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Labor Market Adjustment to Shocks in Australia

by Adil Mohommad

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Abstract

Labor markets in Australia have adjusted smoothly to significant declines in commodity prices with little increase in unemployment. This paper examines several aspects of the adjustment, focusing on (i) evidence of increased labor market frictions following the commodity price decline; (ii) flexibility in labor input adjustment in response to demand shocks; (iii) changes in labor productivity in the wake of resource reallocation with the decline in mining investment, (iv) and the role of migration in adjusting to the commodity price and mining investment cycle. We find little evidence of increased labor market frictions with the decline in commodity prices. The relatively smooth transition has been assisted by increased flexibility in adjustment of worker hours over time. Labor productivity growth has sustained its historical average through the transition, despite some temporary drag as the economy rebalances. Finally, migration has played a key role in labor market adjustment through the commodity cycle.

JEL Classification Numbers: E24, J21, J23, J31, J61, J63

Keywords: labor market dynamics, economic flexibility

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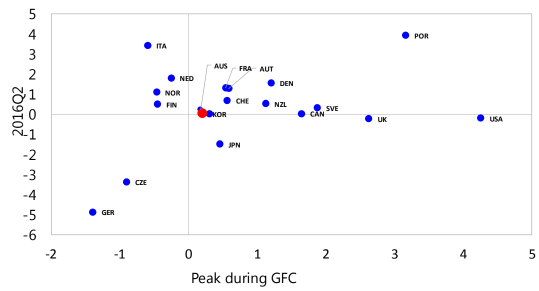
I. INTRODUCTION

1. **The Australian economy has faced two major shocks in recent years, namely the global financial crisis, and the prolonged rise and subsequent sharp drop in commodity prices.** Prices of Australian resource exports nearly doubled between 2005 and 2011 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 2-3 percent of GDP before 2005 to a peak exceeding 9 percent of GDP in 2013. A 35 percent decline in commodity prices since 2011 has led to a similar decline in the terms of trade over 2011-2016. Mining investment has fallen dramatically as major construction projects have come to an end, falling to 4½ percent of GDP by 2016.

2. **Such large external shocks have often been considered catalysts for major displacement in labor markets.** Labor markets in some advanced economies were adversely affected by the global financial crisis for instance, and in some cases the damage has yet to be reversed. Australian labor market appears to have avoided major dislocation at least in terms of unemployment in that period.

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



Sources: OECD harmonized unemployment series and IMF staff calculations.

3. **Figure 1 summarizes key real sector and labor market developments at the aggregate level.** 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 2009 and 2016, peaking at around 6¼ percent in mid-2015 in the wake of the severe terms-of-trade and mining investment decline. Since then, unemployment has fluctuated around 5¾ percent. 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 aided the ongoing rebalancing of the economy.

4. **Despite the benign cyclical labor market fluctuations, Figure 1 shows that both long-term unemployment and underemployment have remained elevated since the global financial crisis, prevailing above their long-term (2000-16) averages since the terms-of-trade collapse.** Elevated long term unemployment often indicates a worsening in labor market efficiency, say due to a skills mismatch, which could arise in events such a sizeable commodity price decline. Elevated underemployment suggests there is more slack than indicated by the unemployment gap alone, and may have implications for wage growth, which have remained

somewhat muted recently.[1] In this context, we conduct a detailed assessment of the labor market effects of and adjustment to the recent shocks that hit the Australian economy, focusing on the following questions:

- Does the rise in long-term unemployment indicate a worsening in skills mismatch or other frictions?
- What are the implications of greater labor market flexibility for assessment of labor market slack, and relatedly for wage growth?
- What effect has the change in sectoral composition of labor since the end of the mining boom had on labor productivity growth?
- How have labor markets at the state level adjusted to the commodity price and mining investment decline, and how important a role has migration played in this adjustment?

5. **The main findings of the paper are as follows.** Labor markets have adjusted smoothly overall. Structural unemployment does not appear to have increased significantly as suggested by elevated long-term unemployment. Flexible adjustment of labor input has helped moderate reductions in employment in the 2000s relative to downturns in previous cycles, likely due in part to labor market reforms in the early 1990s. However, the increasing share of part-time employment in total employment may have led to elevated underemployment, which may also be a contributing factor to weaker wage growth. We find that rebalancing of the economy towards more services sector activity has been accompanied by a transitory decline in aggregate labor productivity growth, partly due to weaker productivity in services. Finally, we find that migration has played a key role in smooth labor market adjustment at the state level, particularly given the geographical concentration of mining related activity in some states.

6. **The paper is structured as follows.** Section II examines the increase in long-term unemployment and whether this reflects an increase in labor market frictions. Section III discusses changes in cyclical labor market adjustment dynamics over time, and the implications for assessing labor market slack and relatedly for wage growth. Section IV assesses the impact of the reallocation of labor following the decline in mining investment on labor productivity. Section V focuses on labor market adjustment at the state level and the role of migration and Section VI provides some final conclusions. Detailed descriptions of the methodologies and data are provided in Appendices I to III.

