to 0.8 percent in the second quarter of 2016, while at no point do the values turn negative. Commenting further on the estimated paths, since the early 2000s, the rates exhibited notable drops during the economic slowdown periods (2000Q4 and 2008Q4). In addition, the natural rate has been above the cash rate through most of the post-GFC recovery which indicate that monetary policy has been in a 'loose' stance (i.e., a period of monetary stimulus), except for a brief period of time around 2011. Given the high uncertainty surrounding this measure, considering the lower bound of the 90 percent confidence region for example, would point to a prevalent 'tight' policy (i.e. a period of monetary contraction). Furthermore, projecting to end of 2021, with output gap near zero and inflation close to 2.5 percent, an appropriate monetary policy setting at that time should be close to neutral (where the cash and the equilibrium rates ought to converge). An appropriate projection for the nominal natural cash rate is close to 3.0 percent (as per the latest WEO projections).

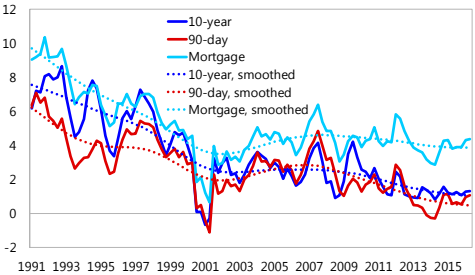
Equilibrium Nominal Interest Rates and Cash Rate
(Percent)



Sources: L-M natural rate is based on Staff Estimates using a (TVP-VAR) model. The solid blue line marks the median posterior estimator and the dashed blue lines indicate the upper and lower bounds of the 90 percent confidence region.L-W natural rate uses updated estimates from the FRBSF.

Indicative HP-based estimates (with stiffness parameter λ=1,600) show downward-trending real interest rates. For instance, the steady fall in the real 10-year interest rate (from over 3 percent in 2000 to just 1 percent in 2016Q2) suggests that markets expect rates will be lower for some time to come as this rate (an indication of expected returns over a longer period) largely looks through cyclical (weak or strong) periods.

Real Interest Rates 1/
(Percent)



Sources: Haver Analytics database; and IMF staff calculations.
1/ Trend real interest rates calculated using Hodrick Prescott filter.

In the model below, the global interest rate linkages are imposed unlike in the first two methodologies. We also think that the neutral rate in Australia is significantly driven by neutral rates in other major economies, and to the extent that these have declined, as per estimates of other authors, the neutral rate in Australia should have declined as well.

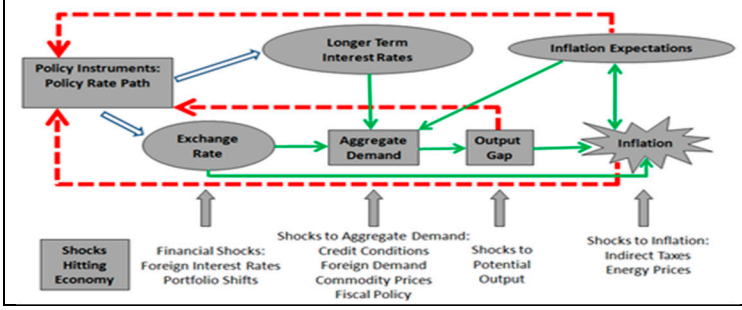
[1]TVP-VAR estimates for three variables, the real GDP growth, inflation and a measure of real rate are calculated. The conditional long horizon forecast (over 5 years) of the observed real rate is used as a measure of neutral rate.

23. Are low interest rates here to stay? A debate is ongoing as to how far the neutral rates have declined since the crisis, how persistent or permanent they are, and what do they actually mean for monetary policy in terms of more frequent and longer episodes of constrained policy at the ELB (Reifschneider and Williams, 2000). One view is that the unusual decline and the long period over which they persisted have represented unusually long-lasting effects of the recession but eventually they will return to more normal levels (Bean and others, 2015 and Hamilton and others, 2015). Others, including Summers (2016) and Brainard (2016), perceive a continuing decline in the rates with no basis for supposing they will increase. For a description of the likely contributors to a persistent low neutral rate, see Brainard (2015) and Goodfriend (2016).

D. Inflation-Forecast Targeting Under Current Conditions: Some Conceptual Issues

24. Inflation-Forecast Targeting (IFT) is based on the principle that, given a long-term objective for the rate of inflation, the central bank's own forecast of inflation is an ideal intermediate target. The inflation forecast is an ideal intermediate target as it would embody all the relevant information available to the central bank, including knowledge of the policymakers' preferences with respect to the trade-off between deviations of inflation from target and output from potential, and the central bank's view of the monetary policy transmission mechanism (Svensson, 1997).

Figure 6. A Monetary Transmission Mechanism



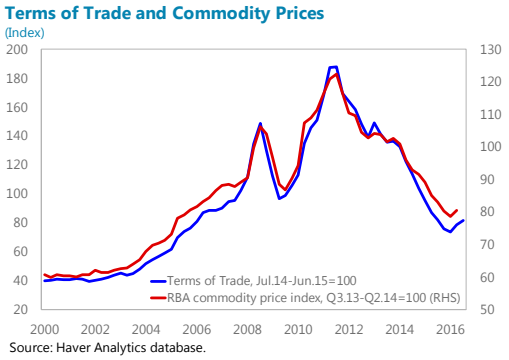
25. A key aspect of IFT is that the policy interest rate should respond in a predictable way to shocks. It should be set so as to minimize deviations of actual inflation from its objective, while taking account of the implications on output. This policy feedback, via the short-term interest rate, ensures that the nominal anchor holds—the future expected path of the policy interest rate is adjusted when unanticipated disturbances hit the economy, in order to bring inflation back to the target gradually over a period of time that limits the disruptions to output. Many central banks incorporate this principle into their forecasting models and thus produce an endogenous path for the interest rate. This strategy differs from other IT approaches (relying on exogenous forecast interest rate paths, or paths derived from market forward rates) which lack the feedback from the expected future inflation rate and output gap to the policy instrument (which is represented by the red-dashed feedback arrows in Figure 6).

26. Expectations of future policy rate movements over the short-to-medium term play a crucial role in the transmission mechanism under IFT. The overnight cash rate directly controlled by the central bank has a key role in influencing the cost of borrowing for businesses and households given the predominance of variable rate, rather than fixed rate, debt. Consequently, expectations about the path of this rate have an important role of play in shaping household and business decisions. Obviously, there are other important channels besides the direct lending channel through which monetary policy can affect real activities, such as wealth, balance sheet and cash flow channels. Those channels are not explicitly modeled in our illustrative simulations below, which are based on a core model of the Australian economy (Section E).

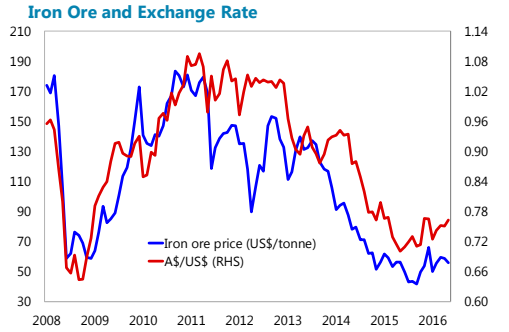
27. The exchange rate acts as a 'shock absorber' for the economy under IFT. This is of particular importance for commodity exporters such as Australia. In the case of a negative terms-of-trade shock, the exchange rate would depreciate, which facilitates resource allocation by stimulating exports and compressing imports. Historically, Australia's terms of trade have been volatile, as is reflected in the RBA-Index of Commodity Prices, ICP (Figure 7-Panel 1). The terms of trade rose by 85 percent from the average of the early 2000s and reached an all-time high in late 2011. It fell 36 percent from its peak but is expected to be nearing a floor soon, albeit at a level that is 25 percent above its pre-boom level (see Kulish and Rees, 2015). The exchange rate against the U.S. dollar has been allowed to vary over a wide range, absorbing large shocks to the terms of trade (Figure 7-Panel 2). Despite the shock absorber role played by the exchange rate, the recent terms-of-trade slump has exerted a large negative shock to real domestic income (Figure 7-Panel 3).

28. When the economy is at or close to the ELB where the nominal interest rate cannot further decline, a transmission mechanism, albeit somewhat weakened, could still apply, through inflation expectations. Consider a negative demand shock. In response to a contractionary shock, during normal times an IFT central bank would be expected to lower the policy rate path sufficiently to steer inflation back to target. At the ELB, under a credible regime, financial market participants would expect that inflation would go back to the target over the

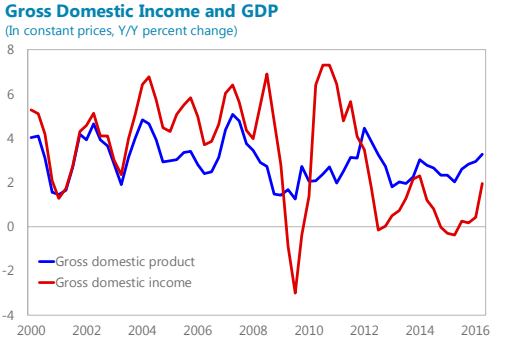
Figure 7. Terms of Trade, Exchange Rate, and the Real Income



Source: Haver Analytics database.



Sources: Bloomberg; and Haver Analytics database.



Source: Haver Analytics database.

medium term. This would cause the expected future path of real interest rates to decline. Under a risk-adjusted uncovered interest parity condition, given unchanged long-term real exchange rate and (expected paths for) foreign real interest rates, a real depreciation would occur which in turn would help support demand, through both exports and domestic expenditure switching (from foreign to domestic goods). In summary, inflation expectations would act as a shock absorber under an active and credible monetary policy regime even when the economy is constrained by the ELB. To manage expectations, which might be difficult in practice, the central bank would publish a forecast which shows that the interest rate would be kept low for long enough to allow inflation to rise, or even to overshoot the long-term target before it returns to the target from above. To ensure the overshooting path for inflation is credible, it may have to be backed by fiscal or other policies that would stimulate the economy, including unconventional monetary policy. For further details, see Obstfeld and others (2016) and Appendix I. To ensure that the path for inflation and the output gap is credible, the central bank might have to use other instruments (quantitative easing, funding for credit, or others.) or even be backed up by fiscal measures.

E. Optimal Monetary Policy under Current Conditions: Illustrative Simulations of a 'Prudent Risk-Management Strategy'

29. Under current circumstances, an effective monetary policy should counteract the possible risk of persistent disinflation building up and prolonged weakness in demand settling in. Under the current baseline, a 'prudent risk-management strategy' should result in a more aggressive cut in interest rates in the future compared to a standard monetary policy reaction function to eliminate the economic slack faster, while also taking into consideration financial stability risks when deciding on the speed with which to bring inflation back to target. To lower risks of 'dark corners', prudent policies call for both monetary and fiscal stimuli, in the event that further contractionary shocks (lower global growth, equilibrium world real interest rates and commodity prices) were to materialize.

30. The paper uses an open-economy New Keynesian model to derive the optimal monetary policy strategy under current conditions. It illustrates the strategy under both a 'baseline' and an alternative 'downside scenario'. The model we use bears similarities to those used at many central banks for forecasting and policy analysis. It has a standard core structure, with equations for the output gap, core inflation, the policy interest rate, and the exchange rate. Expectations are forward-looking, consistent with the projections of the model itself, but the behavioral equations also embody significant lags and rigidities. In addition, the model has equations for headline, food and energy inflation, the commodity terms of trade, trade and financial linkages with the rest of the world, and bond yields of various maturities. It exhibits some nonlinearities, primarily as a result of the ELB constraint and its implications for the monetary policy. The model is calibrated with reference to both historical data and existing theoretical literature to ensure that it plausibly replicates historical data and generates sensible projections. Appendix II contains the model equations and parameter values. As a caveat, it should be noted that in practice, real-time forecasts also involve a substantial deal of judgment and data analysis, given the well-known problems with simple model-driven projections in the short term. That said, the model

simulations under given forecasts and preferences, can demonstrate the key features of an optimal monetary policy strategy.

Three Different Policy Strategies under the Baseline Scenario

31. The baseline scenario is based on benign assumptions of a gradual recovery of the economy going forward, with initial conditions reflecting the Australian's economy conditions as of 2016Q3. The output gap starts at -1.3 percent (excess supply), the year-on-year headline inflation rate at 1.3 percent, and the cash rate at 1.5 percent (assumed to be declining to 1.3 percent by end-2017 as priced by the market).

32. A monetary policy strategy responding to the near-term inflation outlook and current slack would result in a slow recovery. The blue line in Figure 8 is the results for a standard monetary policy reaction function, specifically, an inflation-forecast-based (IFB) reaction function, where the interest rate is set sequentially as a function of the expected year-on-year inflation rate one year into the future and the contemporaneous output gap. Under this scenario, the policy rate is first lowered modestly and then increased gradually over time. This results in a depreciation of the Australian dollar that helps support the economy and a gradual closing of the output gap. Under this scenario, inflation stays below the RBA's 2-3 percent inflation target range for several years.

33. The optimal monetary policy strategy is to respond with a "low for longer" policy, leading to a faster return of inflation to target and output to potential. Here, the optimal policy response is a path of policy rates throughout the projection horizon that is derived by minimizing a loss function which places equal weights on output gap and inflation deviations, rather than a path produced based on an interest rate reaction function, (see Appendix II for more detail). Such a forward-looking policy strategy would put a premium on avoiding 'dark corners', in which the economy gets stuck in a bad equilibrium and becomes resistant to conventional policy instruments. In other words, the optimal policy response is equivalent to a "prudent risk management strategy" that sets policies so as to avert possible prolonged periods of excessive economic slack. Under this case, the policy rate would be cut significantly over a few quarters, falling to 0.75 percent before it increases gradually.[4] As a result, the output gap closes much faster and inflation returns inside the 2-3 percent target range shortly over the next few quarters. Furthermore, with interest rates lower for longer, the Australian dollar depreciates by an additional 6 percent.

34. A combined monetary-fiscal policy response would provide for an even faster return to internal balance while leaving monetary policy space.[5] In this vein, we consider augmenting the 'prudent risk-management strategy' with fiscal support. Under this scenario, which is designed

[4] Based on Lowe (2012), a below 1 percent cash rate can be regarded as the ELB in Australia.

[5] In light of factors challenging monetary policy effectiveness, complementary fiscal (for e.g., well-calibrated infrastructure spending fiscal stimulus) and structural policies (geared at enticing the private sector to increase own spending) are argued to be complementary, efficient and better-targeted policies to tackle distortions in output, growth and employment at their source. See Lowe (2016) and Gaspar and others (2016).

to close the output gap even faster, monetary policy faces a lower burden. Policy rates do not decline as much, and as a result, there is less of a depreciation in the Australian dollar. This leaves the RBA with more space to respond to potential contractionary shocks in the future.[6]

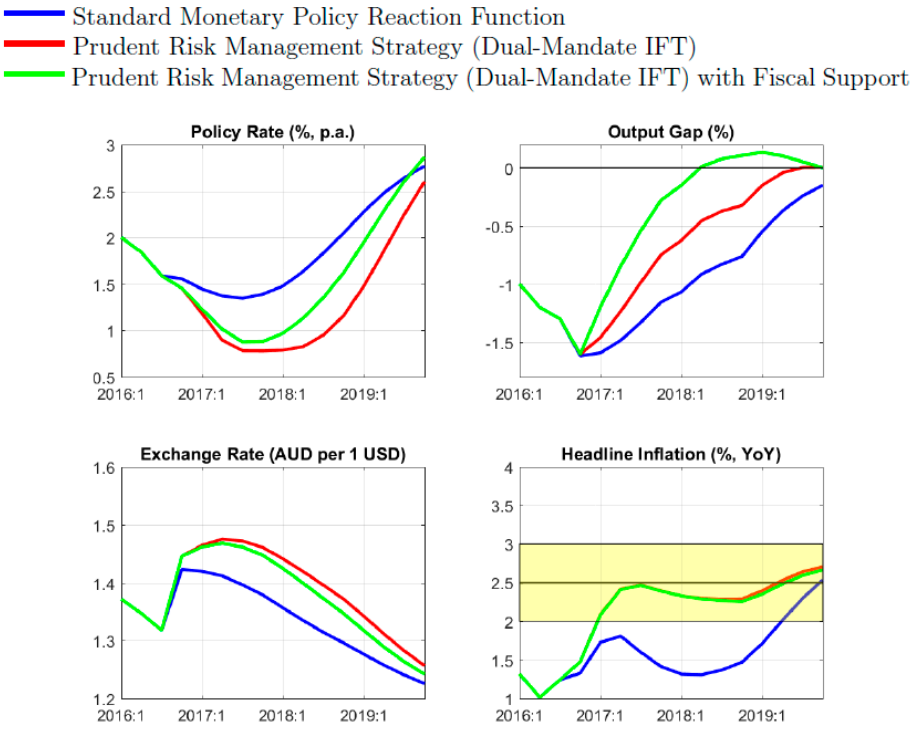
Downside Scenario: China's Economic Growth Surprises on the Downside

35. A disappointing external environment may require a 'low for longer' strategy for monetary policy. Figure 9 considers alternative simulations where China's economic growth surprises on the downside. This has significant spillover effects on the rest of the world and a sizable impact on commodity prices. This downside scenario implies an opening up of the effective foreign output gap relevant for the Australian economy (defined as export-weighted output gaps for Australia's main trading partners). Specifically, the effective foreign output gap is 2.3 percentage points lower and metal prices are 5.3 percent lower at the trough compared to the baseline. Under the *black line*, in anticipation of the negative shocks, the policy rate declines to the ELB (assumed to be 0.75 percent) and stays there for 2 years. This results in a further depreciation in the Australian dollar that helps support the economy. However, a sizable negative output gap remains for the Australian economy as it is largely dominated by the magnitude of the negative shock. Headline inflation slightly overshoots the 2.5 percent mid-point of the RBA's 2-3 percent inflation target range.

36. A coordinated monetary-fiscal policy would provide a much-needed shot in the arm for the Australian economy if the downside shocks were to materialize. Under the *red line*, a direct fiscal stimulus is used to help deal with the negative external shocks hitting the Australian economy. The direct effects of the fiscal stimulus are equal to 0.25 percent of GDP for 2017-18. Monetary policy provides the 'supporting role' to a much-welcomed fiscal expansion by cutting the policy rate aggressively to its lower bound faster than under the previous case. This helps raise inflation and generate a modest overshoot of inflation above the upper bound of the 2-3 percent target range over the medium term. This planned overshoot of inflation raises inflation expectations and reduces the real interest rates, which combined with more depreciated exchange rate helps close the output gap much faster. A faster recovery of the economy under this more accommodative strategy allows monetary policy to normalize earlier than under the previous case.

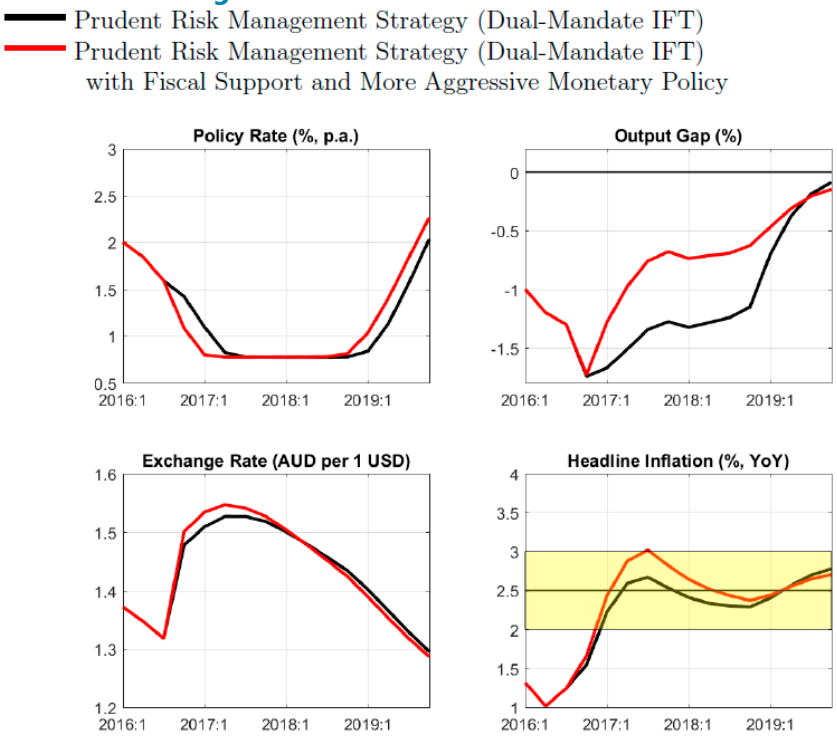
[6] For the purpose of this paper, these fiscal measures are left unspecified. More detailed analysis pertaining to a desirable fiscal policy package identifying instruments with potentially high multiplier effects is dealt with in the accompanying paper entitled "Australia's Fiscal Framework: Issues and Options for Reform," in particular, Box 2.