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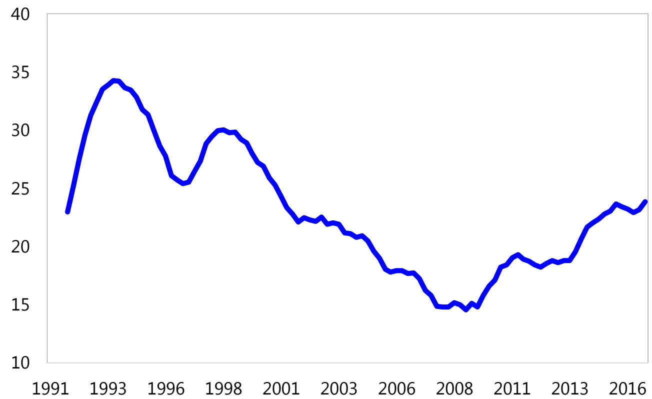
[1] The unemployment gap in 2016 is estimated at just under 1 percent, based on an estimate of NAIRU derived jointly with the output gap using a small Bayesian estimated model in tandem with a Kalman filter. See Blagrave and others (2015) for details of the methodology. Estimates of potential output indicate a negative output gap (excess capacity) in the range of 1.25 to 1.75 percent of potential GDP. 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).

II. Does Higher Long-Term Unemployment Indicate More Labor Market Frictions?

7. Long-term unemployment has risen since the global financial crisis and further following the mining investment decline. Following the crisis, the percent 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 increased from the pre-GFC trough of 27 weeks to a high of 50 weeks in 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 percent of total unemployed, 4QMA)

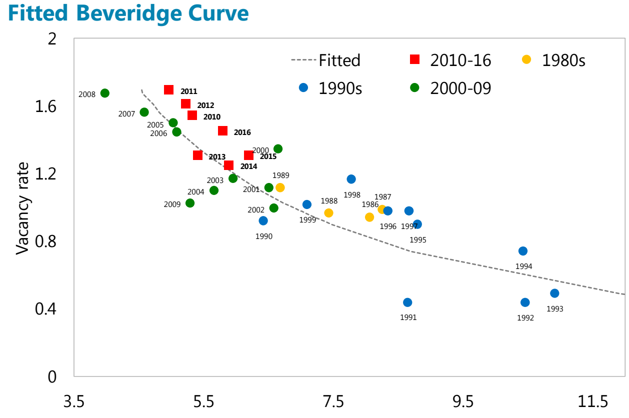


Sources: Haver Analytics database; and IMF staff calculations.

8. To the extent that long-term unemployment reflects skill mismatches, an increase could indicate some worsening in labor market efficiency and an increase in structural unemployment. Consistent with such an interpretation, the estimate of the NAIRU in Australia has risen, albeit by a small amount, since 2011 (Figure 2).

9. Structural unemployment is often illustrated in terms of shifts in a Beveridge curve. For Australia, a simple Beveridge curve plotting unemployment and vacancy rates shows outward shifts in the 1980s, and again in the 1990s, coinciding with periods of high long-term unemployment. Since then, the curve appears broadly stable, other than a small outward shift following the terms-of-trade and mining investment decline, compared to the period over 2000s before the global financial crisis.

Fitted Beveridge Curve



Source: IMF staff estimates.

10. To measure the extent of the recent shift, 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. From this exercise, it emerges that observations on the unemployment rate following the terms-of-trade and mining investment decline are to the right of the fitted curve. In 2016, unemployment was around ¾ of a percent higher than the rate consistent with the labor market equilibrium implied by the Beveridge curve.

11. This gap is consistent with the estimated gap from NAIRU, and does not necessarily signal a structural deterioration in the labor market. The small apparent outward shift of the Beveridge curve in recent years is consistent with the observed increase in long-term unemployment, but this increase is much smaller than in previous downturns, and should recede as slack in the economy is eliminated. Moreover, the shift of the Beveridge curve since the decline in commodity prices is relatively small, and similar in magnitude to those observed in earlier periods. Moreover, the shift is much smaller compared with other advanced economies in the post-GFC period; economies such as Portugal, Spain, Sweden, U.K. and U.S. have experienced much larger outwards shifts, as shown in Hobijn and Sahin (2012).

III. WHAT ARE THE IMPLICATIONS OF GREATER LABOR MARKET FLEXIBILITY FOR LABOR MARKET SLACK AND WAGES?

12. 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.[2] Average hours worked per worker have become more flexible and since the early 2000s, with a relatively greater share of adjustment in aggregate hours worked borne by hours per worker than by aggregate employment. This is consistent with the findings of Bishop and Plumb (2016).

13. 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 through reductions in average hours and in employment. The amplitude of peak-to-trough declines in total hours worked has also decreased.

14. Likely due to increased flexibility in hours per worker, the response of total employment to shocks affecting the economy seems to have moderated over time. To illustrate, we build on Bishop and Plumb (2016) and consider 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, hours per worker, and employment using quarterly data running over 1984Q4–1997Q4, and 1998Q1–2016Q1. The ordering of the VAR reflects the assumption that output responds only with a lag to labor input shocks, and the assumption that firms would first adjust hours per worker in response to GDP

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[2] 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).

shocks before adjusting employment. The IRFs suggest that the response of employment to a 1 percent GDP shock has indeed moderated in the later period (see Appendix II for details).

15. **Conjunctural factors may have also played a part in the moderation in the employment response to output shocks.** For instance, 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 jobs with longer hours were extinguished and replaced with jobs with shorter hours during the crisis, rather than adjustment of hours worked in existing jobs).

16. **Further, rising skill requirements in the labor force along with economic development are likely to have increased the cost of screening and training workers, making hiring and firing decisions costlier for firms.** 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 have occurred in non-cognitive routine tasks of machinery and plant operation, and cognitive routine tasks such as clerical and secretarial functions (Borland, 2011).

17. **Sectoral level data provides evidence that adjustment of employment to output shocks may be inversely related to education levels.** Extending previous work, such as Bishop, Gustafsson, and Plumb (2016), we estimate VARs for selected industrial sectors at the 2-digit 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.

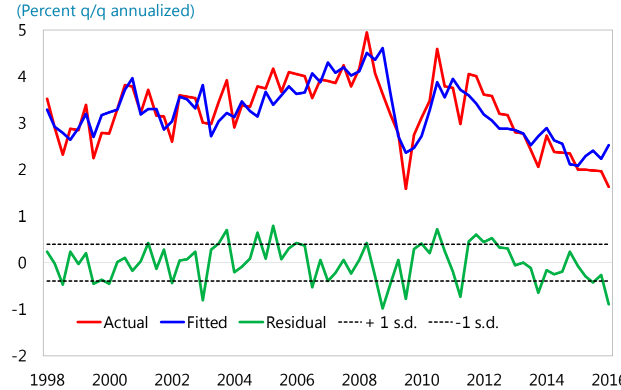
18. **We find that the size of employment adjustment in response to an output shock varies across sectors (Figure 4).** For instance, in transportation and storage industries, and in miscellaneous services, the peak employment impact of a 1 percent shock to gross value added is larger and more sustained than a similar shock in manufacturing or in health services industries. Further, there appears to be a negative relationship in the size of cumulative employment adjustment and the share of skilled workers in that sector. We do not observe such an association between adjustment in average hours and education levels, however.

19. **While flexibility in adjusting hours per worker allows firms greater scope to adjust output without adjusting employment, 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. Likely this reflects both worker preferences for flexible hours, but also firms' unwillingness to offer full-time positions, which would explain an increase in the underemployment rate to above 8½ percent, compared to the stable historical average of around 7 percent before the decline in mining investment. The elevated underemployment rate indicates that there is more slack in the economy than measured by the unemployment rate alone.

20. Elevated underemployment has likely also contributed to weaker wage growth since the terms-of-trade decline.[3] 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 (see Appendix II for details).[4] These models provide a 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). Broader measures of slack in labor markets are therefore important to bear in view of increased labor market flexibility, to gauge the level of slack in the economy and relatedly the pressures on wage growth.

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



Source: IMF staff estimates.

IV. Have Sectoral Shifts in Labor Affected Labor Productivity?

21. Aggregate labor productivity can be affected by shifts in the sectoral allocation of labor. For instance, in the United States, the recent decline in the share of manufacturing and mining sectors in aggregate hours worked, and the corresponding rise in the share of services, is estimated to have reduced labor productivity growth by ¼ and ½ percentage point respectively relative to a scenario with unchanged shares, given higher productivity *levels* in the mining and

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[3] In the case of the United States, Blanchflower and Levin (2015) provide empirical support for the negative impact of underemployment (in addition to unemployment) on wage levels.

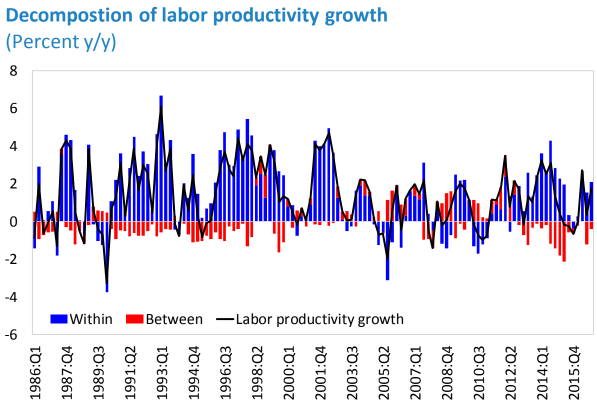
[4] Caution should be taken when inferring a decline in inflation expectations from inflation-indexed bonds, as these measures are also affected by changes in the inflation risk premium. Other measures of longer-term inflation expectations in Australia, such as survey-based measures, have remained around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

manufacturing sectors relative to services. Moreover, the slower pace of labor productivity *growth* in services could exert a drag on aggregate labor productivity growth going forward (Van Zandweghe, 2016).

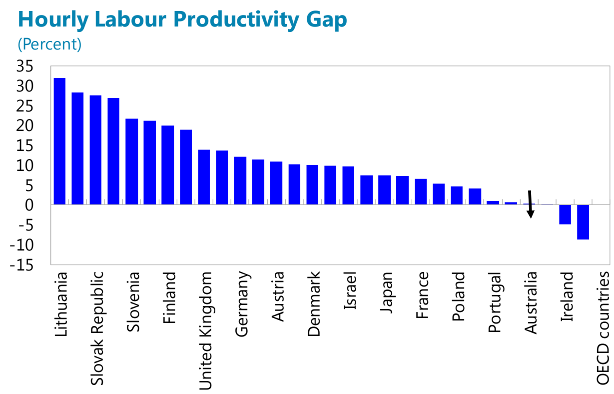
22. **In Australia, changes in the share of aggregate hours worked across sectors reflect a combination of long-term trends, changes since the global financial crisis, and more recently since the terms-of-trade and mining investment decline.** Figure 7 shows the sectoral trends. Among goods producing sectors, the share of manufacturing has declined steadily over time. The small share of mining in aggregate hours relative to other sectors rose sharply over the commodity price boom but has also 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. The mining sector was a major contributor to job growth during the boom period, but its share has fallen since the terms-of-trade peak in late 2011, whereas healthcare services have contributed a third of the jobs added since the peak, higher than its share of one-quarter of total jobs created over the boom (Figure 8). 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.