Figure 8. Baseline Conditional Projections (Alternative Monetary and Fiscal Assumptions)



Source: Authors' simulations.

Figure 9. Downside China Scenario



Source: Authors' simulations.

F. Conclusions

37. The analysis in this paper shows how the RBA could use a 'prudent risk-management strategy' to leverage its conventional policy instruments to avoid "dark corners." By extending the commitment to keep interest rates 'low for long' enough, inflation should eventually start to increase. Inflation expectations would also rise, implying that the real interest rates would decline, and the exchange rate would depreciate. In addition, the analysis also highlights that fiscal policy easing might be critical to support monetary policy; the latter could be largely aided by fiscal support which has a direct effect on demand and reduces the length of time over which the policy rate stays at the lower bound.

38. Policy credibility and the task of anchoring inflation expectations could benefit from a more forecast-oriented communications of the RBA. A reorientation could include more explicit discussion of how the RBA intends to use its policy instruments over time to bring inflation back to target, emphasizing the 'conditionality' of the path and the fact that it is a 'forecast' and not a 'commitment'. The experience in New Zealand (since 1997), Norway (since 2005), Sweden and the Czech Republic (since 2008) suggests that the financial market participants learn fairly quickly about the 'conditional forecast' nature of the path. The importance of such forward guidance on policies would likely increase as the policy rates come closer to the ELB. Such communication would lower risks of drifting inflation expectations at the ELB.

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Appendix I. Exchange Rate and Asset Prices as Shock Absorbers or Amplifiers

The risk-adjusted uncovered interest parity (UIP) condition

This condition, under perfect foresight, may be written as

$$i_t - (i_t^f + \chi_t) = s_{t+1} - s_t ,$$

where i_t is domestic interest rate, i_t^f is foreign interest rate, χ_t is domestic risk premium, s_t is nominal price of foreign exchange. That is, the future change in the exchange rate compensates for any interest differential, such that the return adjusted for change in the exchange rate and the risk premium is the same in either currency.

One period ahead we have

$$i_{t+1} - (i_{t+1}^f + \chi_{t+1}) = s_{t+2} - s_{t+1} .$$

Going forward we have

$$i_{t+2} - (i_{t+2}^f + \chi_{t+2}) = s_{t+3} - s_{t+2} ,$$

...

such that this holds for any time t:

$$i_{t+k} - (i_{t+k}^f + \chi_{t+k}) = s_{t+k+1} - s_{t+k} .$$

Summing up all the equations, from time t to $t+k$, yields

$$i_t + i_{t+2} \ldots + i_{t+k} - (i_t^f + \chi_t) - \ldots - (i_{t+k}^f + \chi_{t+k}) = (s_{t+1} - s_t) + (s_{t+2} - s_{t+1}) + \ldots + (s_{t+k+1} - s_{t+k}) ,$$

or equivalently,

$$\sum_{j=0}^{k} i_{t+j} - \sum_{j=0}^{k} (i_{t+j}^f + \chi_{t+j}) = s_{t+k+1} - s_t .$$

Rearranging, we get

$$\sum_{j=0}^{k} i_{t+j} = s_{t+k+1} - s_t + \sum_{j=0}^{k} (i_{t+j}^f + \chi_{t+j}) .$$

The same equation holds in real terms,

$$\sum_{j=0}^{k} r_{t+j} = z_{t+k+1} - z_t + \sum_{j=0}^{k} (r_{t+j}^f + \chi_{t+j}) ,$$

where r_t is real interest rate, and z_t is real exchange rate defined as

$$z_t = s_t + p_t^f - p_t \ .$$

Real exchange rate as shock absorber

Under normal times with active policy, a negative demand shock reduces inflation in the short term, but does not affect the long-term real exchange rate (z_{t+k+1}). An IFT central bank is expected in normal times to reduce the policy rate sufficiently to steer inflation back to target. This expectation would, through the UIP condition, lead to an immediate depreciation of the currency: the spot price of foreign exchange has to rise (=depreciates) to the point that the expected decrease (=appreciation) from then on compensates for the lower domestic interest rate.

Under a credible regime of aggressive policy responses, the expected medium-term inflation rate would also increase. The decline in real interest rates would be greater than that in nominal rates. At the ZLB, the current nominal interest rate cannot go any lower, but under the aggressive regime people would expect the future nominal interest to be zero for longer, and because of the anticipated increase in inflation, real interest rates would decline. Thus in both normal times, and during the ZLB, we have ($\downarrow \sum_{j=0}^{k} r_{t+j}$). Given that the long-term real exchange rate (z_{t+k+1}) and expected paths for foreign real interest rates $\sum_{j=0}^{k}(r_{t+j}^f + \mu_{t+j})$ do not change, this would result in a real depreciation ($\uparrow z_t$),

$$\downarrow \sum_{j=0}^{k} r_{t+j} = z_{t+k+1} - \uparrow z_t + \sum_{j=0}^{k}(r_{t+j}^f + \mu_{t+j}) .$$

This helps support demand, through both exports and domestic expenditure switching (from foreign goods to domestic goods).

Real exchange rate as shock amplifier

At the ZLB, the exchange rate can act as a shock amplifier. If policy is passive, and not credible, following a negative demand shock, people would expect the inflation rate in the future to be lower. Current and future short-term real interest rates could increase ($\uparrow \sum_{j=0}^{k} r_{t+j}$), resulting in a real appreciation ($\downarrow z_t$):

$$\uparrow \sum_{j=0}^{k} r_{t+j} = z_{t+k+1} - \downarrow z_t + \sum_{j=0}^{k}(r_{t+j}^f + \mu_{t+j}) .$$

This would reduce net exports and further deepen the recession.

Asset prices as shock absorber or amplifier

A similar argument holds for asset prices as for the exchange rate. A credible aggressive policy response would cause increases in asset prices (through the positive impact on profits of currency depreciation, and the effect of lower real discount rate on asset valuations). A non-credible, passive response would do the reverse. Thus depending on the policy regime, asset prices too may act as a buffer or an amplifier for the impact of shocks.

Appendix II. A New-Keynesian Model for Australia

A.II.1. IS Equation

The output gap ($\hat{y}_t$) is defined as the difference between the log-level of output (y_t) and potential output ($\bar{y}_t$). The IS equation relates Australia's output gap ($\hat{y}_t$) to past and expected future output gaps, the deviations of the lagged one-year real interest rate ($r4_t$) and the real effective exchange rate ($reer_t$) from their equilibrium values, and the rest-of-the-world output gap. The metal price gap (Δrp_t^{Metal}) also affects the output gap in a significant way.[1]

$$y_t = \bar{y}_t + \hat{y}_t$$

$$\hat{y}_t = \underset{(0.5)}{\beta_1}\,\hat{y}_{t-1} + \underset{(0.1)}{\beta_2}\,\hat{y}_{t+1} + \underset{(-0.1)}{\beta_3}(r4_{t-1} - \bar{r}4_{t-1}) + \underset{(0.01)}{\beta_4}(reer_{t-1} - \bar{reer}_{t-1}) + \underset{(0.1)}{\beta_5}\,\hat{y}_t^{World} + \underset{(0.01)}{\beta_6}\,\Delta rp_t^{Metal} + \varepsilon_t^{\hat{y}}$$

where, the four-quarter average equilibrium real interest rate ($r4_t$)is defined as

$$r4_t = (r_t + r_{t+1} + r_{t+2} + r_{t+3})/4$$

A.II.2. Phillips Curve

In the Phillips curve, the core inflation rate (π_t^C) depends on inflation expectations ($E\pi_t^C$) and past year-on-year core inflation ($\pi 4_{t-1}^C$), with coefficients on both terms adding up to one. The lagged term reflects the intrinsic inflation inertia, resulting from contracts, costs of changing list prices, etc. Inflation expectations are pinned down by the model-consistent solution of the year-on-year inflation one year ahead ($\pi 4_{t+4}^C$). Core inflation depends on lagged output gap in a non-linear way. Core inflation also depends on the rate of real effective exchange rate depreciation, as well as the deviation of the real effective exchange rate from its equilibrium value, as a real depreciation raises the domestic cost of imported intermediate inputs and final goods, creating upward pressure on prices. Finally, we allow some small pass-through from oil and food price inflation to core inflation. This is captured by adding the two terms on the real price of oil and food adjusted for real exchange rate effects.

$$\pi_t^C = \underset{(0.75)}{\lambda_1 E\pi_t^C} + (1-\lambda_1)\pi 4_{t-1}^C + \underset{(0.2)}{\lambda_2}\,\hat{y}_{t-1} + \underset{(0.025)}{\lambda_3}\Delta reer_{t-1} + \underset{(0.025)}{\lambda_4}\,reer_t + \underset{(0.005)}{\lambda_5}(\Delta rp_t^{Oil} + \hat{z}_t) + \underset{(0.005)}{\lambda_6}(\Delta rp_t^{Food} + \hat{z}_t) + \varepsilon_t^{\pi^C} - \underset{(0.7)}{\lambda_7}\varepsilon_{t-1}^{\pi^C}$$

$$E\pi_t^C = \pi 4_{t+4}^C$$

[1] On calibration, parameter values for three different groups of coefficients affecting the steady state, the dynamics, and the stochastic processes are provided in parentheses below each equation.

A.II.3. Policy Interest Rate: Reaction Function Options

Linear IFB rule

The equation is a fairly standard policy rule. The policy rate takes into account the contemporaneous output gap, as well as the model's forecast of inflation three quarters into the future. An IFB rule ignores shocks to the system that are expected to reverse within the three-quarter policy horizon. More generally, it allows the central bank to take account of all relevant information available to it on future developments over the four-quarter forecast horizon:

$$i_t = \underset{(0.7)}{\gamma_1 i_{t-1}} + (1-\gamma_1)[\underset{(1.2)}{\bar{r}_t + \pi 4^C_{t+4}} + \underset{(0.4)}{\gamma_2(\pi 4^H_{t+4} - \pi^*)} + \gamma_2 \hat{y}_t] + \varepsilon^i_t$$

$$\pi 4_{t+4} = \underbrace{(\pi_{t+4} + \pi_{t+3} + \pi_{t+2}}_{\substack{\text{model forecast of inflation} \\ \text{(depends on all inputs into} \\ \text{forecast including monetary} \\ \text{policy reactions)}}} + \underbrace{\pi_{t+1}}_{\text{partly monitored}}) / 4$$

The nominal interest rate (i_t) is a function of its own lagged value which has the effect of smoothing the interest rate to reflect the fact that, in practice, central banks do not typically change the policy rate in large increments. The policy rate responds to the equilibrium nominal interest rate, as measured by the sum of the equilibrium real interest rate ($\bar{r}_t$) and projected year-on-year core inflation ($\pi 4^C_{t+4}$). The cyclical response of the interest rate is driven by the forecast deviation of projected inflation from its target value (π^*), and by the output gap (*y*): these gap variables determine the policy response to deviations from the two targets of a dual mandate or flexible inflation targeting central bank. The projected year-on-year inflation rate is based on the model forecast of inflation ($\pi_{t+1}, \pi_{t+2}, \pi_{t+3}, \pi_{t+4}$). This formulation has the appropriate property that the real policy interest rate rises in response to an increase in inflation—with a short lag because of the smoothing feature in the adjustment of the nominal rate

Loss minimizing strategy—risk management

This strategy chooses the interest rate path to minimize the discounted current and future losses from inflation deviations from the target, output gaps, and changes in the policy rate. The loss function incorporates the principal objectives of the central bank–expressing an aversion to deviations of output and inflation from desired values that grows ever larger as these deviations increase. It provides more efficient management of the short-term output-inflation tradeoff and is very useful for designing policies to guard against dark corners.[2]

$$Loss_t = \underset{(0.98)\,(1.0)}{\sum_{i=0}^{\infty} \beta^i [\omega_1 (\pi 4^H_{t+i} - \pi^*)^2} + \underset{(1.0)}{\omega_2 \hat{y}^2_{t+i}} + \underset{(0.5)}{\omega_3 (i_{t+i} - i_{t+i-1})^2}]$$

[2] For a technical explanation of the minimization of the loss function see Clinton and others (2015), Annex 5.

The quadratic formulation implies that large errors or deviations are more important in the thinking of central banks than small errors or deviations. The term with the squared change of the policy interest rate prevents very sharp movements in the policy interest rate, which would otherwise occur in the model on a regular basis in response to shocks. Central banks in practice do not typically change interest rates in large steps, and there are sound theoretical reasons for this. By taking account of both current and expected future values of output and inflation, this formulation has the central bank incorporate into its decisions any information currently available that may affect its objectives over the next few quarters. It is worthwhile to note that large deviations are disproportionately more important than small deviations due to rising marginal cost of inflation-targeting errors, output gaps, and interest rate volatility. This is reasonable since policymakers should not even try to avoid small errors (i.e., fine tune), because policy actions are subject to imprecision and uncertainty. The central bank would, however, very much like to avoid recessions, or destabilized inflation expectations and would want to keep the economy far from 'dark corners' where recovery from shocks becomes much more difficult, because of nonlinearities. At the moment, a contractionary shock combined with the ZLB would be the main concern (at least in a lot of advanced economies).

ELB

Under both cases, the interest rate is subject to a lower bound constraint (i^{floor}), which is assumed to be 75 basis points in the historical simulation, consistent with Lowe (2012).

$$i_t \geq i^{floor} \quad (0.75)$$

A.II.4. Real Interest Rates and Real Exchange Rates

The real interest rate (r_t) is defined as the nominal interest rate minus the expected core inflation (π^C_{t+1}).

$$r_t = i_t - \pi^C_{t+1}$$

The bilateral real exchange rate between Australia and the United States (z_t) is defined in terms of Australian core CPI (p^C_t), and in such a way that an increase means a depreciation in the Australian dollar. The real exchange rate is broken down into an equilibrium trend ($\bar{z}_t$) and deviation from that trend ($\hat{z}_t$). The equilibrium real exchange rate trend is assumed to be determined by the equilibrium terms of trade ($\bar{z}^{tot}_t$).

$$z_t = s_t + p^{US}_t - p^C_t$$

$$z_t = \bar{z}_t + \hat{z}_t$$

$$\bar{z}_t = \bar{z}_t^{tot}$$

The real effective exchange rate that enters the output gap equation is the trade-weighted bilateral real exchange rates of Australia versus seven regions in the world (U.S., euro area, Japan, China, emerging Asia, Latin America, and the rest of the world). The breakdown of the regions is consistent with the IMF's Global Projection Model (GPM).

$$reer_t = \underset{(0.120)}{\varpi^{Trade,US}}\hat{z}_t^{US} + \underset{(0.149)}{\varpi^{Trade,EU}}\hat{z}_t^{EU} + \underset{(0.077)}{\varpi^{Trade,JA}}\hat{z}_t^{JA} + \underset{(0.233)}{\varpi^{Trade,CH}}\hat{z}_t^{CH} + \underset{(0.281)}{\varpi^{Trade,EA}}\hat{z}_t^{EA} + \underset{(0.017)}{\varpi^{Trade,LA}}\hat{z}_t^{LA} + \underset{(0.123)}{\varpi^{Trade,RC}}\hat{z}_t^{RC}$$

Risk-adjusted UIP condition

The risk-adjusted uncovered interest parity condition links the bilateral exchange rate between Australia and the United States. with the interest rates in the two economies (i_t and i_t^{US}).

$$i_t - i_t^{US} = 4(Es_{t+1} - s_t) + \sigma_t^{ctry} + \sigma_t^{tot} + \varepsilon_t^s$$

$$\underset{(0.6)}{Es_{t+1}} = \phi s_{t+1} + (1-\phi)\{[s_{t-1} + 2[\Delta\bar{z}_t - (\pi^{*,US} - \pi^*)/4]\}$$

This allows the expected exchange rate (Es_{t+1}) to be a linear combination of the model-consistent solution (s_{t+1}), and backward-looking expectations (s_{t-1}) adjusted for the trend exchange rate depreciation ($2[\Delta z_t - (\pi^{*,US} - \pi^*)/4]$). The factor ¼ after the inflation differential ($\pi^{*,US} - \pi^*$) de-annualizes the inflation rates which are expressed in annual terms, while the factor 2 is necessary as we take the nominal exchange rate in the past period (s_{t-1}), and extrapolates two periods into the future using the steady-state growth rate in the nominal exchange rate. Conversely, in the condition that links Australian and U.S. interest rates, the factor 4 before the expected depreciation ($Es_{t+1} - s_t$) annualizes the expected quarterly depreciation rate, to make it consistent with the interest rate quoted on the annual basis. A time-varying variable (σ_t^{ctry}) is included to account for shocks to country-risk premium. Terms-of-trade shifts (σ_t^{tot}) are also an important factor that determines the nominal exchange rate.

A.II.5. Relative Prices

Headline inflation is affected by the dynamics of relative price movements (core CPI (p_t^C) relative to headline CPI (p_t^H)). In the long term the overall (headline) inflation is assumed to be equal to the underlying (core) inflation, though it can diverge over prolonged periods of time, when there is a trend in the relative prices of non-core items (mortgage interest rates, unprocessed food, energy).

The dynamics of relative prices (rp_t) are modeled as the sum of the relative price trend ($\overline{rp}_t$) and the relative price gap ($\tilde{rp}_t$). The relative price gap depends on the real price of oil and food in the international markets adjusted for exchange rate effects, while the relative price trend growth is assumed to be an autoregressive process with mean zero. The parameters in the relative price gap equation are calibrated based on various information, such as the weights of energy and food in the CPI basket, and the degree and time profile of the pass-through of energy and food inflation to headline inflation.

$$rp_t = p_t^C - p_t^H$$

$$rp_t = \overline{rp}_t + \tilde{rp}_t$$

$$\tilde{rp}_t = \underset{(0.5)}{\rho^{\tilde{rp}}}\tilde{rp}_{t-1} - \underset{(0.01)}{c_1^{\tilde{rp}}}(\tilde{rp}_t^{Oil} + \hat{z}_t) - \underset{(0.01)}{c_2^{\tilde{rp}}}(\tilde{rp}_t^{Food} + \hat{z}_t) + \varepsilon_t^{\tilde{rp}}$$

$$\Delta\overline{rp}_t = \underset{(0.7)}{\rho^{\Delta\overline{rp}}}\Delta\overline{rp}_{t-1} + \varepsilon_t^{\Delta\overline{rp}}$$

A.II.6. Term Structure of Interest Rates

The model allows for long-term bond yields to shed light on the equilibrium real interest rates. Let $i_t^{Gov,k}$ be the nominal government bond yield with a maturity of k quarters, where k could be 4, 8, 20 or 40. The bond yield is equal to the average expected short-term interest rates k quarters into the future plus a term ($\sigma_t^{Term,k}$) that captures both government bond premium (same for bonds with all maturity) and term premium (a premium which increases with the maturity). A shock at the end of the equation ($\varepsilon_t^{Gov,k}$) reflects the measurement error.

$$i_t^{Gov,4} = i4_t + \sigma_t^{Term,4} + \varepsilon_t^{Gov,4}$$

$$i_t^{Gov,8} = (i4_t + i4_{t+4})/2 + \sigma_t^{Term,8} + \varepsilon_t^{Gov,8}$$

$$i_t^{Gov,20} = (i4_t + i4_{t+4} + i4_{t+8} + i4_{t+12} + i4_{t+16})/5 + \sigma_t^{Term,20} + \varepsilon_t^{Gov,20}$$

$$i_t^{Gov,40} = \sum_{i=0}^{9} i4_{t+4i}/10 + \sigma_t^{Term,40} + \varepsilon_t^{Gov,40}$$

$$i4_t = (i_t + i_{t+1} + i_{t+2} + i_{t+3})/4$$

A.II.7 Unemployment Rate

The unemployment rate (u_t) is characterized by a "gap version" of Okun's law. The equation implies that a one percentage point increase in the unemployment gap ($\hat{u}_t$) is associated with approximately

two percentage points of negative output gap. The NAIRU ($\bar{u}_t$) is assumed to follow a stochastic process that has both shocks to the level and to the growth rate.

$$u_t = \bar{u}_t + \hat{u}_t$$

$$\hat{u}_t = \underset{(0.25)}{\rho^{\hat{u}}}\hat{u}_{t-1} - \underset{(0.5)}{c_1^{\hat{u}}}\hat{y}_t + \varepsilon_t^{\hat{u}}$$

$$\bar{u}_t = \bar{u}_{t-1} + \Delta\bar{u}_t + \varepsilon_t^{\bar{u}}$$

$$d\bar{u}_t = \underset{(0.9)}{\rho^{d\bar{u}}}d\bar{u}_{t-1} + \varepsilon_t^{d\bar{u}}$$

A.II.8. Potential Output

The potential growth rate ($\Delta\bar{y}_t$) is assumed to converge to its steady state level ($\Delta\bar{y}^{ss}$) in the longer term. However, it can deviate from the steady-state level for prolonged periods of time.