23. **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 (Figure 9).** 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. **Overall, labor productivity growth in Australia has sustained its historical average rate of growth through the transition.** Post-GFC labor productivity growth has maintained its pre-GFC growth rate of around 1½ percent (in terms of GDP per hour worked). Unlike many other advanced economies still exhibiting large labor productivity level gaps relative to their pre-GFC trend, Australia does not appear to exhibit such a gap. Labor productivity growth did slow in 2015 is due to shifts in sectoral allocation of labor – a transitional "between" effect, and indeed recovered in 2016. However, it remains to be seen whether lower labor productivity growth in services sectors will drag aggregate labor productivity growth down to a lower average rate, once productivity gains from new mining capacities coming on-stream are fully realized, though increasing competition in some services such as retail should provide continued support to productivity growth.

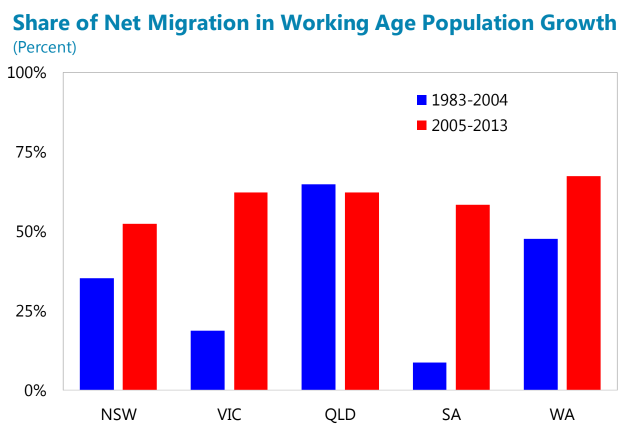


Source: Haver Analytics database; and staff estimates.



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.

V. How Did States' Labor Markets Adjust to the Commodity Price and Mining Investment Cycle?



Sources: ABS migration statistics and IMF staff calculations.

25. The mining 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 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 labor supply response – participation rates rose, and the unemployment rate declined. Working age population rose above long-term average growth rates, particularly in WA and in QLD. Subsequently, with the terms-of-trade decline, labor demand in mining states fell sharply, and was accompanied by sharp declines in working age population growth, reflecting a reversal in previously high migration inflows.

26. Migration is a key driver of working age population growth in Australia and plays an important role in labor market adjustment. On aggregate, about 50-60 percent of the increase in population is due to international migration. In the commodity price and mining investment cycle, migration has helped avoid labor shortages on the upswing, and big increases in unemployment on the downswing in the mining states. To illustrate the importance of migration in adjustment to labor 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 the participation rate. The ordering of variables reflects the assumption that employment is affected by shocks to the unemployment rate and participation rate only with a lag. In regressions focusing on state-specific shocks, the aggregate cycle component is removed from each variable; we also implement regressions that do not remove the aggregate cycle (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 migration (working age population) in response to the employment shocks at the state level.

27. In Figure 11A, we show the IRFs from a 1 percent state-specific shock to employment. As employment adjusts over 10 years to its long run 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 run increase in employment over 10 years.

- 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 run.

- 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). 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, but with exceptions at certain points in time. 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 effect of these 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 commodity price and mining investment cycle.

28. One would expect WA to show a larger migration component in the adjustment to demand shocks given the sizeable swings in working age population growth over the past decade. The relatively smaller size of the migration component likely reflects the state-specific nature of the employment shocks, that remove the influence of aggregate shocks. It is plausible that there is a more vigorous migration response in WA in response to aggregate shocks such as the commodity price boom rather than in response to a state-specific demand shock. Indeed, IRFs from VARs that do not remove the aggregate cycle from the data show WA indeed has the largest migration response among all states in the sample (Figure 11B).

29. The results provide clear evidence that migration is a key aspects of labor market flexibility, that has helped moderate the impact of the recent shocks. Over the boom period, migration likely prevented labor shortages and additional wage cost pressures. Over the subsequent decline in commodity prices and in mining investment, the decline of migration into mining states has likely helped prevent unemployment from rising higher, and likely also prevented wage growth from weakening further.

VI. SUMMARY AND CONCLUSION

30. Australia's labor markets have coped well with recent shocks, adjusting smoothly in response to the terms-of-trade and mining investment decline. 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, enabling firms to adjust labor input without reducing employment. The slowdown in growth since the global financial crisis and commodity price and mining investment downturn produced significantly smaller reductions in employment than in previous cyclical downturns, and the unemployment rate rose only slightly. In addition, migration has played a key role in enabling smooth labor market adjustment at the state level, helping avoid labor shortages during the boom phase and worsened unemployment outcomes in the downturn.

31. However, some concerns remain. With persistent economic slack since the global financial crisis, long-term unemployment has risen, though likely not due to structural deterioration in labor markets. With increasing share of part-time employment in total employment, underemployment has also risen, and likely accounts for some of the on-going weakness in wage growth. The on-going rebalancing of the economy has thus far exerted only a transitory drag on labor productivity growth. However, weaker productivity growth rates in some of the expanding services sectors particularly in human services may have longer lasting effects on aggregate productivity growth.

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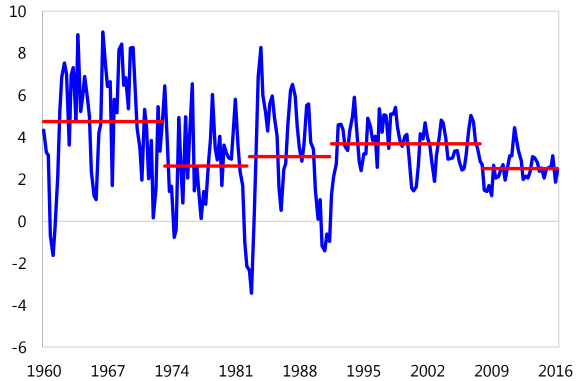
Figure 1. Key Real Sector and Labor Market Developments

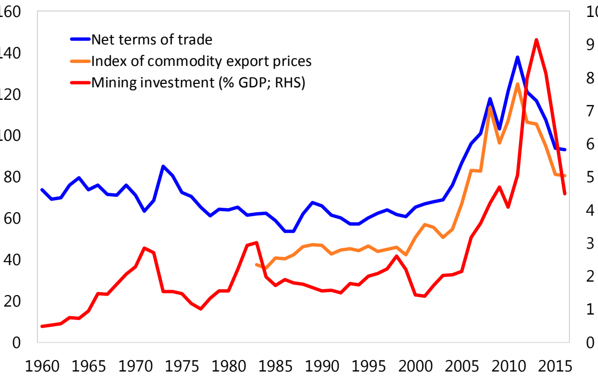
Growth has slowed since the global financial crisis by 0.75 percent on average…

Real GDP
(Y/Y % change and averages)



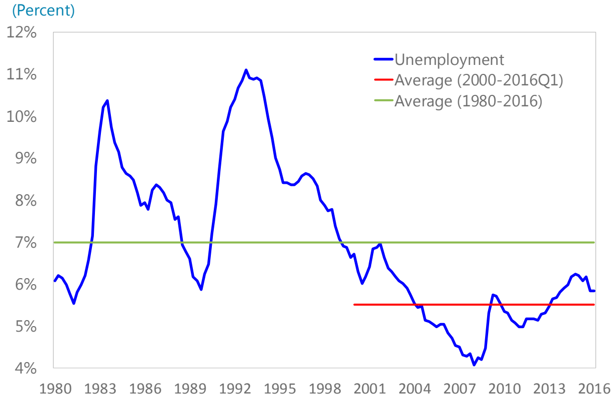
… and terms of trade and mining investment have reversed sharply.

Commodity Prices (2013/14 = 100), and Mining Investment



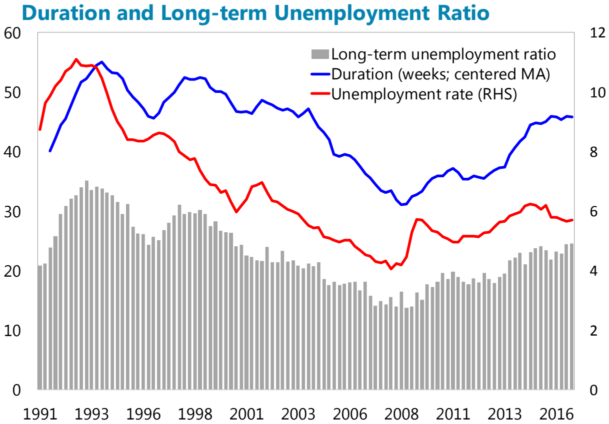
Unemployment increased modestly …

Unemployment Rate
(Percent)



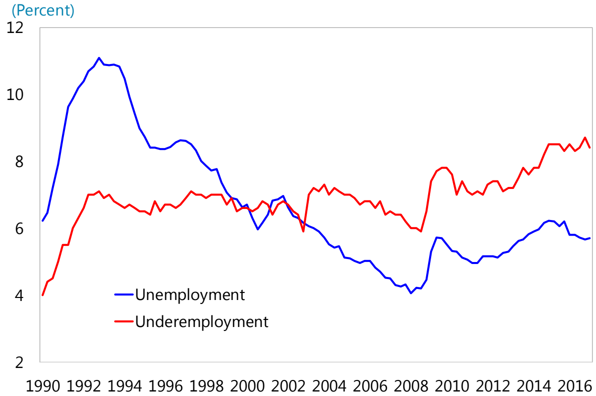
…but long term unemployment has risen…

Duration and Long-term Unemployment Ratio



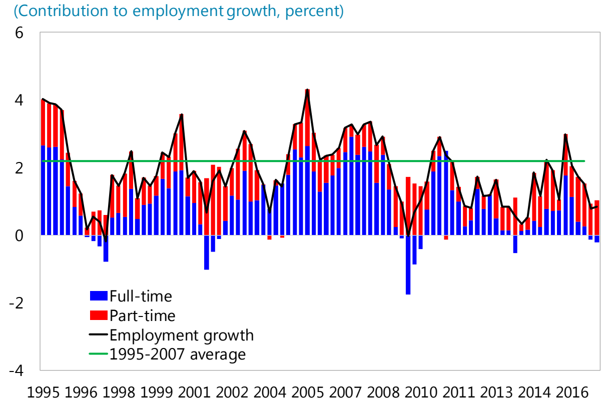
…underemployment rates are above historical averages…

Unemployment and Underemployment Rates
(Percent)



…and recent employment growth has been driven mainly by part-time workers.

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

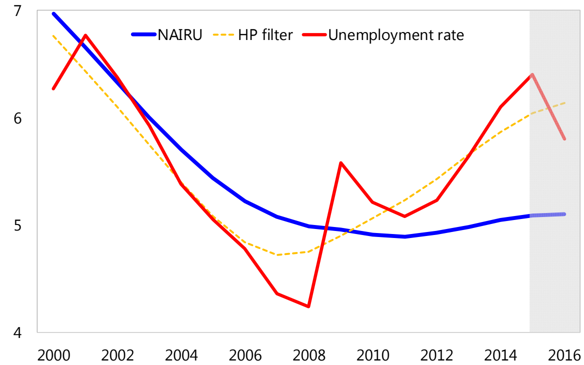


Sources: Haver Analytics database, and IMF staff calculations.