$$\Delta\bar{y}_t = \underset{(0.9)}{\rho^{\bar{y}}}\Delta\bar{y}_{t-1} + \underset{(2.47)}{(1-\rho^{\bar{y}})}\Delta\bar{y}^{ss} + \varepsilon_t^{\Delta\bar{y}}$$

A.II.9. The Rest of the World

The Australian economy is linked to the rest of the world through both the trade linkage and the financial linkage. The rest-of-the-world output gap relevant for the Australian economy is defined as a weighted average of output gaps in the seven regions (U.S., euro area, Japan, China, emerging Asia, Latin America, and the rest of the world), using export shares as weights.

$$\hat{y}_t^{World} = \underset{(0.047)}{\varpi^{Exp,US}}\hat{y}_t^{US} + \underset{(0.030)}{\varpi^{Exp,EU}}\hat{y}_t^{EU} + \underset{(0.200)}{\varpi^{Exp,JA}}\hat{y}_t^{JA} + \underset{(0.375)}{\varpi^{Exp,CH}}\hat{y}_t^{CH} + \underset{(0.270)}{\varpi^{Exp,EA}}\hat{y}_t^{EA} + \underset{(0.008)}{\varpi^{Exp,LA}}\hat{y}_t^{LA} + \underset{(0.070)}{\varpi^{Exp,RC}}\hat{y}_t^{RC}$$

The equilibrium real interest rate in Australia is modeled in relation to that in the United States.

$$\bar{r}_t - \bar{r}_t^{US} = 4(\bar{z}_{t+1}^{xtot} - \bar{z}_t^{xtot}) + \sigma_t^{ctry}$$

$$\Delta\bar{z}_t = \underset{(0.5)}{c^{\bar{z}}}\Delta\bar{z}_t^{tot} + \Delta\bar{z}_t^{xtot}$$

$$\Delta \bar{z}^{xtot}_{t+1} = \rho^{\Delta \bar{z}^{xtot}}_{(0.95)} \Delta \bar{z}^{xtot}_{t} + (1-\rho^{\Delta \bar{z}^{xtot}_{t}})\Delta \bar{z}^{xtot,ss}_{(-2)} + \varepsilon^{\Delta \bar{z}^{xtot}}_{t}$$

A.II.10. Commodity Terms of Trade

The real price of oil (rp^{Oil}_t) is defined as the global oil prices (p^{Oil}_t) relative to the U.S. CPI (p^{US}_t). In the equilibrium, the real price of oil is assumed to grow at a rate of zero, although the actual growth rate can deviate from zero for significant long periods of time. The real price of oil gap ($\tilde{rp}^{Oil}_t$), defined as the difference between the real price of oil and its equilibrium trend value, is modeled as an autoregressive process with a shock.

$$rp^{Oil}_t = p^{Oil}_t - p^{US}_t$$

$$rp^{Oil}_t = \bar{rp}^{Oil}_t + \tilde{rp}^{Oil}_t$$

$$\Delta \bar{rp}^{Oil}_t = \rho^{\Delta \bar{rp}^{Oil}}_{(0.95)} \Delta \bar{rp}^{Oil}_{t-1} + \varepsilon^{\Delta \bar{rp}^{Oil}}_t$$

$$\tilde{rp}^{Oil}_t = \rho^{\tilde{rp}^{Oil}}_{(0.7)} \tilde{rp}^{Oil}_{t-1} + \varepsilon^{\tilde{rp}^{Oil}}_t$$

We follow similar modeling strategy for the real price of food.

$$rp^{Food}_t = p^{Food}_t - p^{US}_t$$

$$rp^{Food}_t = \bar{rp}^{Food}_t + \tilde{rp}^{Food}_t$$

$$\Delta \bar{rp}^{Food}_t = \rho^{\Delta \bar{rp}^{Food}}_{(0.95)} \Delta \bar{rp}^{Food}_{t-1} + \varepsilon^{\Delta \bar{rp}^{Food}}_t$$

$$\tilde{rp}^{Food}_t = \rho^{\tilde{rp}^{Food}}_{(0.7)} \tilde{rp}^{Food}_{t-1} + \varepsilon^{\tilde{rp}^{Food}}_t$$

The terms-of-trade gap ($\tilde{tot}_t$) for Australia is determined by the real price of metal gap ($\tilde{rp}^{Metal}_t$). The weight in front of the term represent the share of this commodity in Australia's total GDP.

$$tot_t = c_1^{tot} rp_t^{Metal} \quad (0.01)$$

The real exchange rate depreciation consistent with changes in the terms of trade (Δz_t^{tot}) is related to the movements in the real price of metal (Δrp_t^{Metal}). The same condition holds for this variable at its respective equilibrium value.

$$\Delta z_t^{tot} = -c_0^{\Delta \bar{z}^{tot}} \Delta rp_t^{Metal} \quad (0.6)$$

$$\Delta \bar{z}_t^{tot} = -c_0^{\Delta \bar{z}^{tot}} \Delta \bar{rp}_t^{Metal} \quad (0.6)$$

The terms-of-trade premium that goes into the UIP condition (σ_t^{tot}) is modeled as the "surprise" component in the real exchange rate movement consistent with the terms of trade.

$$\sigma_t^{tot} = 4(z_t^{tot} - E_{t-1} z_t^{tot})$$

AUSTRALIA'S FISCAL FRAMEWORK: ISSUES AND OPTIONS FOR REFORM[1]

Under the current fiscal framework, the Government of Australia is required to report against a medium-term fiscal strategy that is based on principles of sound fiscal management when it presents budgets to Parliament. Since the inception of the framework in 1998, the medium-term strategies have aimed to achieve a budget balance target, on average, over the course of the economic cycle, with a view to control debt accumulation.

In recent years, budget have proposed ambitious fiscal consolidation to achieve a medium-term budget surplus. Budget proposals have typically not presented policies aimed at short-term demand management, a mandate that has been delegated to monetary policy. This approach may no longer be a viable option, as the overnight cash rate may hit its effective lower bound if a large negative shock to activity materializes.

This paper reviews Australia's current fiscal anchor and framework against the backdrop of a serial misses of some budget targets, raising questions about the framework's credibility in public debate.

- Underperformance vis-à-vis hitting the targets is not necessarily a shortcoming of the framework itself, as a weaker-than-expected economy can easily explain the misses.
- While a testimony to the flexible nature of the framework, clear communication of the reasons behind target misses can preserve the credibility of the framework.

In the absence of strict constraints on governments' discretion, we propose revising the setting of anchors in the current fiscal framework, using analysis based on the IMF's model, G20MOD.

Budget repair is required to return to the Government's medium-term balance anchor although its pace is in question**.**

- Overly ambitious budget repair at this juncture poses risks to the recovery and future growth, given primary downside risks from the "new mediocre."

We recommend replacing medium-term budget balance anchor with a long-term debt anchor.

- A flexible long-term debt anchor can reinforce the commitment to debt sustainability under both temporary and persistent shocks and still allow for fiscal policy to a play a role in short-term macroeconomic stabilization. The medium-term budget balance anchor is less robust in maintaining long-term sustainability in the face of persistent negative shocks.
- A medium-term budget balance anchor can still be employed, but only as an intermediate objective. It should be conditional on initial conditions and outlook to be consistent with the long-term debt anchor.
- The recommended long-term debt anchor can be achieved and maintained by a combination of fiscal rules based on 1) expenditure restrictions and 2) a flexible horizon for converging toward the anchor.

[1] Prepared by Allan Dizioli (RES), Philippe Karam, Dirk Muir and Siegfried Steinlein (all APD).

A. Introduction

"The Charter of Budget Honesty provides a framework for the conduct of Government fiscal policy. The purpose of the Charter is to improve fiscal policy outcomes. It requires fiscal strategy to be based on principles of sound fiscal management and facilitates public scrutiny of fiscal policy and performance."

Charter of Budget Honesty Act 1998 (Commonwealth of Australia, 2014)

1. We review the fiscal anchor and its framework against the backdrop of a sequence of budget targets misses, throwing the credibility of the framework in question. Over the years, the Commonwealth government has announced repeatedly its intentions to achieve its medium-term fiscal strategy, one of reaching and maintaining an annual government surplus of 1 percent of GDP – a medium-term balance anchor – while reducing the size of government. Faced with persistent growth underperformance since 2011 driven by the drop in global iron ore prices, the recession in the mining sector and weakness in other commodities markets, fiscal policy has played a macroeconomic stabilization role, delaying the Government from meeting its stated medium-term objectives, and leading to increased uneasiness about the current fiscal framework.

2. In recent years, the repeated ambitious fiscal consolidation to reach medium-term fiscal targets under a slowly recovering economy highlights the traditional focus on medium-term fiscal objectives. Furthermore, the Government has been less inclined traditionally to deploy more liberally and regularly fiscal policy for short-term stabilization purposes which has meant that monetary policy has had to assume such a role. Current circumstances of weak recovery and low equilibrium interest rates have meant that the conventional monetary policy toolkit is likely to be constrained and alone may not be able to provide the sufficient stimulus in the economy.

3. There are immediate and longer term challenges spanning slower recovery and growth and incipient aging-related spending. Australia is confronted, as are most advanced economies, by the spectre of the "new mediocre," with the disappointing promise of a sustained lower growth path which is likely to dampen expectations about future growth in the short term. Over the longer term, governments face the persistent challenge of higher spending from demographic pressures related to the ageing of its population.

4. At this juncture, the Commonwealth government budget plans are to meet the medium-term fiscal strategy goals, although we see this as an opportunity to reconsider the fiscal framework. To return to the medium-term fiscal strategy requires budget repair, and then a renewed focus afterwards. We see this as a unique opportunity to evaluate several questions:

- What is the appropriate response for budget repair with the current medium-term balance anchor, in terms of speed and short-term implementation, given the current outlook, and the downside risk of the "new mediocre?"
- Is the fiscal anchor still appropriate in the long term, given the dangers inherent in the "new mediocre" and long-term demographic pressures, starting from higher initial debt levels than in the past?

- What are the possibilities for a new fiscal anchor and its implementation, within a better-defined long-term fiscal strategy?

5. The medium-term anchor is still viable in principle, but an ambitious budget repair strategy risks being destabilizing in the short term. We suggest a mixed spending and tax strategy tilted towards spending measures under a longer adjustment horizon given the current risk from the "new mediocre." This would entail measures beyond the ones already recognized in *Budget 2016-17* (Commonwealth of Australia, 2016).

6. Given the uneasiness surrounding the medium-term balance anchor, we demonstrate that a long-term debt anchor is a good option on which to build a long-term fiscal strategy. A long-term debt anchor can be used to manage efficiently the trade-off between debt sustainability and economic stabilization with the added benefit of reducing uncertainty around the government's behavior when it is based on a target related to its debt stock, compared to a flow-based approach with less well-defined time horizon. The *2015 Intergenerational Report* (Commonwealth of Australia, 2015) highlights that without policy action, spending trends related to demographic issues (primarily health care, aged care and pensions) will lead to an unsustainable situation with a high debt-to-GDP ratio. Our proposed strategy is an explicit long-term debt anchor, based on a flexible response from the tax regime. We demonstrate that a flexible rule to reach the long-term debt anchor can minimize the costs of the transition, even in the response to different shocks, provided that communication of the new long-term strategy is clear. A lack of clarity may be costlier with a long-term anchor, but a clearly stated debt anchor provides greater benefits than one based on the budget balance.

7. The paper is organized as follows. Section B outlines the Australian fiscal framework. Section C looks at the fiscal performance of Australia since the *Charter of Budgetary Honesty Act 1998* came into force, with more emphasis on the later years. Section D describes the main features and calibration of the IMF's macroeconomic model, G20MOD, with an emphasis on fiscal policy and fiscal rules. Section E uses G20MOD to consider how the fiscal authority can meet the stated short-term objective of its fiscal framework. Section F uses the model to examine the transition path to a proposed new long-term strategy as part of the fiscal framework. Concluding comments are in Section G.

B. The Fiscal Policy Framework

8. Fiscal frameworks play an important role to anchor fiscal credibility. The adoption of a sound fiscal framework can help policy makers who are committed to fiscal responsibility, strengthen the institutional basis of their commitment, and signal it to economic agents both domestically and internationally, thus reaping benefits from increased policy credibility. A clear signal of their efficacy would be a favorable assessment provided by the credit rating agencies (Standard and Poor's, Moody's and Fitch).

9. Australia follows a principles-based rather than a numerically oriented, rules-based fiscal framework, that provides for "constrained discretion". The principles are enshrined in the *Charter of Budgetary Honesty Act 1998*. The Charter provides procedures for setting fiscal objectives

and requires extensive fiscal transparency and reporting against a medium-term fiscal strategy. Fiscal objectives are to abide by the Charter's "Principles of Sound Fiscal Management". Those are stated in general terms and do not mandate any specific fiscal targets. Moreover, based on these principles, it is left to the government in office to specify budgetary objectives in its fiscal strategy. Fiscal strategy and budgetary objectives are spelled out in a Fiscal Strategy Statement, which is part of the annual budget documentation.

Background on Australia's Framework

10. There has been remarkable continuity in budgetary objectives, with a budget balance target occupying center stage. Budget balance objectives have been at the center of all governments' fiscal strategy statements since 1996 – either in the form of a balanced budget over the economic cycle pre-FY2008/09 or a return to a budget surplus of at least 1 percent of GDP in the medium term as part of a post-FY2008/09 "budget repair" strategy.

11. Additional objectives were more time-varying. They related to, for instance, (net) debt or net (financial) worth, caps on the tax share in GDP, and/or a cap on expenditures. A well-specified expenditure objective – limiting real expenditure growth to 2 percent in periods with above-trend growth – was used in the fiscal strategy statements from FY2009/10 to FY2013/14 as part of the exit strategy from the global financial crisis stimulus.

The Current Framework

12. The current framework is built on a medium-term fiscal strategy combined with a short-term budget repair strategy to address deficits born from the global financial crisis. These have both been articulated clearly, and repeatedly in the Commonwealth budgets. They meet the requirements of the Charter. *Budget 2016-17* (Commonwealth of Australia, 2016) contains the most recent formulation, and provide useful projections that we use as guideposts in our analysis. The medium-term fiscal strategy properly defines the intentions of the Commonwealth government (referred to hereafter as the 'Government'), and how they relate to the conduct of fiscal policy. In order to position itself for the medium term, the Government first must bring its budget to a better stance as motivated by the budget repair strategy.

13. The Government's medium-term fiscal strategy is to achieve budget surpluses, on average, over the business cycle. There are four policy elements (Commonwealth of Australia, 2016, Statement 3, p. 7):

- "investing in a stronger economy by redirecting Government spending to quality investment to boost productivity and workforce participation;
- "maintaining strong fiscal discipline by controlling expenditure to reduce the Government's share of the economy over time in order to free up resources for private investment to drive jobs and economic growth, with: the payments-to-GDP ratio falling; stabilizing and then reducing net debt over time;

- "supporting revenue growth by supporting policies that drive earnings and economic growth; and
- "strengthening the Government's balance sheet by improving net financial worth over time."

14. Real payments growth over the Government's forward estimate period (FY2016-17 to FY2019-20) is expected to be 1.9 percent per annum on average, largely surpassed over Treasury's medium-term forecast period. Over the period from FY2020-21 to FY2026-27, average annual real growth in payments is projected to be around 2.9 percent, around 1 percentage point higher than estimated average real growth in payments over the forward estimates.

15. The Budget repair strategy aims to deliver budget surpluses of at least 1 percent of GDP as soon as possible and will stay in place until the surplus goal is achieved. This is to be achieved by offsetting any new spending measures with other spending cuts. Furthermore, any upward surprises on revenues or spending because of a strengthening economy will be put towards reducing the deficit. "A clear path back to surplus is underpinned by decisions that build over time" (Commonwealth of Australia, 2016, Statement 3, p. 7). The horizon over which to maintain the surplus goal is contingent on sound economic growth prospects and unemployment remaining low. However, the horizon is currently not well defined in *Budget 2016-17*. In fact, the medium-term projections to the end of FY2019/20 still only see a surplus of 0.1 of GDP, also reflected in the IMF's October 2016 World Economic Outlook (WEO), which only sees a balanced budget in percent of GDP by the end of 2021.

16. The Intergenerational Report 2015 (Commonwealth of Australia, 2015, referred to hereafter as IGR 2015) is a key part of the Government's long-term view on the Australian economy. IGR 2015, a report issued by the Commonwealth Treasurer, as mandated by the Charter, is a detailed analytical effort aimed at highlighting the long-term fiscal challenges facing Australia, as a result of the ageing of its population and of other factors likely to boost the demand for some key public services, especially health care and aged care. The IGR 2015 'proposed policy' presents a baseline long-term projection, constructed to highlight the implications for the Government's finances (in particular the net debt) from the projected long-term ageing of the population, consistent with the policies active at the time of the 2014-2015 Mid-Year Economic and Fiscal Outlook (MYEFO). IGR 2015 further considers alternative scenarios where budget repair is not achieved, or higher productivity and labor force participation help stabilize net public debt at moderately low levels of debt. These scenarios underpin our long-term analysis below.

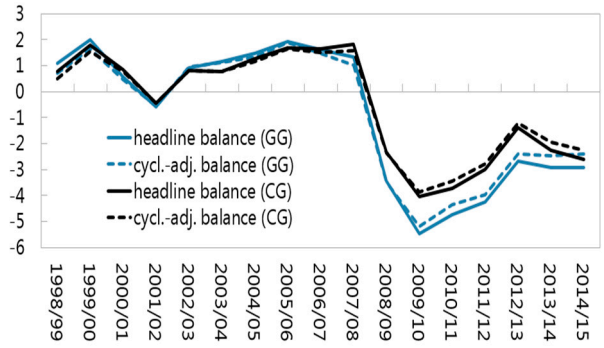
C. Fiscal Performance

17. The performance of Australia's current fiscal framework is assessed over three periods, surrounding the global financial crisis (pre-, during, and post- crisis). The current framework began with the *Charter of Budget Honesty Act 1998*.

18. Before the global financial crisis, the fiscal framework helped maintain the favorable conditions for budgetary surpluses most of the time, further strengthening fiscal sustainability and creating ample fiscal buffers. The initial conditions for implementing a

balanced budget rule after the Charter had entered into force were favorable, with the economy growing at potential and the budget already in surplus. Indeed, except for FY2001/02, the balanced budget objective was overachieved (Figure 1). This created very favorable debt dynamics, and the Commonwealth government started to accumulate net assets from FY2003/04, with net asset-to-GDP ratio peaking at 7.3 percent in FY2007/08 (Figure 2).

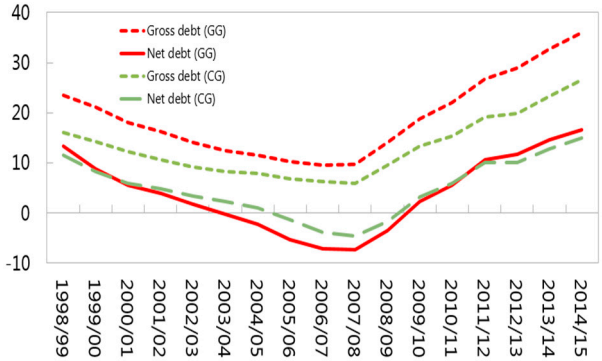
Figure 1. Fiscal Balances 1/
(% of GDP)



Sources: ABS, IMF staff estimates

1/ cycl.-adj. = cyclically-adjusted; GG = General consolidated Government; CG = Central Government

Figure 2. Debt Dynamics 1/
(% of GDP)



Sources: ABS, IMF staff calculations

1/ cycl.-adj. = cyclically-adjusted; GG = General consolidated Government; CG = Central Government

19. However, macroeconomic stabilization was less prevalent as a fiscal objective (Figure 3). In the years preceding the global financial crisis, the fiscal stance at the Commonwealth level (as measured by the cyclically-adjusted primary balance) would appear to have been broadly neutral, with some pro-cyclicality in the last three fiscal years before the crisis at the state government level.

20. At the onset of the global financial crisis, considerable fiscal buffers enabled a massive fiscal stimulus. Australia launched one of the most sizeable fiscal stimulus programs among advanced economies of roughly 4.5 percent of GDP. This shifted the path of the Commonwealth deficit firmly into negative territory and reversed the debt trajectory from FY2008/09 onwards.