Figure 2. Structural Unemployment

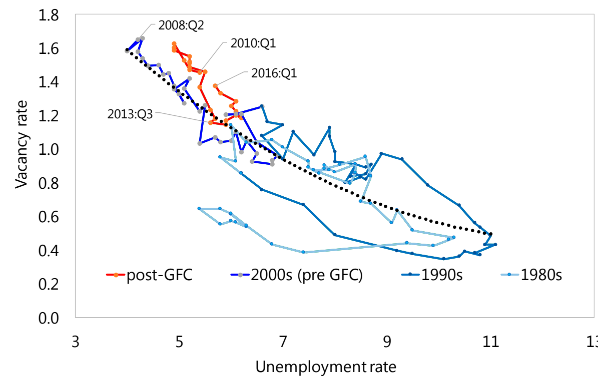
NAIRU has increased somewhat since 2011...

Unemployment Rate and NAIRU (U*)
(Percent)



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

Beveridge Curve
(In percent of labor force)

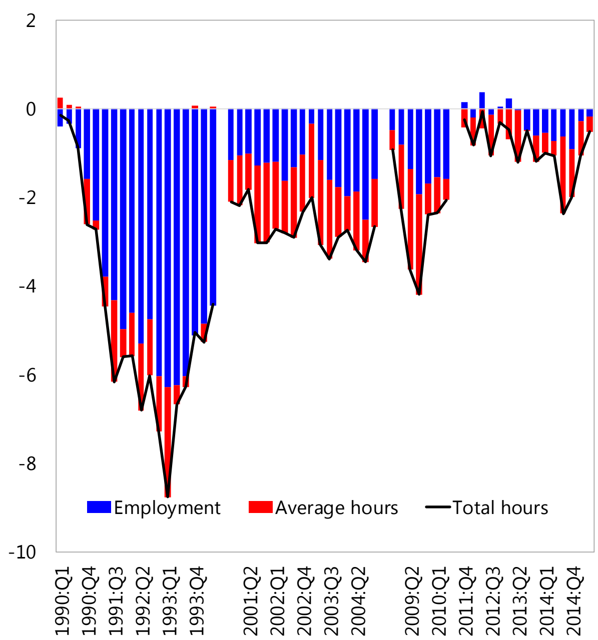


Sources: Haver Analytics database, and IMF staff calculations.

Figure 3. Cyclical Adjustment in Labor Input

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

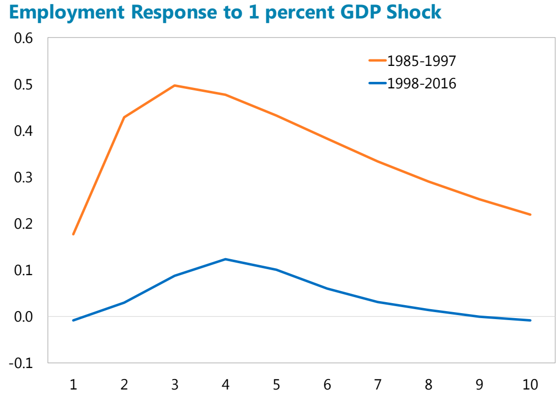
Labour Input Adjustment in Downturns
(Cumulative change from pre-downturn peak in total hours)



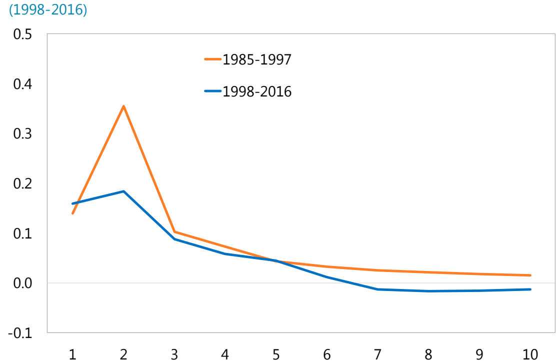
Note: Figure shows log differences from peak multiplied by 100. All variables are detrended using an HP filter (lambda = 1600). Peaks are dated 1989Q4, 2000Q3, 2008Q3, and 2011Q3.

Panel 2. Employment and Hours Worked Response to Output Shocks

Employment Response to 1 percent GDP Shock



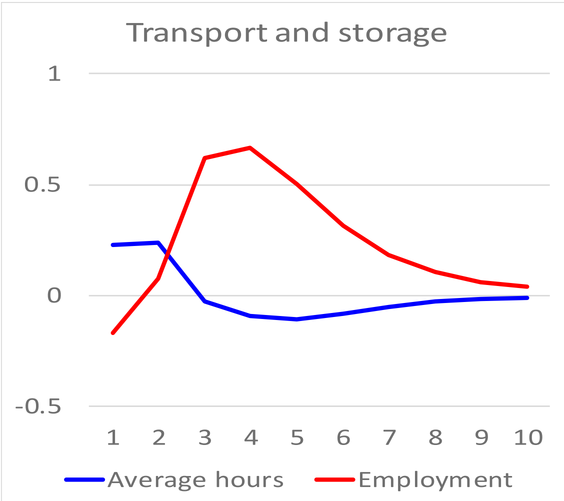
Hours Response to 1 percent GDP Shock
(1998-2016)