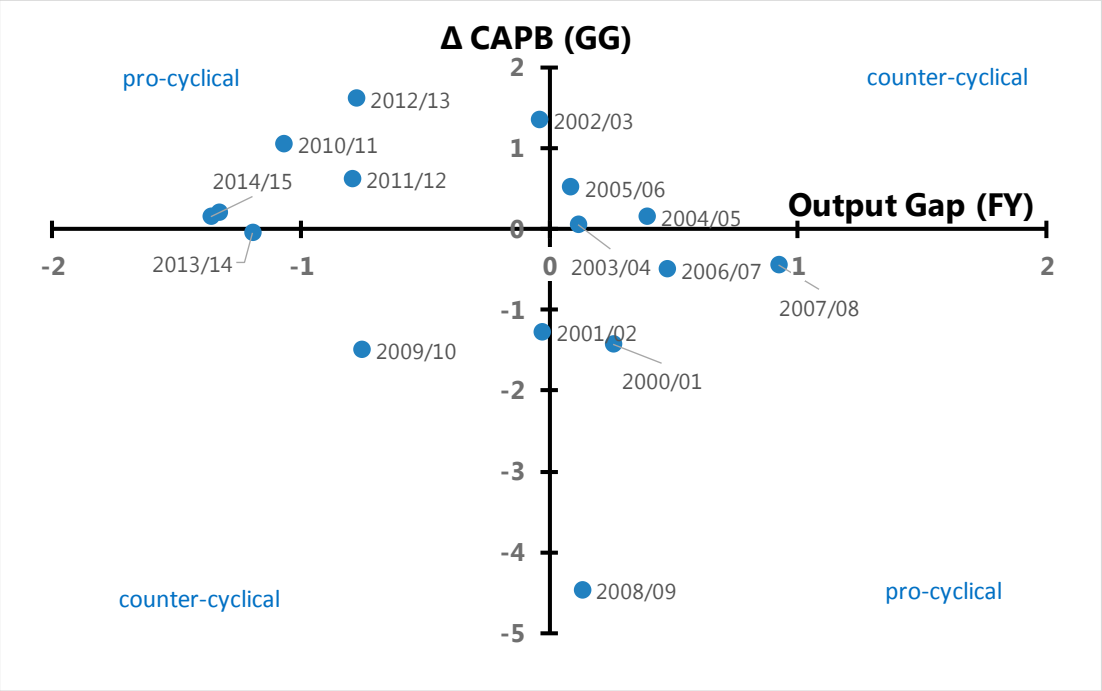
21. After the crisis, a fiscal repair strategy was put in place, aiming at returning to a budgetary surplus position of 1 percent of GDP in the medium term. In its *Updated Economic and Fiscal Outlook* of February 2009 (Commonwealth of Australia, 2009, pp. 38-39), the Commonwealth government re-affirmed its commitment to the previous medium-term strategy of achieving budget surpluses, on average, over the economic cycle; keeping taxes as a share of GDP on average below the FY2007/08 level; and improving the government's net financial worth over the medium term. "Allowing tax receipts to recover naturally" and "reprioritizing spending to fast-track the return to surplus," were the two planks in return to budget surplus with a view to reducing annual real growth in its spending to 2 percent as economic growth returned to trend.

22. In the first years after the global financial crisis, the repair strategy achieved some reversal of the deficit effect of the stimulus, albeit at the cost of some pro-cyclicality. While budget balance projections have proved to be overly optimistic throughout, mainly due to revenue

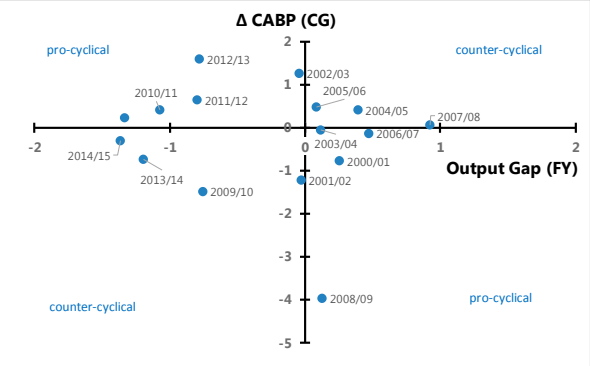
projections, the Commonwealth deficit was reduced to 2.7 percent of GDP by FY2012/13 on the back of some pro-cyclicality in FY2010/11 to FY2012/13.

Figure 3. The Cyclically Adjusted Primary Balance and Stability 1/

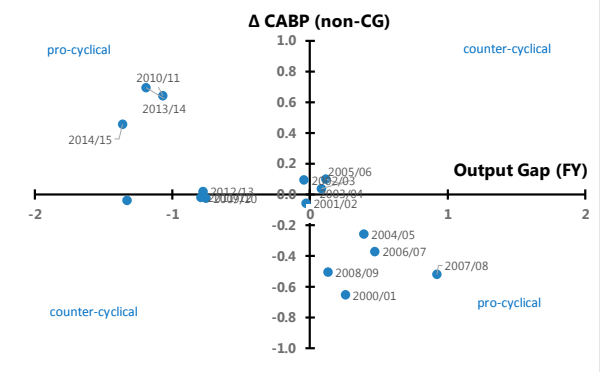
General Government



Central Government



State Government



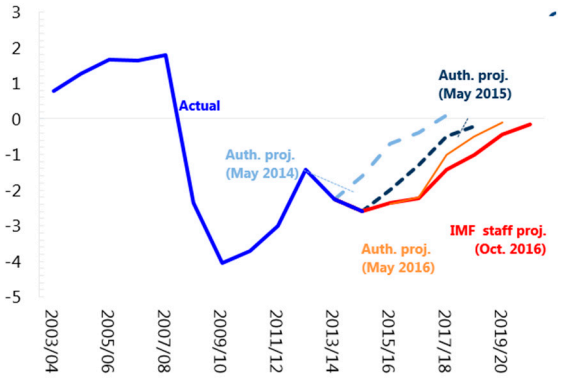
Sources: ABS, Commonwealth and State Treasuries

1/ GG = General consolidated Government; CG = Central Government; FY = Fiscal Year

23. Since FY2012/13, deficit reduction has stalled and planned consolidation has been repeatedly shifted into the future. After FY2012/13, the deficit has remained elevated, stabilizing slightly above 2.7 percent of GDP, mostly driven by deteriorating revenues from the mining sector. While avoiding pro-cyclicality, it has also entailed a repeated shift of the envisaged trajectory to a surplus of 1 percent of GDP further into the future (Figure 4). More generally, the planned budget consolidation has been based on overly optimistic GDP and revenue projections starting with the

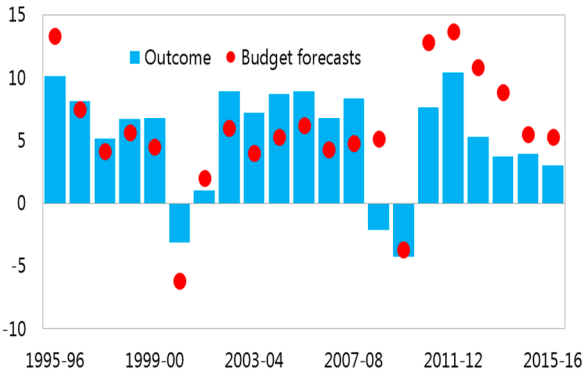
post mining bust period (Figure 5). *Budget 2016-17* projects a deficit of 0.1 percent of GDP in FY2019/20, relying on revenue projection assumptions akin to previous ones that yielded overestimated revenues, implying a downside risk of high revenues not materializing.

Figure 4. Commonwealth Gov't Deficits (% of GDP)



Sources: ABS, Commonwealth Treasury, IMF staff estimates and projections.

Figure 5. Budget Forecasts of Tax Growth (% of GDP)



Sources: Commonwealth Budget 2016-17

24. While a postponement of fiscal consolidation may have been warranted on both economic stabilization and sustainability grounds, the repeated underperformance against budget plans and the longer consolidation horizon has weakened the credibility of the fiscal framework. Together with the relatively rapid increase of debt-to-GDP ratios after the global financial crisis and the high share of foreign debt financing, repeated postponement of the consolidation path may have had a negative effect on the credibility of fiscal policy going forward. Indeed, Standard and Poor's in 2016 have placed the Australian sovereign's AAA rating outlook at negative, although both Moody's and Fitch Ratings have confirmed their outlooks as stable.

D. Understanding the Model

25. Our analysis on budget repair and the use of a long-term debt anchor depend on the use of the G20MOD module of the IMF's Flexible System of Global Models (FSGM). In this section, we discuss the features most salient to our scenarios for Australia. This leads to an extensive discussion of the fiscal rules framework we are using. Finally, we discuss how we calibrate Australia, and the most important interactions with our scenarios.

Brief Overview of the Theoretical Structure[2]

26. G20MOD is an annual, multi-region, general equilibrium model of the global economy combining both micro-founded and reduced-form formulations of various economic sectors. Structurally, each country/regional block is close to identical, but with potentially different key steady-state ratios and behavioral parameters. Real GDP in the model is determined by the sum of its aggregate demand components in the short term, and the level of potential output in the long

[2] See Appendix I for a succinct description of G20MOD. A complete description can be found in Andrle and others (2015).

term. Aggregate demand follows the standard national expenditure accounts identity. Components such as household consumption and private investment are based on optimizing behavior, while trade is of a more semi-structural nature, and government is mostly exogenously specified. The two key prices in the model is the consumer price index (CPI) and wages, modeled by inflation and wage inflation Phillips' curves, respectively. The commodities sector consisting of oil, metals and food is modelled on both a global and country basis, with metals playing an important role in Australia. The fiscal sector is also fairly comprehensive, and while the financial sector is fairly simple, it does provide a role in the model for both a 1-year interest rate, which serves as the short-term instrument for monetary policy, and a 10-year interest rate. The external sector is based on aggregate trade of countries with the rest of the world, instead of tracking individual bilateral relationships.

27. The key feature on the demand side is a consumption block based on the Blanchard-Weil-Yaari overlapping generations (OLG) model (Blanchard, 1985; Weil, 1989; and Yaari, 1965). Using OLG households rather than infinitely-lived households results in important non-Ricardian properties whereby the path for government debt has significant economic implications. In the OLG framework, households treat government bonds as wealth since there is a chance that the associated tax liabilities will fall due beyond their expected lifetimes. The OLG formulation results in the endogenous determination of national saving and the demand for net foreign assets given the level of government debt. The global real interest rate adjusts in the long-term to equilibrate the global supply of and demand for savings. The central role for government debt allows for a powerful role for fiscal policy in the long term, not just in the short term. There are also households who only consume out of current income and are considered liquidity-constrained (LIQ) households

Fiscal Policy

28. Fiscal policy is driven by a sufficiently detailed government sector that can reproduce simplified fiscal accounts for each country. Eight policy instruments are featured. On the spending side, in addition to government consumption and infrastructure spending, there are general lumpsum transfers to all households (such as pensions, aged care provisions, unemployment insurance) and lumpsum transfers targeted to LIQ households (such as welfare, certain pensions). On the revenues side, there are taxes on consumption (the goods and services tax, GST), personal income (PIT, on both wage and dividend income) and company income (CIT), as well as taxes and royalties from the mining and production of metals. For Australia, the government is an amalgam of the Commonwealth and State governments. However, many of the issues in this paper focus on the Commonwealth accounts and balances.

29. The budget constraint in the model is met by the choice of a long-term deficit target, relative to GDP. Specifically, the deficit is expenditures and interest payments, less revenues. One instrument, which is general lumpsum transfers by default, is constantly adjusted to make sure that the budget constraint always holds. The long-term government debt target, relative to GDP, can be derived from the government deficit target, based on the nominal growth rate of the economy:

$$b^{tar} = \frac{(1+\pi)(1+g)}{(1+\pi)(1+g)-1} gdef^{tar}$$

where π is inflation, g is the steady-state growth rate, b^{tar} is the long-term debt target, and $gdef^{tar}$ is the long-term deficit target. The explicit deficit target therefore pins down the long-term government debt, a fundamental decision variable for firms and households worldwide. The level of government debt affects the global interest rate (the price used to equilibrate global saving with global investment), and the real exchange rate (a country's relative price for its contributions and use of the global saving-investment pool).

Fiscal Rules

30. We introduce the concept of a fiscal rule, to lay the groundwork for both the model and the ensuing analysis. The use of the deficit target to implement a stable government-debt-to-GDP ratio is a fiscal rule, for instance. In following the terminology used in IMF (2009), three primary fiscal rules of concern in this paper are pursued.

- ***Expenditure rule (ER)*** – The government specifies some restriction on some component of spending to provide control. The ER does not directly provide any restriction to the budget balance, as it does not imply any particular restriction on the revenue side of the economy, or its borrowing intentions.
- ***Budget balance rule (BBR)*** – The government specifies some restriction to ensure the budget meets a particular target level after some time horizon. A balanced budget (where the deficit is zero) is special case of a BBR. The BBR also implies a long-term debt level (see the equation above relating the deficit and debt targets), but this is not a required consideration for the choice or implementation of its particular form.
- ***Debt rule (DR)*** – brings the government debt to some particular target level after some time horizon.

31. The BBR and the DR can be either strict or flexible. 'Strict' means the target level for the BBR or the target path for the DR is met in full each year. If it is 'flexible', the BBR's target level or the DR's target path is met on average over some particular time horizon – for example, "over the business cycle" or "over the course of three years."

32. G20MOD's deficit target is a strict BBR, which at the same time embeds a short-term feature which provides some flexibility. The government has legal obligations to provide social transfers (such as unemployment insurance, or welfare). These are part of the general lumpsum transfers in G20MOD intended to smooth the business cycle (i.e. provide more unemployment insurance in the recessionary phase of excess supply, and less in the expansionary phase of excess demand). Therefore, under this strict BBR, the deficit-to-GDP target translates into the deficit-to-GDP ratio $gdef^{rat}$, while allowing for flexibility:

$$gdef^{rat} = gdef^{tar} - d^{ygap} y^{gap}$$

where d^{ygap} is the countercyclical weight on the measure of the output gap, y^{gap}. In referring to the automatic social transfers below, these are related to the additional spending (or saving) that is always added to general lumpsum transfers.

Calibrating the Australian Economy

33. We describe below the salient parameter values for G20MOD as used in this paper. Most of the parameters are calibrated for the model as a whole, using the process explained in Andrle and others (2015). Some of the baseline data is also key for the behavior of the Australian economy, particularly the share of the commodity sectors, and their trade relationships with the rest of the world. Calibration is informed by estimation work from older versions of the model, stylized facts, and properties of the IMF's other structural macroeconomic models. The goal is to obtain sensible system-wide properties. Given that we are calibrating a steady state in the model, the numbers may not match raw data in quantity, but should qualitatively capture their significance.

The External Sector and Commodities

34. The most important factors in calibrating Australia's external sector are data related to its size (Table 1). Australia has a small share of global GDP – approximately 1.6 percent. Its permanent fiscal shocks have little impact on global real interest rates (unlike the United States or euro area, for example). However, it is a large market participant in the global metals market (consisting of aluminum, copper, iron, lead, nickel, tin, uranium, and zinc in G20MOD), with a 13.6 percent share of global production. Resources combine for roughly 9.1 percent of Australian real GDP, and are slightly below conventional calibrations of 10 to 15 percent of GDP, as the G20MOD basket is limited in its coverage.

Table 1. External Sector Calibration

% Share of Global GDP for Australia		1.57
% Share of Real GDP	**Exports**	**Imports**
Aggregate	24.6	23.5
Oil	0.8	2.2
Mining	8.3	0.0
% share of global production	13.6	...

Sources: IMF staff calculations and World Economic Outlook

35. Australia's openness is key in determining how activity in the rest of the world (in particular, China) spill over onto it, and how Australia influences the rest of the world. Australia exports about 24.6 percent of GDP, and imports 23.5 percent of GDP which is marginally below the G-20 average of 26.6 and 26.9 percent of GDP, respectively. Compare this with the United States, a less open economy, with ratios of 17.3 and 16.2 percent of GDP, respectively. Under openness, monetary and fiscal policy actions have a large leakage component. For example, a 1 percent increase in the nominal 1-year interest rate only decreases real GDP by 0.3 percent in Australia, versus 0.4 percent in the case of the United States. Similarly, a two-year real GDP multiplier for government consumption for Australia is merely 0.62, versus 0.71 for the United States.

36. We pay special attention to the metals sector. The real global metals price is governed by a global equation with both production and global demand effects proxied by output gaps. The measure for demand responsiveness is weighted by metal consumption weights, and for supply responsiveness by metal production weights. The level of the metals price and the parameters governing its price dynamics and dynamics caused by reactions to metals price movements are consistent with the October 2016 WEO metals price. In Australia, we calibrated the share of metals

royalties and resource taxes to be 0.75 percent of GDP, which can potentially be a source of procyclical volatility from the fiscal revenue side. As metals demand expands or the metals price increases, usually in tandem with a domestic economic expansion, royalties increase and allow further government spending for a fixed debt target. The opposite is true in a recession. Given the magnitude of royalties, this effect is second order, and is not a prime driver of the scenarios discussed below.

The Domestic Economy

37. Australia's economy is calibrated using roughly current national accounts ratios and fiscal ratios with G-20 ratios reported to provide contrast (Table 2). Several features are notable. First, Australia draws much more of its tax income from corporate taxes as a percent of GDP relative to the rest of the G-20. Second, the net foreign liability position is large relative to the G-20, so U.S. interest rate shocks can pose a greater threat in G20MOD to Australia than other countries. Finally, they have low general consolidated government debt on a net basis (only 20 percent of GDP) relative to the rest of the G-20, so shocks do not have as strong effects in Australia on government interest payments as in other countries.

Table 2. General G20MOD Calibration

	Australia	Average G-20
National Accounts (% of real GDP)		
Household Consumption	56.4	58.9
Private Investment	22.6	20.7
Government Absorption	19.9	20.1
Exports	24.6	26.9
Imports	23.5	26.6
Public Sector (% of GDP)		
Government Debt (net)	20.0	75.9
Government Spending	35.6	41.8
Consumption	16.8	16.0
Investment	4.2	4.9
Transfers	13.4	17.4
Tax Revenues	34.6	38.9
VAT	5.7	7.9
CIT	6.7	3.1
PIT	16.1	13.8
Mining Royalties and Taxes	0.8	0.0
Net Foreign Liabilities (% of GDP) 1/	82.3	40.8

1/ G-20 average uses G-20 debtor countries only
Sources: IMF staff calculations, World Economic Outlook and GFS

38. Much of the parameterization for Australia's behavior is the same as the other advanced economies in G20MOD. This is the standard approach to calibration for parameters such as the intertemporal elasticity of substitution (governing the dynamics and speed of the current account response because of the shift between consumption and private saving) and the share of LIQ households, which is at the standard 35 percent. Similarly, the price and wage Phillips' curves (lead and lag on inflation; the output gap) are calibrated the same as the non-European advanced economies, and the financial accelerator matches that of the other advanced economies.

Fiscal Rules

39. Fiscal rules in G20MOD have both a short-term and long-term component. The *short-term* component is automatic social transfers, whereby the level of general lumpsum transfers are negatively correlated with the output gap, given shifts in other tax bases and spending components, as found in Girouard and André (2005), Table 9. The average value of this correlation for advanced

OECD countries is 0.44, while that of Australia is 0.39. The long-term component is either the general consolidated government deficit or debt as a ratio of nominal GDP. The deficit-to-GDP target is used for the strict BBR, and the debt-to-GDP target for the strict DR. The government sets its deficit or debt as a target ratio to GDP (with an additional adjustment for the short-term automatic social transfers) and by choosing to adjust one instrument such that the government budget constraint always holds. The flexible rules move the adjusting fiscal instrument based on the deviations of the actual deficit- or debt-to-GDP ratios from their targets (a deficit or debt gap). The lower the weight on a deficit or debt gap, the longer it takes for a rule to achieve its target.

40. The flexible BBR and DR have a more complex structure and calibration. For a flexible rule, the deficit is endogenous, and a chosen instrument reacts directly to the deficit and/or debt gap. For the flexible BBR, there is only a weight on the deficit gap, of 0.8. For the flexible DR, there is a weight on both the debt gap and the deficit gap. The weight on the debt gap is the inverse of the number of years (0.1 for 10 years, 0.2 for 5 years), which controls the rate at which debt returns to its target. The weight on the deficit gap is 0.25, with the flexible DR using the first difference of the debt-to-GDP ratio to help minimize the general volatility of the economy as the debt-to-GDP ratio adjusts.

E. Achieving the Medium-Term Balance Anchor through Budget Repair

41. In the short term, the Government is committed to achieving its medium-term balance anchor of +1 percent of GDP, through the process of budget repair. However, by 2021 (FY2020/21), the October 2016 WEO projects a government balanced budget (zero percent of GDP), short of the 1 percent target. We therefore analyze what adjustments are needed now in meeting that target and in setting the stage for further comprehensive long-term adjustments.

42. The required budget repair is +1 percent of GDP relative to the WEO baseline. In illustrating how this gap might be closed, we propose to achieve 25 percent of this by increasing the GST at some date from the revenue side, and 75 percent from the spending side, split evenly between government consumption and general transfers, phased in linearly over 30 years. With regard to the GST adjustment, two time horizons are considered: 5 years, with an immediate increase in the GST so that the medium-term balance anchor is achieved by FY2020/21; and 10 years, with an increase in the GST introduced only after five years so the medium-term balance anchor is achieved by FY2025/26.

43. The contemplated baseline scenario is fairly benign, with continued strength in real GDP and revenue growth and moderate spending pressures in the short-term, but not without risks. However, under a current environment, risks are skewed to the downside, of uppermost concern is the "new mediocre." In the case of Australia, the "new mediocre" can be described as spillovers from global secular stagnation, which results in a permanent decline in global metals prices. Such global factors may cause a localized version of secular stagnation, coupled with a further decline in Australia's terms of trade (See Box 1). Given the considerable uncertainty surrounding forecast, we analyze achieving the medium-term balance anchor under both environments, using an illustrative scenario for the "new mediocre".

Box 1. The "New Mediocre" and its Implications on Australia

The illustrative version of the "new mediocre" we consider is summarized in the accompanying figure. In the case of Australia, it can be described as secular stagnation, where households and firms realize that future productivity will be lower than originally expected. On a global scale, secular stagnation permanently drives down global metals demand, which is a negative terms-of-trade shock for Australia. The government deficit moves in tandem with changes in revenues and expenditures – tax rates are exogenous, as is spending, except for the automatic social transfers.

The "new mediocre" is basically a realization that ongoing productivity growth will be lower than originally anticipated by households and firms. It is akin to a negative productivity shock. There is lower demand for factors of production, so the capital stock and investment contract. There is also lower labor income and wealth. Goods cost more to produce, lowering consumption for a given level of income, leading to a contraction of real GDP. The Australian dollar also appreciates by about 1.5 percent, so supply contracts in response, and there is a shortage of goods to meet foreign demand.

We assume it is exacerbated by a decline in the global price of metals due to weaker global demand which negatively affects Australia's terms of trade. There is a further contraction of metals production from the lack of global demand and price pressures that make it more difficult to meet production costs. This is a negative wealth shock, and there are negative implications on consumer spending, and harmful second round effects. Overall, real GDP contracts by 1.5 percent relative to baseline after 10 years, led by large declines in consumption and investment (2.1 and 2 percent, respectively).

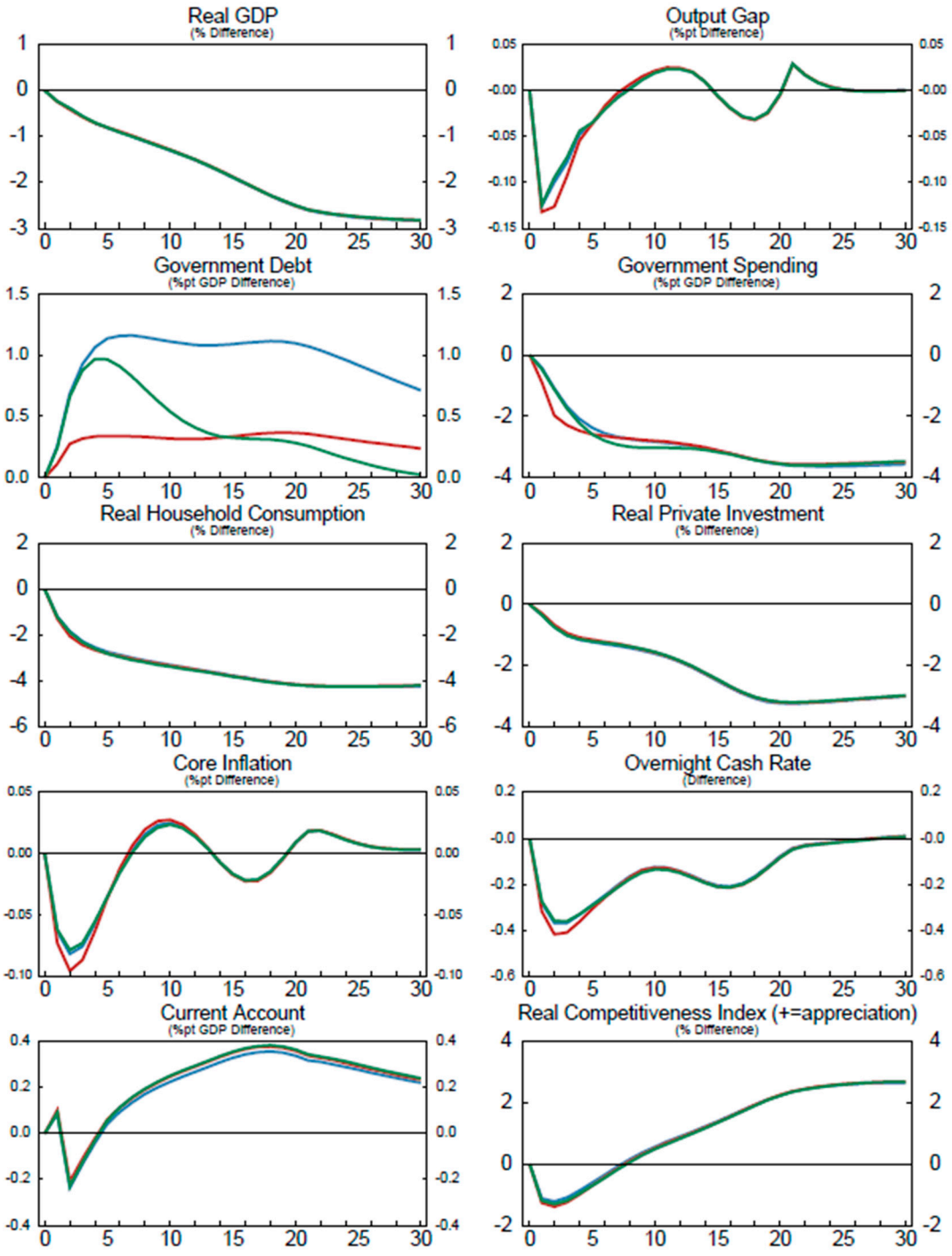
The Government also faces strains in its balance, and monetary policy is assumed to have room for easing. The Government faces higher spending from automatic social transfers, and downward pressure on tax revenues as a result of both a general contraction of the tax bases and weaker royalties and resource taxes. This raises the deficit by 0.5 percent of GDP by the second year, and 0.8 percent of GDP by the tenth. In playing a supporting role to weaknesses in demand, monetary policy is deployed with the RBA only needing to cut the overnight cash rate by around 30 basis points at its trough in the second year. However, under increased probability of hitting the effective lower bound on interest rate, the RBA may be constrained in cutting rates further and given that this is a negative permanent supply shock, the RBA can only smooth, but not prevent, the downward decline in the economy.

Box 1. The "New Mediocre" and its Implications on Australia (concluded)

The "New Mediocre"

(Percent deviation from baseline, unless otherwise stated)

Medium-Term Balance Anchor
Long-Term Debt Anchor = Strict DR over 10 Years
Long-Term Debt Anchor = Flexible DR over 10 Years

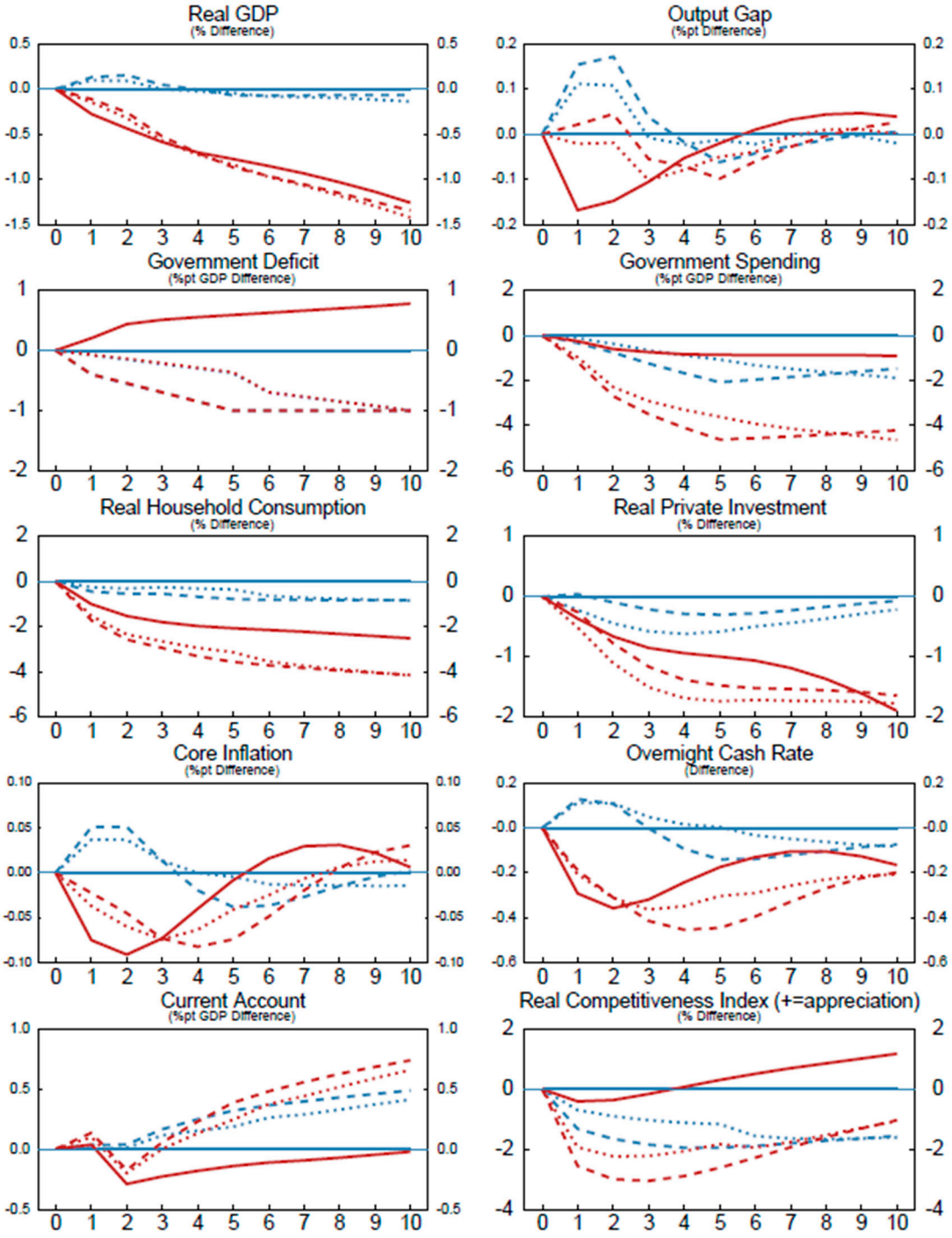


Source: IMF staff calculations.

Figure 6. Budget Repair at a Risky Juncture

(Percent deviation from baseline, unless otherwise stated)

= The Baseline Scenario
Budget Repair over - - 5 Years ... 10 Years
= The "New Mediocre"
Budget Repair over - - 5 Years ... 10 Years



Source: IMF staff calculations.

44. Therefore, we can consider that budget repair is at a risky juncture (Figure 6). We consider the cases for budget repair that take either 5 years or 10 years, under both the baseline and "new mediocre" scenarios. Under both cases, the external sector has a large influence on the results and favors the five-year horizon. For consumption, the ten-year option is more favorable, as the GST increase is delayed, by construction. In both scenarios, consumption falls, by about 0.8 percent relative to baseline, and about 1.0 percent relative to the "new mediocre". This is not the case for investment, which sees a generally higher cost of capital, as the presence of a zero or negative output gap indicates a worse environment for firms' financial health, thereby raising the corporate interest rate. But the fall in investment is temporary, albeit worse in the 10-year case, and worse under the "new mediocre", in the fourth year – an additional 1.0 percent relative to the "new mediocre" versus about -0.6 percent relative to baseline.

45. The reduction in government debt leads to a lesser availability of domestic assets for households. To maintain their desired level of financial wealth, households seek more foreign assets, in turn reducing net foreign liabilities, requiring a higher current account (through net exports) in the short-term. This encourages a real exchange rate depreciation in the magnitude of about 0.6 percent under the 10-year case relative to baseline, or 2.6 percent under the 5-year case.

46. In terms of its impact on the economy, the adjustment process yields more substantive positive effects under 5-year repair in light of the more rapid consolidation. It leads to a higher trade balance in the near-term, causing a larger depreciation. Higher net exports also lead to excess demand and therefore inflationary pressures, leading to tighter monetary policy via an increase in the overnight cash rate. The excess demand also reduces investment risk as firms have a lower probability of default and firms actually face lower corporate interest rates compared with repair under the longer 10-year horizon.

47. As an offset to the short-term costs as a result of adjustment over either the five- or ten-year horizon, infrastructure investment is introduced. There is a small increase in deficit-financed spending devoted to infrastructure investment (of 0.25 percent of GDP for each of the first two years) which is a direct stimulus to real GDP through government absorption. This spending is likely to buttress productivity at a time of falling capacity. It also encourages a larger real exchange rate depreciation, which further magnifies the positive effects in the external sector. Nonetheless, in light of it size effect, it does little to counteract the large short-term impacts if a risk such as the "new mediocre" were to materialize.

48. In conclusion, budget repair may be difficult to carry out fully at this juncture. There is uncertainty on the required magnitude for budget repair, since it is dependent on revenue forecasts. These forecasts, as shown in Section C, have a history of being over-optimistic, so the required amount for budget repair could practically be larger than 1 percent of GDP. Furthermore, budget repair is relying on rebalancing of the Australian economy, shifting to the external sector from the domestic sector, which may not be a desired outcome for the Government. This is also why a shorter horizon works better, as it takes advantage of a quick external sector adjustment, where the larger depreciation offsets the larger consumption contraction.

49. Regardless, budget repair under the "new mediocre" could also prove to be a much costlier endeavor than what it entails in terms of attaining the 1 percent surplus target. Beyond the initial required adjustment in the magnitude of an equivalent 1 percent of GDP improvement in the budget balance, the automatic social transfers and weaker tax base effects, estimated at 0.9 percent of GDP in our illustrative scenario, need to also be offset. Budget repair in such an environment would also prevent the Government from engaging in additional stimulus, which is not consistent with its historical stimulative behavior under economic stress– for example, the estimated 4.5 percent of GDP fiscal impulse at the onset of the global financial crisis in FY2008/09.

F. Suggesting a New Long-Term Fiscal Strategy

50. Once the desired medium-term balance anchor has been achieved, we can turn to issues of stabilizing the long-term level of debt on a sustainable basis. We propose an extension to the current fiscal framework, with the introduction of a long-term debt anchor. In better explaining the motivation and analysis of such strategy, this is done over four parts. First, we discuss the long-term spending pressures that motivate the extension to a long-term anchor. Second, we compare the efficacy of a long-term debt anchor to that of the existing medium-term balance anchor under three illustrative scenarios, namely an unexpected and substantial pick-up in aggregate demand, a boom-bust cycle related to swings in the global price of metals, and the "new mediocre," using a set of metrics related to debt sustainability and economic stability. Third, we show ways of implementing the long-term debt anchor, based on combinations of an expenditure-debt rule under differing speeds of adjustment to achieve the debt target. We consider this under an optimized mix of indirect versus direct taxes setting. Fourth, we conduct again the aggregate demand scenario and boom-bust cycle from the second part to better elucidate the strengths of the fiscal rules under consideration once again using the set of metric mentioned above. We conclude our analysis by looking at potential short-term effects of clear and credible communication on the adjustment process.

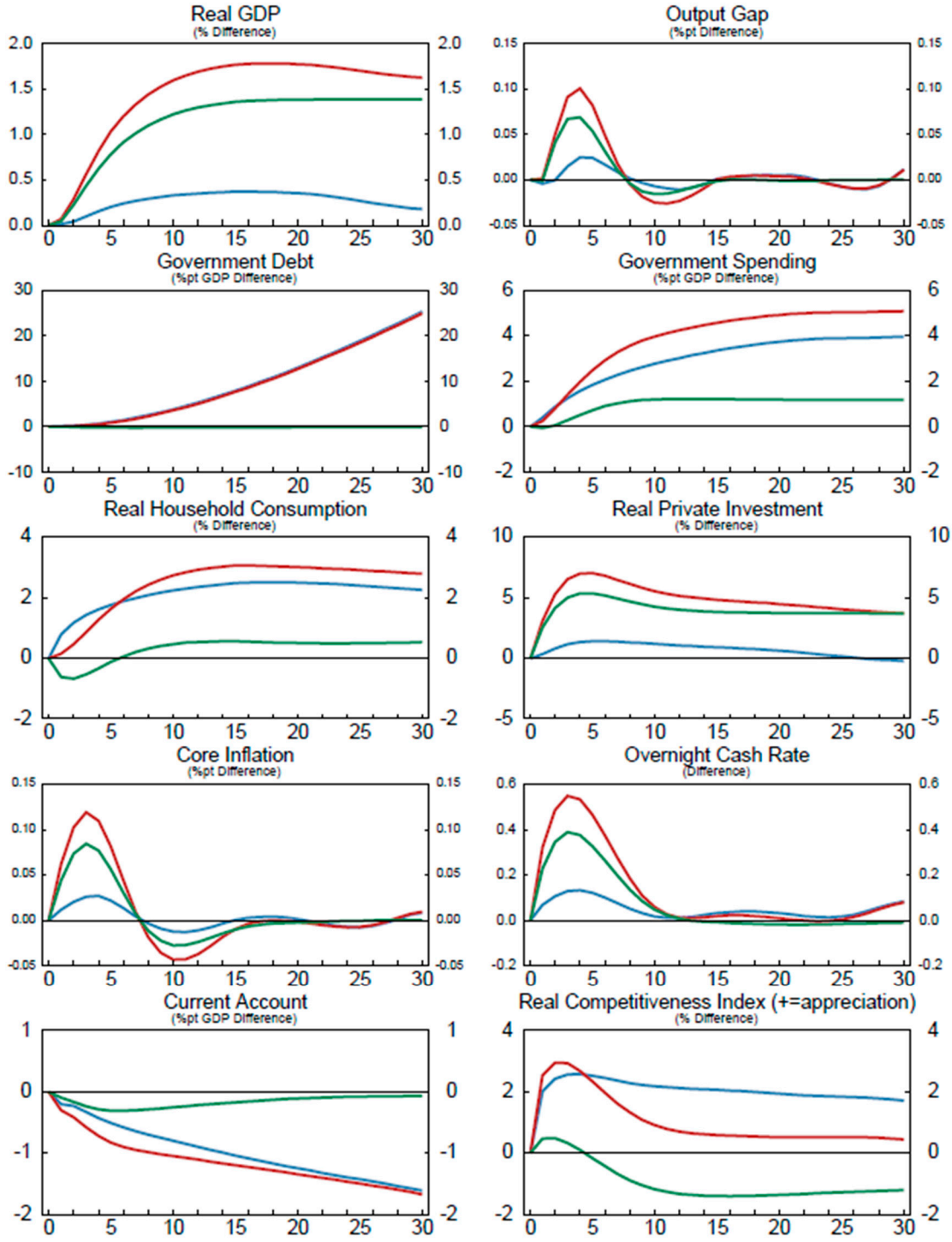
Long-Term Spending Pressures from Demographics

51. Long-term pressures on the budget related to primarily demographic issues such as health care, aged care, and pensions are looming. By 2050, IGR 2015 estimates that the Government will have to spend an additional 2.5 percent of GDP on such outlays. Even assuming a linear trend starting from zero in 2021, and reaching its long-term value after 30 years, we estimate this to add up to 21 percent of GDP of net debt in 2050. Moreover, in the very long term, net debt would stabilize after increasing by a whopping 58 percent of GDP. This is referred to below as the '*No Policy Action Scenario'*.

Figure 7. Long-Term Spending Pressures

(Percent deviation from baseline, unless otherwise stated)

No policy action to offset spending pressures
Add tax switching by reducing income taxes and increasing GST
Add a balanced budget with help of general transfer adjustments



Source: IMF staff calculations.

52. Apart from consolidation, there are measures available to the Government that could lessen the pressure on the Australian economy. In this regard, revenue-neutral tax switching is proposed. While it does not prevent the large run-up in debt, it does ameliorate the situation somewhat, and strengthen domestic demand in face of the crowding out effects of increased government demand for funds in the economy. We propose a reduction in direct taxes – the CIT by 0.7 percent of GDP, the PIT by 1.4 percent of GDP – offset by an equivalent GST increase worth 2.1 percent of GDP, similar to that proposed in Pitt (2015). This is referred to below (and in Box 2) as the '*Tax Switching Scenario*', which embeds the no policy action scenario.

53. Given that this tax strategy does not reduce the debt burden significantly, we further propose the fiscal consolidation required to achieve debt control. For simplicity, to contain the costs that could result, we consider cuts in other lumpsum transfers, outside of aged care and pensions. The government adheres to a balanced budget, aside from allowing for the effects of automatic social transfers. We refer to this as the '*Simple Balanced Budget Scenario'* which builds on the tax switching scenario.

54. We see in the *No Policy Action Scenario* that real GDP is stronger by less than 1 percent after 30 years (Figure 7), This is despite the strong increase in general transfers, which feed directly into household consumption, which increases in the long-term by about 2 percent. Not only does the spending have an immediate impact on LIQ households, but it also changes the consumption profile of OLG households, given the inevitable and inexorable path of spending increases. Private investment, on the other hand, suffers as it is crowded out by government debt, holding roughly at 0 percent relative to baseline in the long term. Nonetheless, the additional consumption demand stimulates the supply side on the economy, and increases demand for both capital and labor as factors of production.