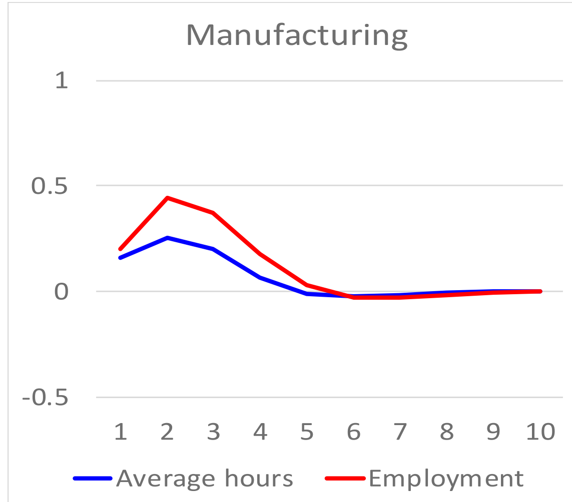
Sources: Haver Analytics database, and IMF staff calculations.

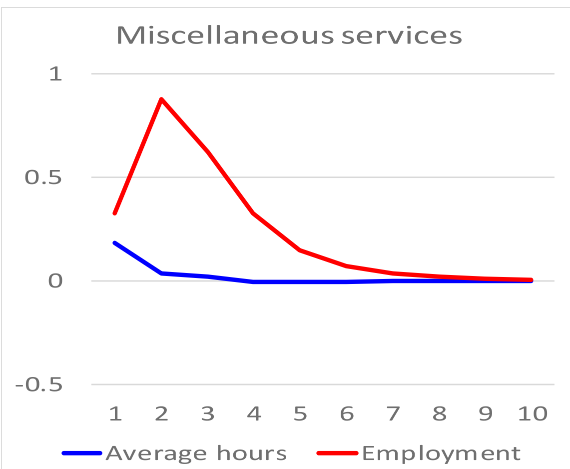
Figure 4. Differences in Sectoral Cyclical Adjustment in Labor Input

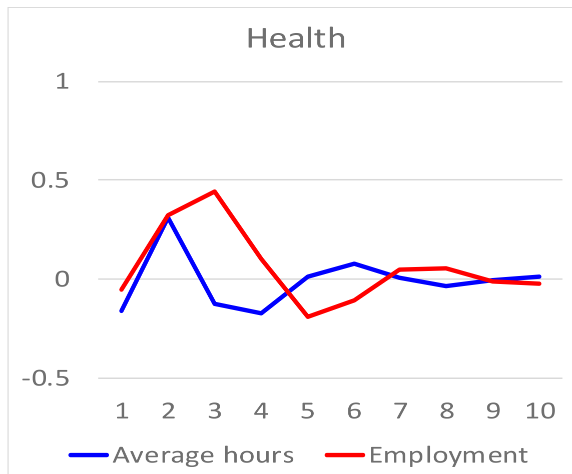
In some sectors, employment response is bigger, and more persistent…



…and lower and less persistent in others.

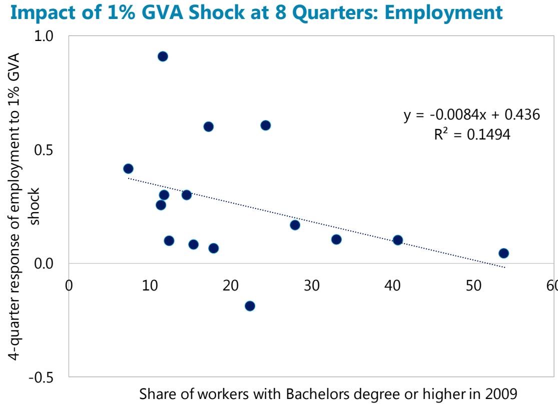






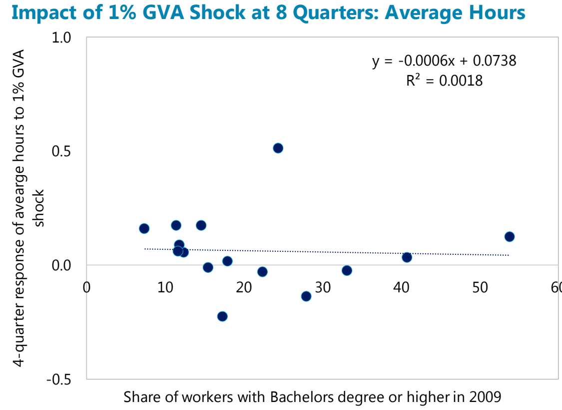
Employment appears to adjust relatively less in sectors with high educational qualifications…

Impact of 1% GVA Shock at 8 Quarters: Employment



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

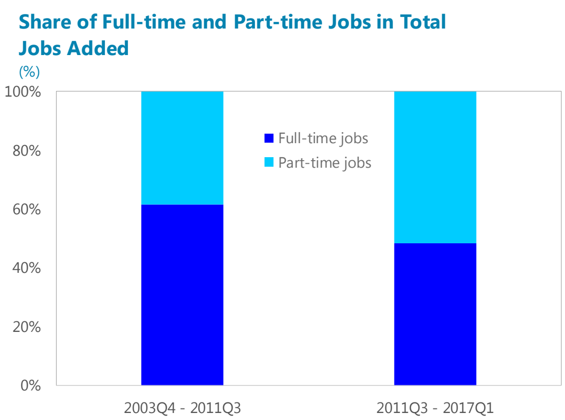
Impact of 1% GVA Shock at 8 Quarters: Average Hours