55. The new spending increases government debt, which is dissaving, increasing the demand for foreign financing, with overall little changes in GDP. This increases the Australian net foreign liability position further, by about 20 percent of GDP, and lowers the current account, thereby supporting a notable real appreciation of around 2 percent relative to baseline in the long term. There is a rebalancing between the domestic and external sectors, with a worsening net trade position offsetting the strength in consumption. Overall, real GDP barely changes.

56. Under the *Tax Switching Scenario*, the long-term positive effects of PIT and CIT cuts are greater than the equivalent increase in the GST and confer strong positive effects on real GDP (Box 2). The CIT cut has a direct positive impact on investment demand, while the PIT cut works to increase labor supply and income.. Indirect effects from PIT and CIT also play an important role in decreasing costs for firms, stimulating potential output, and generating positive effects on wealth through the capital stock and labor income. The GST increase works against consumption, and offsets some of the positive impacts of both the PIT and CIT cuts. In aggregate, consumption gains 0.5 percentage points, and investment gains 4.0 percentage points so that real GDP is about 1.4 percentage points higher, all relative to the *No Policy Action Scenario*.

57. Since the tax switching acts as a positive supply shock, the output gap goes into excess supply before rising as the expansion becomes more general. However, there are positive inflationary pressures from higher demand on impact, leading the RBA to increase the overnight cash rate by over 50 basis points to maintain inflation on target. In the short term, the RBA could play a role in amplifying the positive effects from the tax switching regime by changing the overnight cash rate, thereby preventing some of the rebalancing against the domestic sector.

Box 2. Decomposition of the *Tax Switching Scenario*

We decompose the tax switching scenario into two components. First we consider a switch from the CIT to the PIT (on both wage and dividend income) of 0.7 percent of GDP. Second, we analyze a further switch from PIT (on wage income alone) to GST, of 2.1 percent of GDP. A roughly linear combination of these two switches give us the results for the *Tax Switching Scenario* in Figure 7. A key point to remember that PIT is not only payable on all households' wage income, but also on dividend income, exclusively received by OLG households.

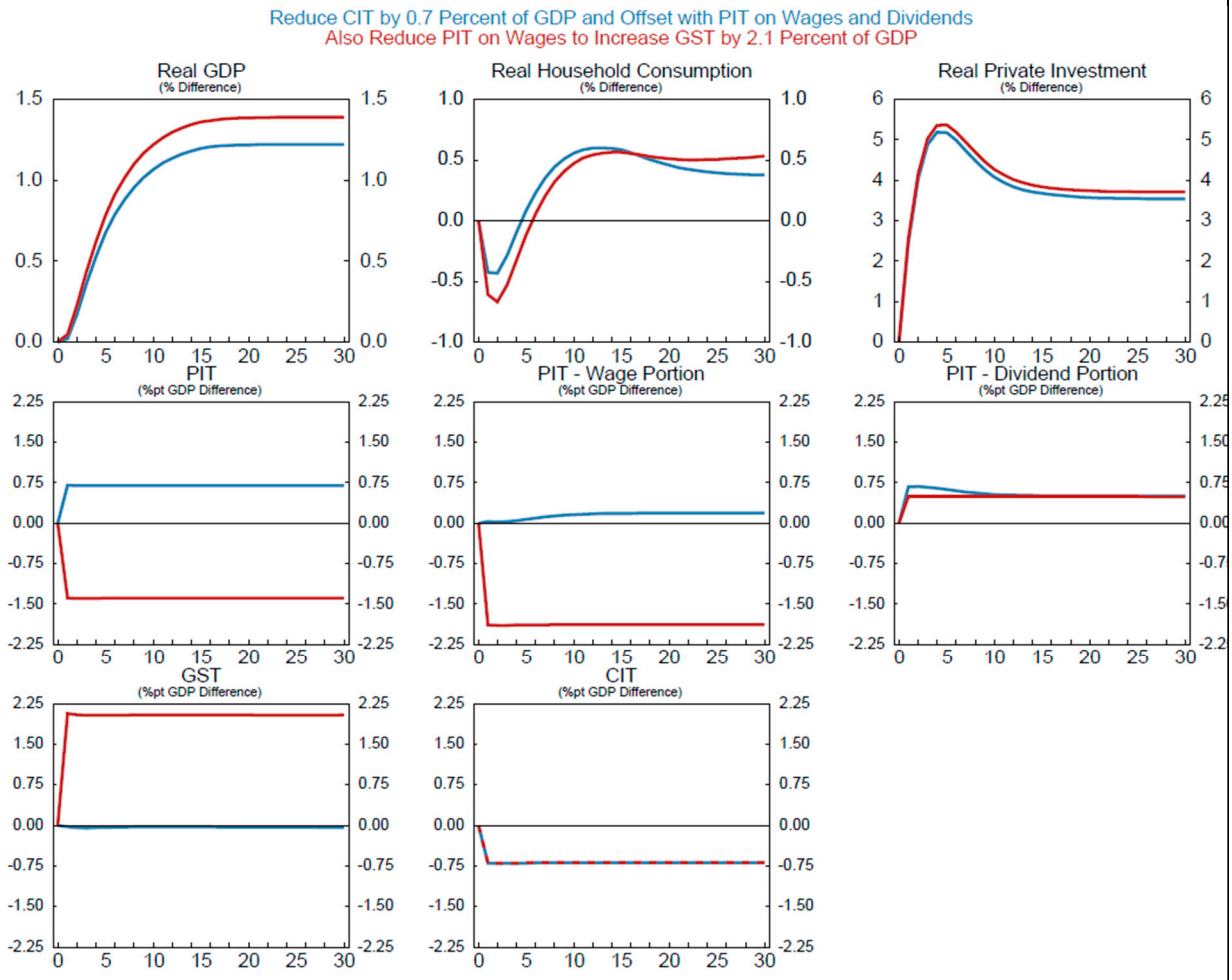
First, we consider the switch from CIT to PIT. When the CIT is cut, OLG households will receive fewer franked dividends, and automatically face a greater tax liability for their dividend income (see the fiscal section of Appendix I for a discussion of franking). There will be only a slight increase in taxes on wages, and dividend income will bear the brunt of the PIT increase. When the cut in CIT is netted with the aggregate increase in PIT, the increase in investment outweighs the direct negative impact of the PIT shift on consumption, which is offset within the first 5 years.

Second, we consider a further switch from PIT to GST. For the second part of the scenario we decrease the wage portion of the PIT (instead of increasing it), in order to offset it with a 2.1 percent of GDP increase in the GST. Because the GST increase dampens consumption for both OLG and LIQ households immediately, but the PIT cut serves to stimulate it, we find that the effect on real GDP is relatively weak at 0.3 percent of GDP – a small multiplier of 0.14. This is in line with work presented by the Treasury (Commonwealth of Australia, 2016).

Box 2. Decomposition of the *Tax Switching Scenario* (concluded)

Tax Switching

(Percent deviation from baseline, unless otherwise stated)



Source: IMF staff calculations.

58. Under the *Balanced Budget Scenario*, a key channel is the crowding in of private investment, as private saving and foreign assets are no longer being diverted to the government. Furthermore, the embedded tax switching acts to arrest the rebalancing of the economy towards the external sector, encouraging an expansionary depreciation of 1.2 percent relative to baseline in the long term. Import compression occurs, but is offset by the expansion that is occurring from private investment, which happens to be more import-intensive than household consumption.

59. Going forward, the *No Policy Action Scenario* is our *Benchmark Scenario*. To summarize, under the *Benchmark Scenario*, if nothing is done to offset future spending pressures, net government debt and the net foreign liabilities position deteriorate in the medium term. Under such a benchmark, additional possible risks, such as sovereign risk premia that would raise the

government's borrowing costs, and possibly that of the economy as a whole, further crowding out investment and discouraging consumption are not explored.

60. We posit that we can improve outcomes with a government-debt-to-GDP target as a long-term anchor. To achieve this, a long-term fiscal strategy is required. To illustrate, we carry out our analysis under a constructed environment, where the benchmark scenario is taken as given, with its large run-up in debt, and examine the reaction of the economy to the implementation of the long-term anchor over the medium-term horizon of 2021 to 2050. The tax switching is maintained in attempt to better position future fiscal actions. Our method is analyzing a debt norm – considered to be a reduction of net government debt by 10 percent of GDP - to better elucidate the costs and benefits involved. We intend to demonstrate that there are benefits to a long-term debt anchor, and to that we now turn.

The Argument for a Long-Term Debt Anchor

61. A long-term debt anchor provides certainty for households and firms in their decision making. Just as price stability removes uncertainty about the nominal economy, a set debt target removes a significant source of uncertainty about the real economy. Government debt is a vital part of wealth holdings by households. It also crowds in or out net foreign liabilities (through its flow, the current account) and capital stock (through its flow, investment). Therefore, a long-term debt anchor (a stock concept) helps stabilize the Australian economy in a way which the medium-term deficit anchor (a flow concept) cannot. The adoption of a long-term debt anchor can help governments which are committed to fiscal responsibility strengthen the institutional basis of their commitment, and signal it domestically and internationally, thus reaping benefits from increased policy credibility.

62. We assess whether the long-term debt anchor performs better than the medium-term balance anchor when faced with economic surprises, under different scenarios. We consider three illustrative scenarios that cover both demand and supply disturbances, that can be regarded as possible upside and downside risks:

1. ***A temporary but substantial increase in aggregate demand (Box 3).*** We assume that aggregate demand turns out to be stronger than expected by about 2 percent of GDP at its peak in year 3.

2. ***A terms-of-trade-driven boom-bust cycle (Box 4)***. We build a term-of-trade boom-bust cycle by imposing a path of real global metals prices that loosely matches the changes in the RBA's Index of Commodity Prices.

3. ***The "new mediocre" (Box 1):*** We consider again the combined secular stagnation and permanent negative terms-of-trade shock. While a risk, it can be argued that it may not unfold for years to come. It is important to understand that the shock is a negative one to future expectations, and not a well incorporated and understood decline in outcomes by forward-looking households and firms.

63. We analyze three different fiscal rules to draw our conclusions. Under the first considered rule, a current medium-term balance anchor is held over the course of the business cycle; this is interpreted as a flexible BBR over 7 years (flex BR in Table 3 below). Two debt rules (DR) are then deployed in attempt to achieve the long-term debt anchor – one strictly holds debt at its target (strict DR) and the other achieves the debt target flexibly, consistent with a 10-year horizon (flex DR (10 yrs)), as shown in Table 3 below.

64. Evaluating the relative performance of the fiscal rules is based on five indicators. As guiding principles, rules are evaluated against achieving debt control (debt reduction along a debt norm path) and economic stabilization (primarily their degree of countercyclicality), based on the methodology presented in Kinda (2015). Debt control should have a degree of flexibility, which is measured by the root mean squared deviation (RMSD) from the debt norm; the further from 0, the more debt can respond under a rule to any given shock, which should minimize additional adverse impacts on real GDP. Debt control is also a matter of precision, which can easily be measured as the deviation from target as a particular year (here, 10 years by 2030) and also by the absolute mean deviation of debt from the debt norm path where closer to 0 is preferred. On the other hand, economic stabilization can be captured by the variability of real GDP over 10 years (where closer to zero is preferred) and by a measure of procyclicality.

Box 3. A Temporary but Substantial Increase in Aggregate Demand

We consider a temporary but substantial increase in aggregate demand. Real GDP peaks at over 1.6 percent above the baseline in the third year. Investment movements are significantly more sizeable than consumption (in the order of four times) relative to baseline. The government deficit moves in tandem with changes in revenues and expenditures – tax rates are exogenous, as is spending, except for the automatic social transfers.

Monetary policy plays a key role. As the economy enters excess demand (the output gap is greater than zero), there are upward pressures on inflation, which must be addressed by the RBA in achieving its mandate of price stability. They increase the policy rate by 2.5 percent by the second year, and maintain it an elevated level into the fifth year.

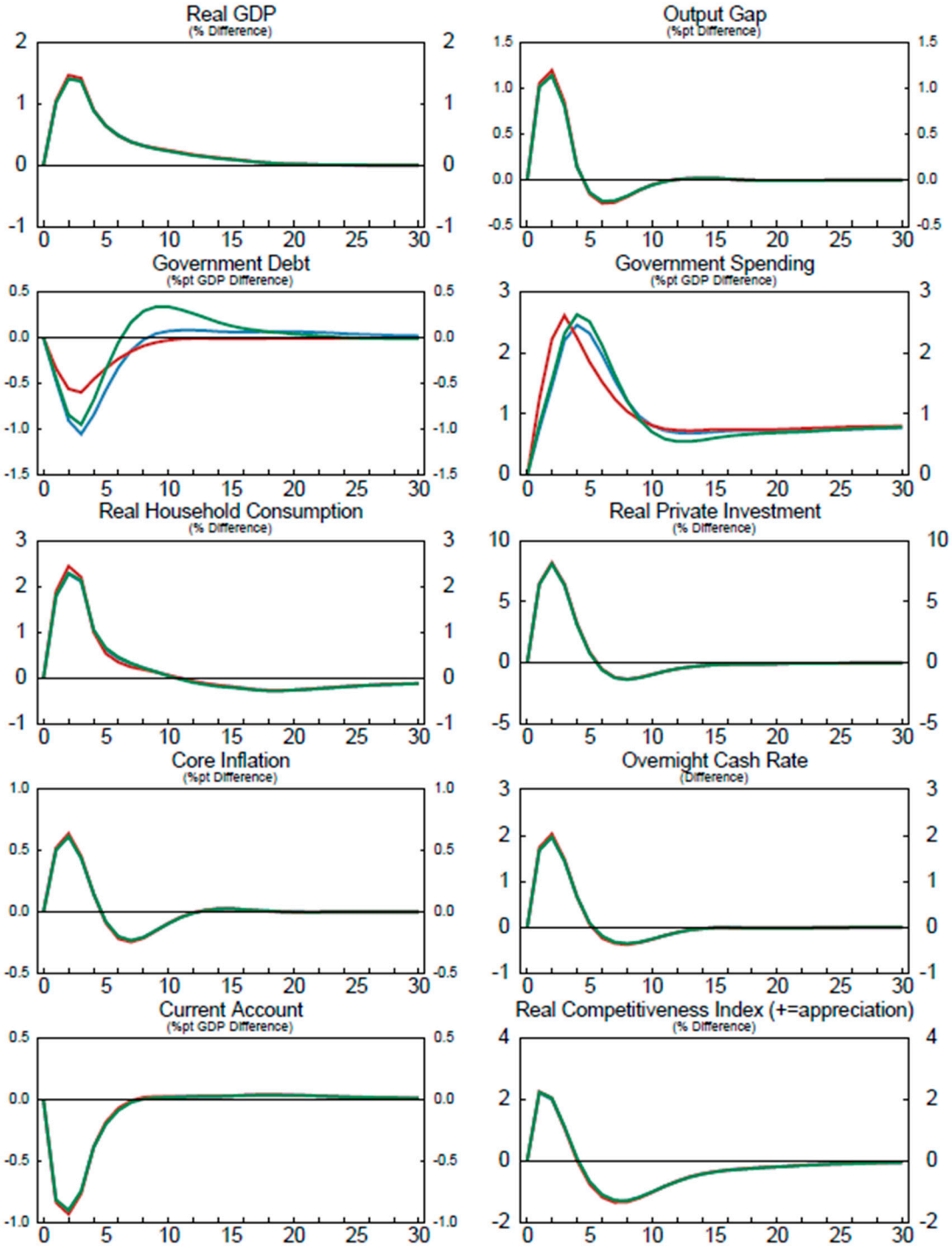
Economic growth results in a strong debt consolidation. The government deficit falls by almost 0.9 percent of GDP in the second year.

Elsewhere in the economy, the external sector worsens. Import demand is higher, encouraged by the upward pressure exerted by monetary policy on the real exchange rate. Here, we are assuming fiscal policy follows the simple balanced budget rule and reduces social transfers, meaning fiscal policy is countercyclical and works against the increase in aggregate demand.

Box 3. A Temporary but Substantial Increase in Aggregate Demand (concluded)

(Percent deviation from baseline, unless otherwise stated)

Medium-Term Balance Anchor
Long-Term Debt Anchor = Strict DR over 10 Years
Long-Term Debt Anchor = Flexible DR over 10 Years



Source: IMF staff calculations.

Box 4. A Terms-of-Trade-Driven Boom-Bust Cycle

The terms-of-trade-driven boom-bust cycle causes substantial disruptions over the first ten years. As is the case with most boom-bust cycles, we assume that during the boom years, there is only an expectation that commodity prices will stabilize; there is no prescience of a collapse (as in Rees and others, 2015). This makes the downturn that much more disruptive for the economy in general, and investment in particular. The government deficit moves in tandem with changes in revenues and expenditures – tax rates are exogenous, as is spending, except for the automatic social transfers.

The boom-bust cycle is strongly reflected in real GDP fluctuations. There is a continuing upward expansion in the first 4 years, then as real global metals prices unexpectedly unwind and undershoot their long-term trend, real GDP weakens and contracts before strengthening to return to its trend path after about 10 years.

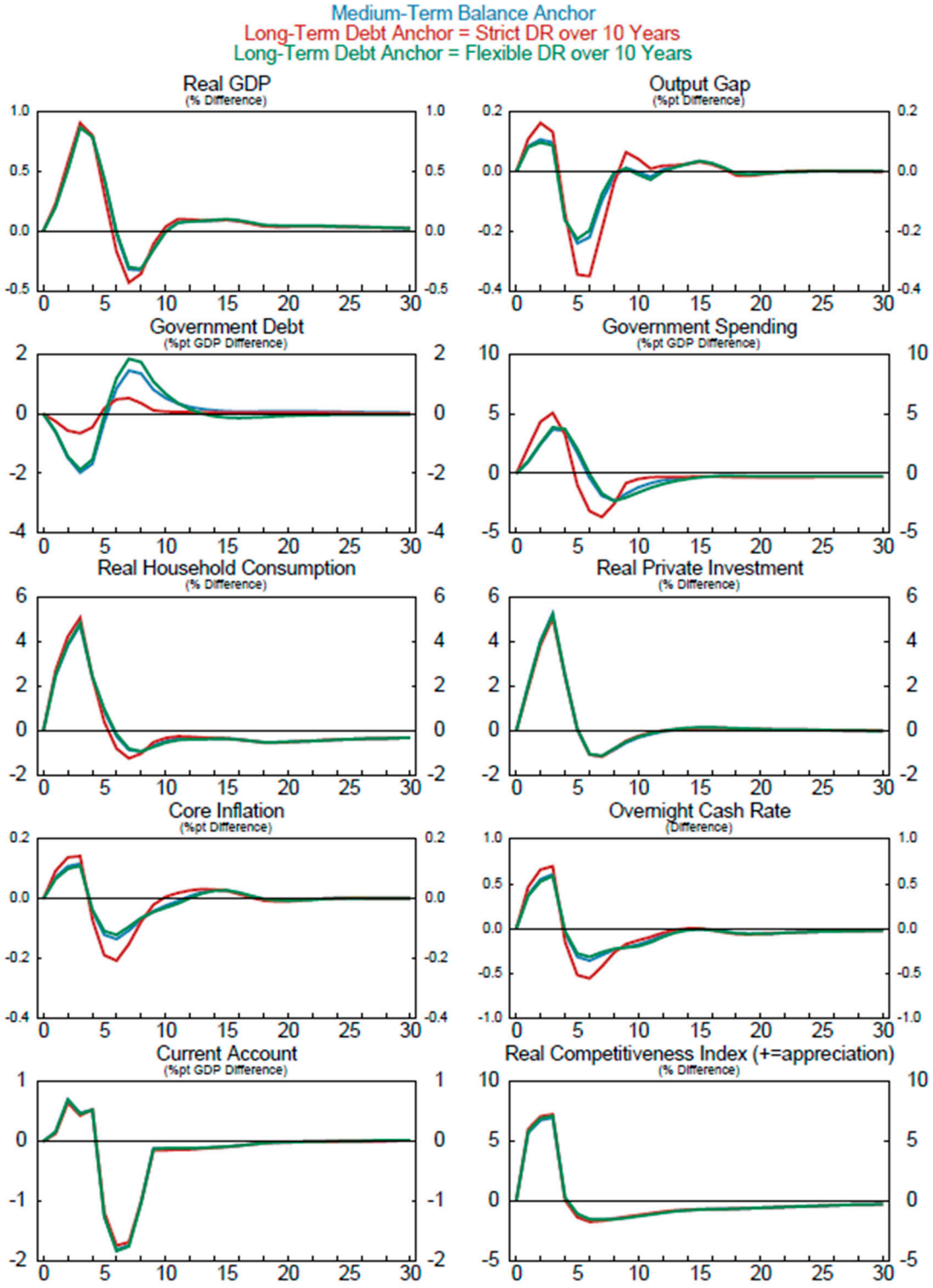
In the first part of the cycle, there are highly expansionary wealth effects which encourage private investment. The follow-up contraction leads to a fall in investment, falling to 2.6 percent below baseline in the sixth year from its peak of 2.2 percent above the baseline in the third year. Investment is also the driver for the behavior of imports. Note that the investment response is different from the current boom-bust cycle, which had a large infrastructure component for mining. We assume that the current infrastructure will be sufficient to accommodate another boom, and will not cause an additional investment response.

The rapid appreciation is part of the commodity price cycle, which generates a wealth transfer to commodity exporters such as Australia, while the converse is true during the downturn, with a large depreciation. In the case of non-mining exports, the exchange rate is the dominant influence, so they first contract during the economic boom, and expand during the downturn. Therefore, non-mining exports are countercyclical and help stabilize the economy to some degree.

Monetary policy works to smooth the cycle. Since a boom-bust cycle is a classic aggregate demand shock, inflation first rises then falls, meaning that the cash rate cycles in the same way, peaking at +50 basis points in the second year, before troughing at -50 basis points in the fifth year, relative to baseline.

Box 4. Terms-of-Trade-Drive Boom-Bust Cycle (concluded)

(Percent deviation from baseline, unless otherwise stated)

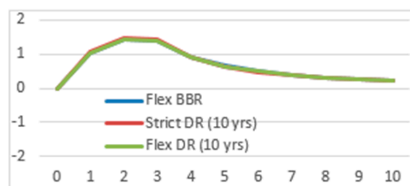
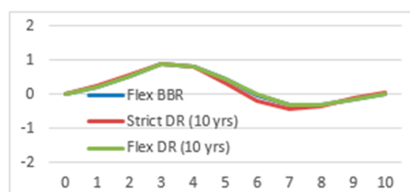
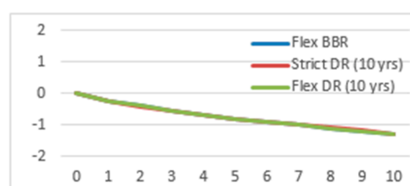


Source: IMF staff calculations.

65. The measure of procyclicality is centered around zero, comparing the change in the primary surplus with that of the change in the output gap. Fiscal policy is considered procyclical if the output gap becomes more positive (negative) and primary surplus decreases (increases), then. The preference is for countercyclicality, where the primary surplus and the output gap are positively correlated, where fiscal policy works on smoothing business cycle movements, and provides economic stabilization.

66. In summarizing the results, we argue that the long-term debt anchor outperforms the medium-term balance anchor (Table 3). The RMSD shows that there is more flexibility (debt would respond better to shocks) under the flexible debt rule, as can the medium-term balance anchor. The debt rule is more precise in the long-term, as shown by the lower value for the AMD for both debt rules. We also learn that real output is less variable under the debt rules implying more certainty of the outcome and more rapid adjustment on the part of households and firms as they make their behavioral choices. By design, the DR achieves faster convergence to the desired debt-to-GDP ratio. Furthermore, the medium-term debt anchor is more countercyclical, but flexible DR also demonstrates notable countercyclicality. Given the fact we do not capture the uncertainty inherent in the long-term end-point in the announced medium-term balance anchor in the results here, the long-term debt anchor under the flexible DR performs strongly.

Table 3. The Long-Term versus the Medium-Term Anchor

	M-T anchor Flex BBR	L-T anchor Strict DR	L-T anchor Flex DR (10yrs)	Additional real GDP difference
Under a Temporary Increase in Aggregate Demand				
1. RMSD	0.6	0.4	0.5	
2. AMD	0.5	0.3	0.4	
3. Difference in 2030	0.1	0.0	0.3	
4. Procyclicality	-1.0	-0.3	-0.9	
5. GDP variability	0.45	0.47	0.45	
Under a Terms-of-Trade-Driven Boom-Bust Cycle				
1. RMSD	1.2	0.4	1.3	
2. AMD	1.1	0.4	1.2	
3. Difference in 2030	0.5	0.1	0.7	
4. Procyclicality	-3.2	-0.1	-2.8	
5. GDP variability	0.44	0.47	0.43	
Under the "New Mediocre"				
1. RMSD	1.0	0.3	0.8	
2. AMD	1.0	0.3	0.7	
3. Difference in 2030	1.1	0.3	0.5	
4. Procyclicality	0.0	0.0	0.0	
5. GDP variability	0.35	0.34	0.35	

Sources: IMF staff estimates and calculations

Implementing the Long-Term Debt Anchor with Fiscal Rules

67. To implement the long-term debt anchor requires a long-term fiscal strategy. In practice, there should be a consolidation plan to support both macro and fiscal stability. The outcome should be that real GDP would be larger and debt would be expected to be more

sustainable than otherwise. To support a long-term debt anchor, and take full advantage of its power, there should be a regime based on an aggregated rule that is a composite of explicit fiscal rules. The component fiscal rules need to be appropriate to macro-fiscal conditions and institutional settings.

68. The rationale for adopting legislated numerical fiscal rules can be weaker in a country like Australia. It has a well-established record of responsible fiscal policies under Governments of different political ideologies. The question is how do the potential benefits of a clearly and specifically defined fiscal policy targets backed by a stronger legal basis compare with their potential costs. We also recognize that fiscal rules are not a panacea. They involve delicate trade-offs between ensuring inter-temporal consistency in the conduct of fiscal policy, and garnering an appropriate degree of flexibility in fiscal management (ensuring a scope for countercyclical policy and the full operation of automatic social transfers). These trade-offs can be moderated, through an appropriate design of the rules, such as the inclusion of escape and revision clauses. Such flexibility generates better growth and debt outcomes, and governs the choices on the rules we implement below.

69. We analyze the aggregated fiscal rules under an intuitively constructed environment. Our medium-term target horizon extends between 2021 and 2050, taking the benchmark scenario as given, with its large run-up in debt. We implement tax switching to better position future actions. Our analysis is then based on a debt norm, defined as a reduction in net debt of 10 percent of GDP relative to the benchmark scenario, in better tracking the costs and benefits under consideration. This is treated to be the '*benchmark consolidation*' case.

70. For our analysis, we construct three different aggregated rules. We draw components from the different types of fiscal rules, as defined in Section D. Guided by both *Budget 2016-17* and IGR 2015, we focus on the component rules deemed most relevant to the Australian situation:

- ***An expenditure rule (ER)*** – We assume that government consumption and general transfers grow at only 2 percent a year for 10 years starting in 2021, roughly consistent with the average over the WEO horizon extending from 2016 to 2020. This is also in line with the Government's stated goal of reducing the size of government. Relative to *Budget 2016-17*, this means a reduction spending growth by 0.9 percentage points each year.

- ***Variants of a debt rule (DR)*** – We meet the long-term government debt target after 5 or 10 years by varying the GST rate to achieve the debt norm of 10 percent, with either a strict or flexible pursuit of the debt norm path from 2021 to 2050.

Given these component rules, we choose three aggregated fiscal rules:

- ***ER + strict DR***, where 90 percent of debt norm is achieved by 2030, with a strict adherence to the debt target each year;

- ***ER + flexible DR***, where 90 percent of debt norm is achieved by 2030 (***over 10 years***) allowing for some variability in debt that is consistent with an average business cycle frequency of six to

seven years, further implying an average decrease in the deficit of around 1 percent of GDP relative to the '*benchmark scenario'*; and

- ***ER + flexible DR***, where 90 percent of debt norm is achieved by 2025 (***over 5 years***) allowing for some variability in debt that is consistent with an average business cycle frequency of six to seven years, and an average decrease in the deficit of around 2 percent of GDP relative to the '*benchmark scenario*'.

71. In the benchmark consolidation, real GDP is always stronger, thanks to the embedded tax switching strategy (Figure 8). However, there are short-term downward pressures from the consolidation. The profiles of real GDP depend on the rule in force. The shorter time horizon of 5 years inflicts the largest near-term costs, while the more flexible rules allow real GDP to react positively to the tax switching, with debt reacting more gradually to it and to the expenditure rule.

72. The components of domestic demand act at cross purposes in the short term. Consumption is weakened by the increase in GST to pursue debt reduction, dominating the positive effects from the PIT cut. At the same time, private investment is stronger because of the lower CIT, with further crowding in from the reduction in government dissaving. This dichotomy is reinforced by the DR with 5-year adjustment.

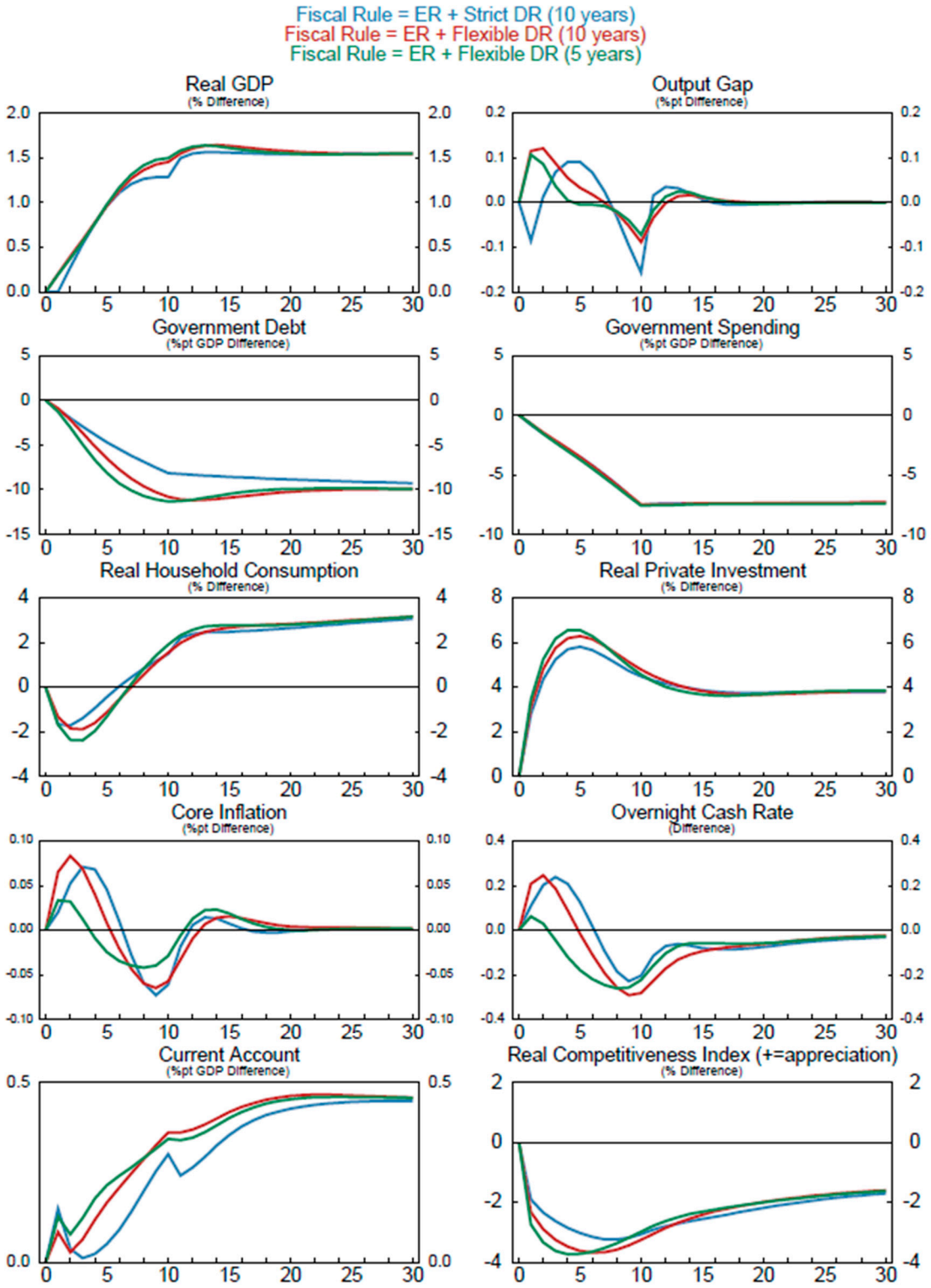
73. In the short-term monetary policy acts as a drag, except under the five-year horizon. The RBA works to maintain its inflation target, which smooths the path of real GDP. The GST is increased so much under the DR that weakness in consumption is disinflationary, and the RBA increases the overnight cash rate less on impact, followed actually by further cuts in the medium term.

74. In the long term, the components of domestic demand move in one direction. The positive investment effect as exhibited over the short term applies, and helps expand the productive capacity of the economy, leading to higher labor demand and wages. With the increase in labor income and wealth, consumption flips to become a positive contributor to GDP as is the case with private investment.

75. The reduction in government debt means that there are less domestic assets available to households. So in order to maintain a certain desired level of financial wealth, households would demand more foreign assets, which implies a higher current account is required to accumulate those assets, especially in the short term. Furthermore, the real exchange rate depreciates as more goods are available that need to be sold abroad.

Figure 8. The Benchmark Consolidation

(Percent deviation from the *No Policy Action Scenario*, unless otherwise stated)



Source: IMF staff calculations.

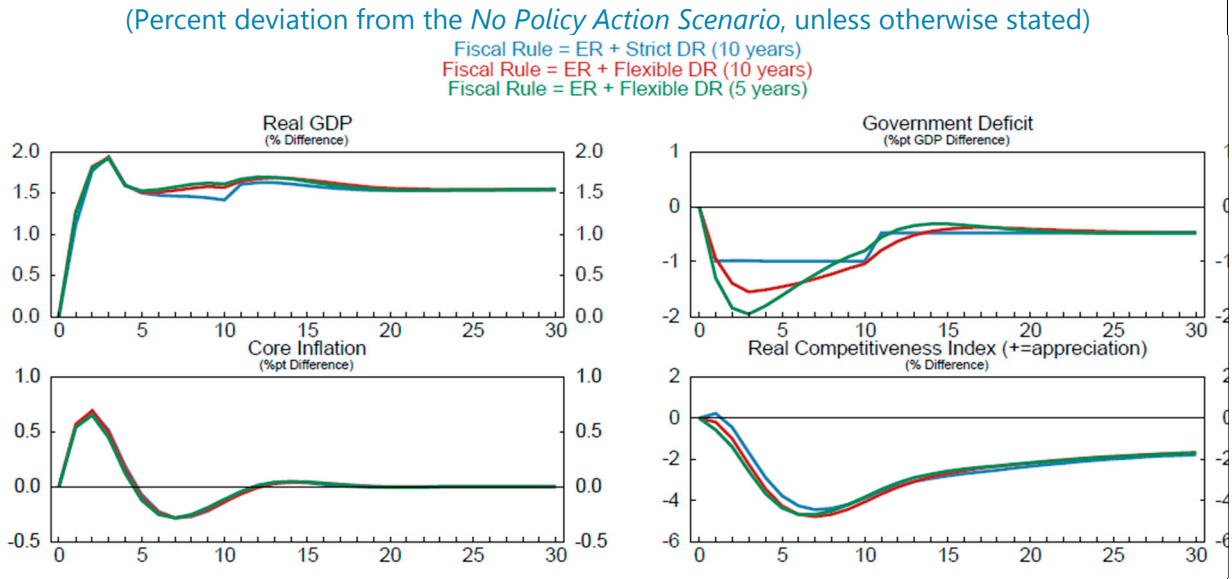
76. These results are stronger when the debt rule is more aggressive, pursuing the five-year horizon to meet the target. The faster convergence to the long-term debt target implies changes in economic flows occur rapidly in the first several years. As noted above, since GST is the adjusting instrument, this further reduces consumption in the short-term and lead to looser monetary policy and stronger private investment. The faster government dissaving leads to a quicker real exchange rate depreciation, with larger current account surpluses on impact.

The Best Aggregated Fiscal Rule for the Transition Regime

77. We assess below which debt rule performs the best under the benchmark scenario and other illustrative downside scenarios. In weighing the effect of risks, we revisit two of our illustrative scenarios from above in order to compare the usefulness of the long-term and medium-term anchors – the unexpected temporary but substantial increase in aggregate demand (Box 3), and the terms-of-trade-driven boom-bust cycle (Box 4).

Figure 9. The Consolidation under a Temporary but Substantial Increase in Aggregate Demand

(Percent deviation from the *No Policy Action Scenario*, unless otherwise stated)

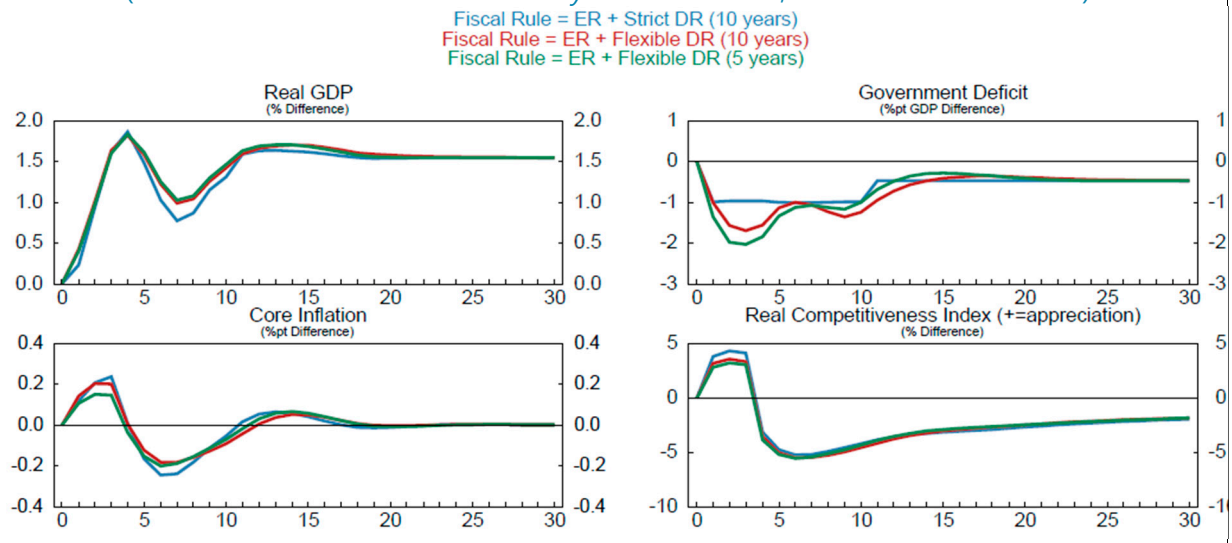


Source: IMF staff calculations

78. First, consider the temporary but substantial increase in aggregate demand in the context of the benchmark consolidation (Figure 9). Relative to the benchmark scenario, there is more slack in the economy. There is the potential for higher revenues, and automatic social transfers are lower. Prices (including the real exchange rate) face additional upward pressures, requiring a tightening in monetary policy. In terms of the aggregated fiscal rules, the primary role of the increase in aggregate demand is to modify the amount the Government needs to increase the GST to meet its debt rules. The increase in GST also dampens the effect of the shock; it is no longer just the role of monetary policy.

Figure 10. The Consolidation under a Terms-of-Trade-Driven Boom-Bust Cycle

(Percent deviation from the *No Policy Action Scenario*, unless otherwise stated)



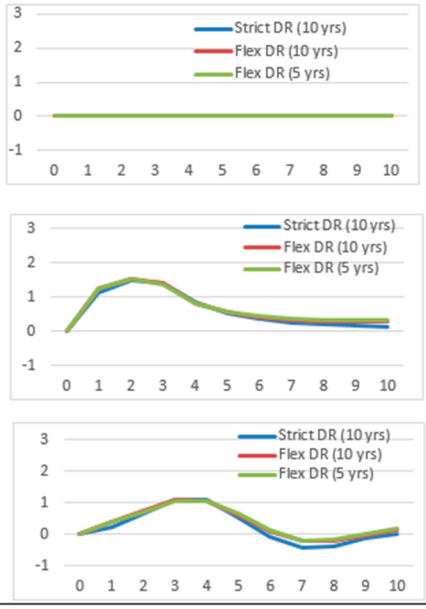
Source: IMF staff calculations.

79. Second, we analyze the impact of the terms-of-trade-driven boom-bust cycle on the benchmark consolidation (Figure 10). Real GDP is much more volatile, and this is reflected in fiscal policy, as the automatic social transfers should be more variable, causing greater interactions with the aggregated fiscal rules, but generally constrained by the ER component. The real exchange rate movements are now dominated by the commodity-driven swings, which is not the case in the benchmark consolidation, leading to an enhanced role for stability from both monetary and fiscal policy.

80. Both the ER and the DR are important for achieving the long-term debt anchor. The ER, by definition, always restricts government spending. So, when the economy is expanding it is countercyclical, all else equal, discouraging spending of additional revenues. But when there is an economic contraction, it is procyclical, all else equal, as it may offset the additional spending from automatic social transfers. On the other hand, the DR always works to reduce government debt. So in an expansion, it is countercyclical, absorbing at least some of the fiscal gains, but it is procyclical in a contraction, as it may offset automatic social transfers, just like the ER.

Table 4. Comparing the Performance of the Aggregated Fiscal Rules

	Strict DR (10 yrs)	Flex DR (10 yrs)	Flex DR (5 yrs)	Additional real GDP difference
Baseline Consolidation with Tax Switching ...				
1. RMSD	0.9	1.3	1.1	
2. AMD	0.6	1.1	1.0	
3. Difference in 2030	1.8	-0.9	-1.4	
4. Procyclicality	0.8	-0.5	0.1	
5. GDP variability	0.46	0.45	0.48	
... Under a Temporary but Substantial Increase in Aggregate Demand, or ...				
1. RMSD	0.9	1.4	0.9	
2. AMD	0.7	1.3	0.7	
3. Difference in 2030	1.8	-0.7	-1.2	
4. Procyclicality	-1.4	0.1	0.5	
5. GDP variability	0.22	0.18	0.17	
... Under a Terms-of-Trade-Driven Boom-Bust Cycle				
1. RMSD	1.1	1.2	1.0	
2. AMD	0.9	1.0	0.8	
3. Difference in 2030	1.9	-0.5	-1.2	
4. Procyclicality	-0.1	-0.1	-0.1	
5. GDP variability	0.47	0.40	0.41	



Sources: IMF staff estimates and calculations

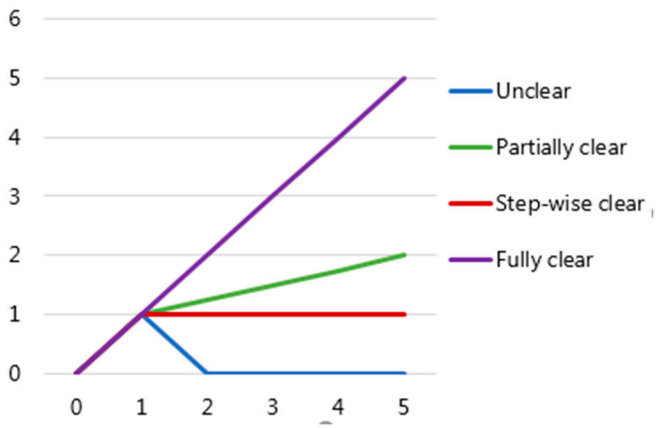
81. We analyze and summarize the outcomes in Table 4. The pace of consolidation ([3] of the criteria in the table) is as expected, since this is a design element of the rules. At least here the rules with the ER and the flexible DR may overshoot – something that would most likely not occur in real-world implementation. The rules with the ER and the strict DR are less flexible ([1] and [2]). They also restrict faster real GDP growth under the alternative scenarios, pushing towards greater countercyclicality [4]. The opposite is true for the rules with flexible DR, becoming more procyclical. Under the benchmark consolidation, such rules are more countercyclical [4], especially under the shorter consolidation horizon of 5 years. Their flexibility also allows automatic social transfers to work, resulting in slightly more real GDP variability [5]. This can be reduced by the faster consolidation rate of 5 years.

Communicating the Fiscal Rule

82. Any multi-year fiscal reform package is subject to scrutiny by households and firms. When the Government currently announces a fiscal policy path based only on the medium-term balance anchor, without clear long-term intentions on debt levels and spending, households and firms may not believe the announced path – the path lacks clarity (see Box 5). As a result, economic adjustment by firms and households could be insufficient, implying delayed, and possibly more costly, adjustment. In this sort of environment, which aggregated fiscal rule functions best under a new fiscal regime that is not communicated clearly?

Box 5. The Concept of Clarity

Four concepts of clarity are illustrated below. These can all be easily implemented in G20MOD.



1. **Fully or immediately clear** = Announced reform path is fully stated, so households and firms act upon it immediately and every year following;
2. **Unclear** = This year's reforms are believed and acted upon for only this year; everything returns to its original state starting next year;
3. **Stepwise clear** = This year's reforms are believed as permanent, but the future announced path is ignored; or
4. **Partially clear** = This year's reforms are believed as permanent, and some share of the future announced path is also believed and acted upon – usually contingent on previous years' actions

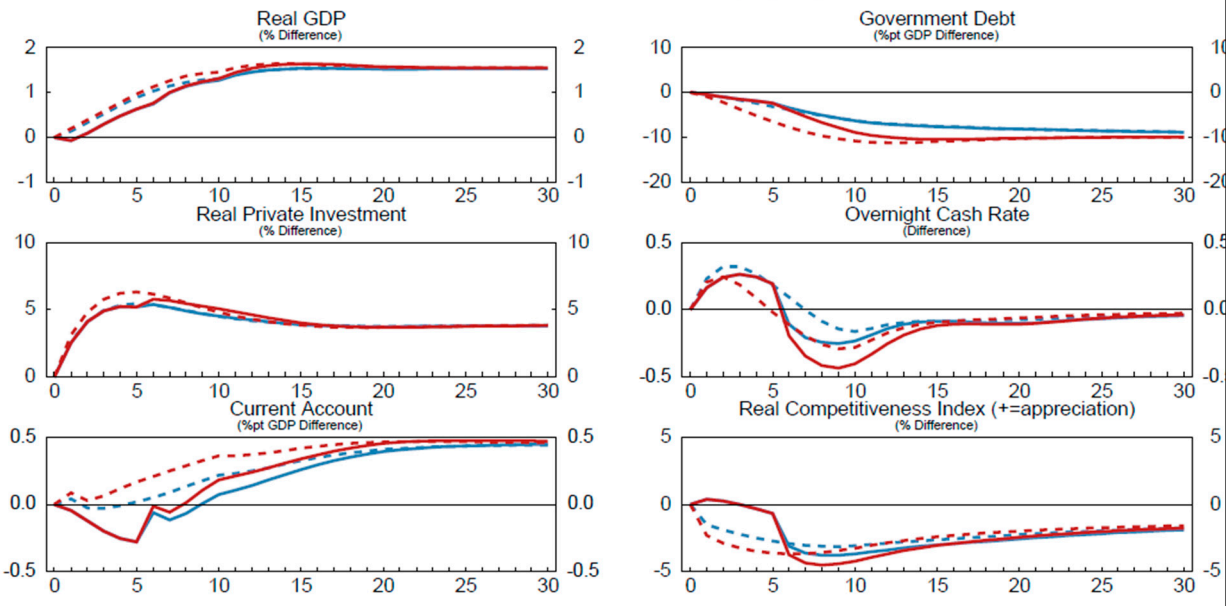
The role of clarity in the economy is heavily influenced by the share of LIQ households in the economy. The issue of clarity is irrelevant to LIQ households' decision process, as they consume only from current disposable income. Their perception of future has no bearing on current decisions, but they are affected by clarity through two other channels. First, firms make decisions that affect labor demand based on clarity. Second, LIQ households have a rule of thumb element in G20MOD, insofar that they take their labor supply decision as given from *OLG* households.

83. Figure 11 considers the transition to a long-term debt anchor under either an ER with the medium-term balance anchor (a flexible BBR), or an ER and a flexible DR over 10 years. How does this compare to a case where the Government's intentions are clear from the beginning? In the first year, households and firms believe that after the current year, no further debt reduction takes place (BBR and DR are both abandoned), and government spending growth returns to previous levels (ER abandoned). In the second year, households and firms are proven wrong by continued implementation of the Government's plans. Once again in the third year, they make the same decision. We assume this continues until the fifth year, when households and firms finally believe the Government will carry out their future announced actions.

Figure 11. Achieving a Fiscal Anchor – The Problem of Clarity

(Percent deviation from the *No Policy Action Scenario*, unless otherwise stated)

___ = Fiscal Rule = ER + Flexible BBR with clarity problems
- - = Fiscal Rule = ER + Flexible BBR
___ = Fiscal Rule = ER + Flexible DR (10 years) with clarity problems
- - = Fiscal Rule = ER + Flexible DR (10 years)



Source: IMF staff calculations

84. Unclear communications lead to more negative effects from fiscal consolidation, summarized by real GDP. Once forward-looking households and firms doubt the announced fiscal policy path, they do not account for future consumption and investment decisions. But as the Government enacts its path, the needed adjustment is much larger than it would be otherwise – this is particularly true of the debt rule, as it is more ambitious than the balanced budget rule, despite the flexibility present in both. Conversely, full clarity also allows households and firms to accrue benefits more rapidly, by borrowing against future gains in wealth – that is, they smooth their consumption. Some of the losses can be offset by the central bank, with greater decreases in the overnight cash rate.

Conclusions on the Long-Term Fiscal Strategy

85. The long-term fiscal strategy is better served if it uses an explicit long-term objective, such as a long-term debt anchor based on the government-debt-to-GDP ratio. We have demonstrated that a long-term debt anchor is better than a medium-term balance anchor. It can be achieved by the combination of an expenditure rule and a debt rule. Our subjective ranking on which rule is best on the sustainability of debt and stability of the economy during transition to the long-term debt anchor is as follows.

86. We prefer the flexible DR that aims to return debt to its target after 10 years, even though it is a slower adjustment to the debt norm. This rule is more consistent on procyclicality across our illustrative scenarios and is closer to zero. Debt behavior is more flexible under this rule,

as shown by the higher values for RMSD, although this sacrifices somewhat on precision of achieving the target (the higher values for AMD). On the positive side, real GDP is less variable.

87. Our second choice is that of the flexible DR returning debt to its target after 5 years, followed by the strict DR. The differences are not substantial, and either of the flexible DR may be more advantageous than the strict DR as they provide greater certainty, either through a shorter adjustment horizon, or a definitive stance on the debt target in any given year.

88. Using the GST as the adjusting fiscal instrument would require some tactical planning. The Commonwealth and State governments could introduce a portion of the GST that accrued strictly to the Commonwealth government, which the Commonwealth could then use as a policy instrument. In that case, for example, the Government could propose a schedule of implementation of increase in GST in its tax switching. In addition, they could announce a schedule of tax credits that increase as needed later on. Another approach would be to announce tax credits even in the short term, and offset the weakening effects on revenues by broadening the tax base now.

G. Conclusions

89. We do not recommend a strict pursuit of the medium-term balance anchor at this point in time. We acknowledge the usefulness of the *Budget 2016-17* commitment to a +1 percent of GDP Commonwealth government surplus. First, there is uncertainty on the required magnitude for budget repair. Second, it relies on rebalancing, shifting to the external sector from the domestic sector which may not be a desirable property. Moreover, the primary risk right now is the "new mediocre," where budget repair would be very costly.

90. Regardless of the resolution of the short-term situation, for long-term stability, we recommend the use of a fiscal rule for consolidation, based on a long-term debt anchor. Such a rule should increase households' and firms' certainty about their wealth holdings and enable clear planning. We do not address the precise value for the anchor, as this should be a choice of the Government. Moreover, choices for short-term fiscal plan also affect how and when to implement the long-term fiscal strategy.

91. For the new long-term strategy, we recommend the flexible debt rule that attempts to achieve its debt norm over 10 years. On average, it best addresses risks and communication issues. In order to provide favorable conditions for the transition, the Government could also switch the composition of taxes, by taxes on the factors of production (the CIT and PIT) and replace it with an equivalent increase in the GST, in tandem with the introduction of the new long-term strategy.

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Appendix I. Overview of the Theoretical Structure of G20MOD

G20MOD is an annual, multi-region, general equilibrium model of the global economy combining both micro-founded and reduced-form formulations of various economic sectors. Structurally, each country/regional block is close to identical, but with potentially different key steady-state ratios and behavioral parameters. We discuss, first, the demand side of the economy, with particular emphasis on the inclusion of an overlapping generations model for households and firms; second, the supply side and prices; and, third, the commodity sector and its role as a global stabilizer. We then provide a brief overview of the financial features and monetary policy, concluding with a short description of the fiscal block. The interested reader is referred to Andrle and others (2015) for a more complete description of the model and its properties.

The consumption block uses a discrete-time representation of an OLG model as in Blanchard (1985), Weil (1989) and Yaari (1965). It is based on a constant-elasticity-of-substitution utility function, dependent only on household consumption. Using OLG households rather than infinitely-lived households results in important non-Ricardian properties whereby the path for government debt has significant economic implications. In the OLG framework, households treat government bonds as wealth since there is a chance that the associated tax liabilities will fall due beyond their expected lifetimes. The OLG formulation results in the endogenous determination of national savings given the level of government debt. The global real interest rate adjusts to equilibrate the global supply of and demand for savings. The use of an OLG framework necessitates the tracking of all the stocks and flows associated with wealth - human wealth (based on labor income) and financial wealth (based on government debt, the private business capital stock, and net foreign assets). It should be noted that financial markets are incomplete, so international financial flows are tracked as net positions (net foreign assets or net foreign liabilities) and denominated in U.S. dollars.

Consumption dynamics are driven not only by OLG households, but also by liquidity-constrained (LIQ) households. LIQ households do not have access to financial markets, do not save, and thus consume all their income each period. This feature amplifies the non-Ricardian properties of the basic OLG framework, particularly in the face of temporary fiscal shocks.

Private investment uses an updated version of the Tobin's Q model, with quadratic real adjustment costs. It is negatively correlated with real interest rates. Investment cumulates to the private capital stock, which is chosen by firms to maximize their profits. The capital-to-GDP ratio is inversely related to the cost of capital, which is a function of depreciation, the real corporate interest rate, the company income tax rate, and relative prices. The corporate interest rate is a mix of the 1-year and 10-year interest rates, with a risk premium negatively correlated with the output gap, to capture a financial accelerator effect as in Bernanke and others (1999).

Government absorption consists of spending on consumption good and infrastructure investment. Both are exogenous choices determined by the government. Government consumption spending only affects the level of aggregate demand. Government investment, in addition to affecting aggregate demand directly, also cumulates into a public capital stock, which can be thought of as public infrastructure (roads, buildings, etc.). A permanent increase in the public capital stock permanently raises the economy-wide level of productivity.

Net exports react to its long-term determinants, the real competitiveness index (RCI), adjusting to achieve the current account balance. In turn, the current account balance is required to support the desired net foreign asset position. Exports and imports, individually, are modeled as reduced-form equations. Exports increase with foreign activity, and are also an increasing function of the depreciation in the RCI. Imports increase with domestic activity, and are an increasing function of the appreciation of the real effective exchange rate (REER). The RCI differs from the REER in that it is export-weighted and accounts for third-country competition effects. In our analysis, when we mention real exchange rate movements, they apply equally to the RCI and the REER at least qualitatively, if not quantitatively.

The model does not track all the bilateral trade flows among countries. This keeps the dimensionality of the model small enough to allow it to have a large number of individual country blocks. The model has been developed to have exchange rate and export volume properties that are similar to the IMF's multiple-good, structural models. This is accomplished by having time-varying trade shares that are a function of the relative level of tradable and nontradable productivity within each country. Consequently, the model is able reproduce the currency appreciation that results when a country's tradable sector productivity growth exceeds that in the nontradable sector (the Balassa-Samuelson effect). Further, even though only the aggregate levels of exports and imports are tracked in each country, there are mechanisms in place that ensure global exports and imports sum to zero.

The current account and implied net-foreign-asset positions are intimately linked to the saving decision of households. The model can be used to study both creditor and debtor nations as non-zero current accounts can be a feature of the well-defined steady-state in the OLG framework.

Aggregate supply is captured by potential output. It is based on Cobb-Douglas production technology with trend total factor productivity, the steady-state labor force, the non-accelerating inflation rate of unemployment (NAIRU), and the actual capital stock. This allows for the computation of the output gap, allowing for the tracking of excess demand and excess supply, and is a key driver for prices in the economy.

There is an endogenous labor sector. Steady-state population growth is taken as exogenous, although there are cyclical variations in both the participation rate and the unemployment rate. The behavior of the participation rate is based on properties of labor supply observed in other IMF structural models, the Global Integrated Monetary and Fiscal model (GIMF) and the Global Economy Model (GEM), with both a substitution effect based on the real wage, and an income effect based on the total level of wealth in the economy. The unemployment rate varies relative to the NAIRU in the short term according to an Okun's law relationship based on the output gap.

The core price is the consumer price index excluding food and energy, CPIX, determined by an inflation Phillips curve. CPIX inflation is sticky and reflects the expected paths of exchange rates and the economic cycle, as captured by the output gap. In addition, although the direct effects of movements in food and energy prices are excluded, there is a possibility that persistent changes in oil prices can leak into core inflation. The degree of forward looking behavior in inflation is country specific.

Relative prices mimic the structure of the national accounts. They are usually some weighted average of a domestic consumer price and an import price. Export prices account for third country effects in its foreign component, and import prices are an import-weighted average of all other countries' export prices

In addition, there is a Phillips curve for nominal wage growth. Wage inflation exhibits stickiness and allows the real wage to return to its equilibrium only gradually depending on the expected evolution of overall economic activity and the deviation of labor supply from labor demand in the short term.

There are three commodities – oil, food and metals. Australia is an oil importer in this context, but a notable exporter of metals. The demand for commodities is driven by global demand and is relatively price inelastic in the short term due to limited substitutability of the commodity classes considered. The supply of commodities is also price inelastic in the short term. Countries trade in commodities, and households consume food and oil explicitly, allowing for the distinction between headline and core CPI inflation.

Commodities can function as a moderator of business cycle fluctuations in the model. In times of global excess aggregate demand, the upward pressure on commodities prices from sluggish adjustment in commodity supply relative to demand puts some downward pressure on global aggregate demand. Similarly, if there is global excess supply, falling commodities prices softens the effect of deterioration. However, shocks originating in the commodities sectors can be highly disruptive to global macroeconomic activity. Also, when countries' or regions' own business cycle is out of sync with the global business cycle, commodity prices act to amplify rather than dampen fluctuations in activity.

In the short term, the nominal side of the economy is linked to the real side through monetary policy. The behavior of monetary authorities is represented by an interest rate reaction function based on a 1-year interest rate, referred to as the overnight cash rate in the case of Australia. The standard form is an inflation-forecast-based rule operating under a flexible exchange rate, as is the case for Australia. Monetary policy can play a key role in fiscal matters, either by working at cross-purposes when the inflation target is being strictly pursued in a time of deliberate fiscal stimulus, or by working in tandem by allowing monetary accommodation at the appropriate times. Under constrained monetary policy space and rising probability of hitting the effective lower bound on interest rates, overly ambitious fiscal consolidation can exacerbate the cost to the economy.

Long-term interest rates affect households' and firms' decisions. The model features a 10-year interest rate, based on the expectations theory of the term structure, plus a term premium. The interest rates on consumption, investment, government debt and net foreign assets are weighted averages of the 1-year and 10-year interest rates, reflecting their differing term structures, and allowing for a meaningful role for the term premium.

Fiscal policy is driven by a sufficiently detailed government sector that can reproduce simplified fiscal accounts for each country. Eight policy instruments are featured. On the spending side, in addition to government consumption and spending on infrastructure spending,

there are general lumpsum transfers to all households (such as pensions, aged care provisions, unemployment insurance) and lumpsum transfers targeted to LIQ households (such as welfare, certain pensions). On the revenues side, there are taxes on consumption (the goods and services tax, GST), personal income (PIT, on both wage and dividend income) and company income (CIT), as well as taxes and royalties from the mining and production of metals. For Australia, the government is an amalgam of the Commonwealth and State governments. However, many of the issues in this paper focus on the Commonwealth accounts and balances.

Relative to other versions of G20MOD, there is more detail related to the taxation of firm (or 'company') income, which applies specifically to Australia. Firms pay CIT, and also issue dividends. Households notionally pay their marginal tax rate on dividend income as part of their payment of PIT (along with taxes on their wage income). In Australia, households are rebated the tax amount already paid by firms as CIT – the dividends are "franked." This means that if the CIT rate is lowered, the amount of franked dividends that OLG households receive will be reduced, and the dividend income tax portion of their PIT liability will be higher. Therefore, if there is a tax switch from CIT to PIT, not only will the PIT liability on households increase, the burden of the increase will fall on OLG households, as they are solely responsible for the dividend income portion. Only the wage income portion of the PIT increase will be shared with LIQ households.

The budget constraint in the model is met by the choice of a long-term deficit target, relative to GDP. Specifically, the deficit is expenditures and interest payments, less revenues. One instrument, which is general lumpsum transfers by default, is constantly adjusted to make sure that the budget constraint always holds. The long-term government debt target, relative to GDP, can be derived from the government deficit target, based on the nominal growth rate of the economy:

$$b^{tar} = \frac{(1+\pi)(1+g)}{(1+\pi)(1+g)-1} gdef^{tar}$$

where π is inflation, g is the steady-state growth rate, b^{tar} is the long-term debt target, and $gdef^{tar}$ is the long-term deficit target. The explicit deficit target therefore pins down the long-term government debt, a fundamental decision variable for firms and households worldwide. The level of government debt affects the global interest rate (the price used to equilibrate global saving with global investment), and the real exchange rate (a country's relative price for its contributions and use of the global saving-investment pool). The operational implementation of the deficit target is complemented with the use of fiscal rules, which are explained more fully in the body of the paper.