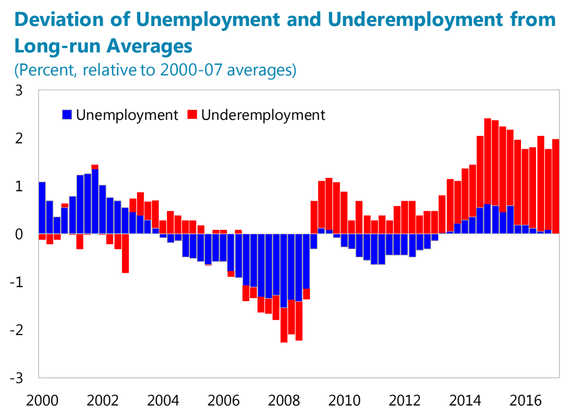
Sources: ABS Survey of Education and Training data; and IMF staff estimates.

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

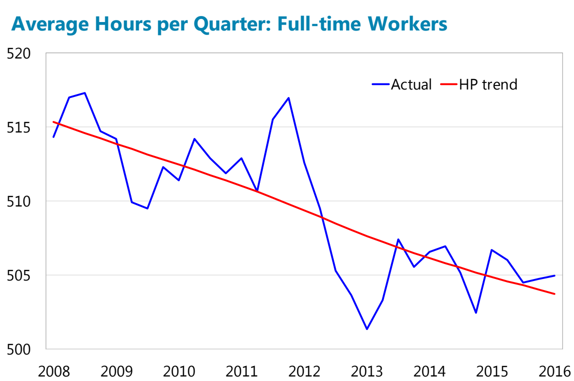
The share of part-time employment has increased…



…and underemployment gaps remain quite high…

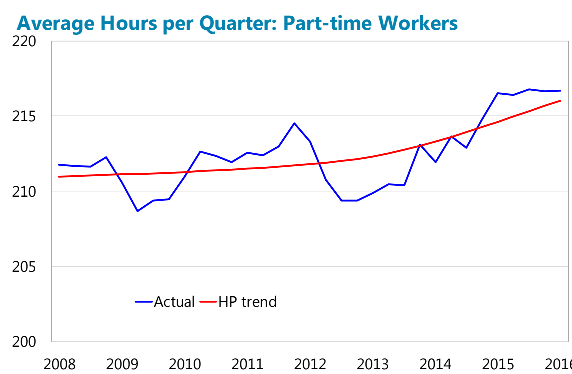


…even though hours worked gaps have closed the commodity price decline for full-time …



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

… and part-time workers.

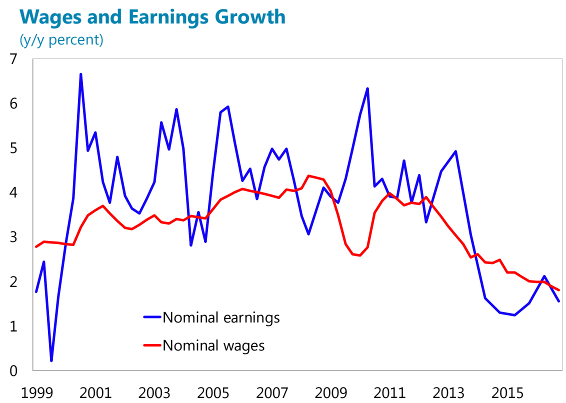


Note: Average quarterly hours worked estimated from monthly hours worked and employment status.

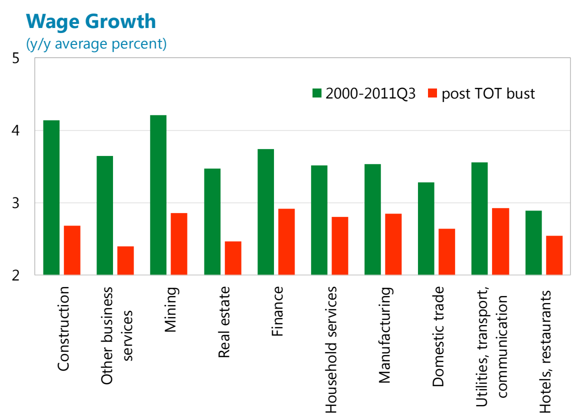
Sources: Haver Analytics database; and IMF staff calculations and estimates.

Figure 6. Wages and Labor Market Slack

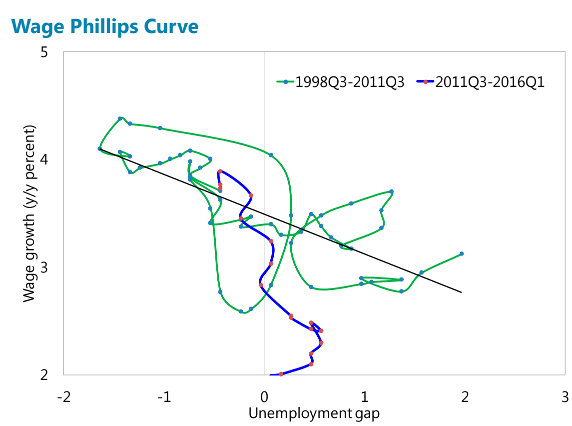
Wages and earnings growth declined sharply



… across all sectors, especially commodity related sectors.



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



Sources: Haver Analytics; and IMF staff calculations

Figure 7. Share in Aggregate Hours Worked (percent)

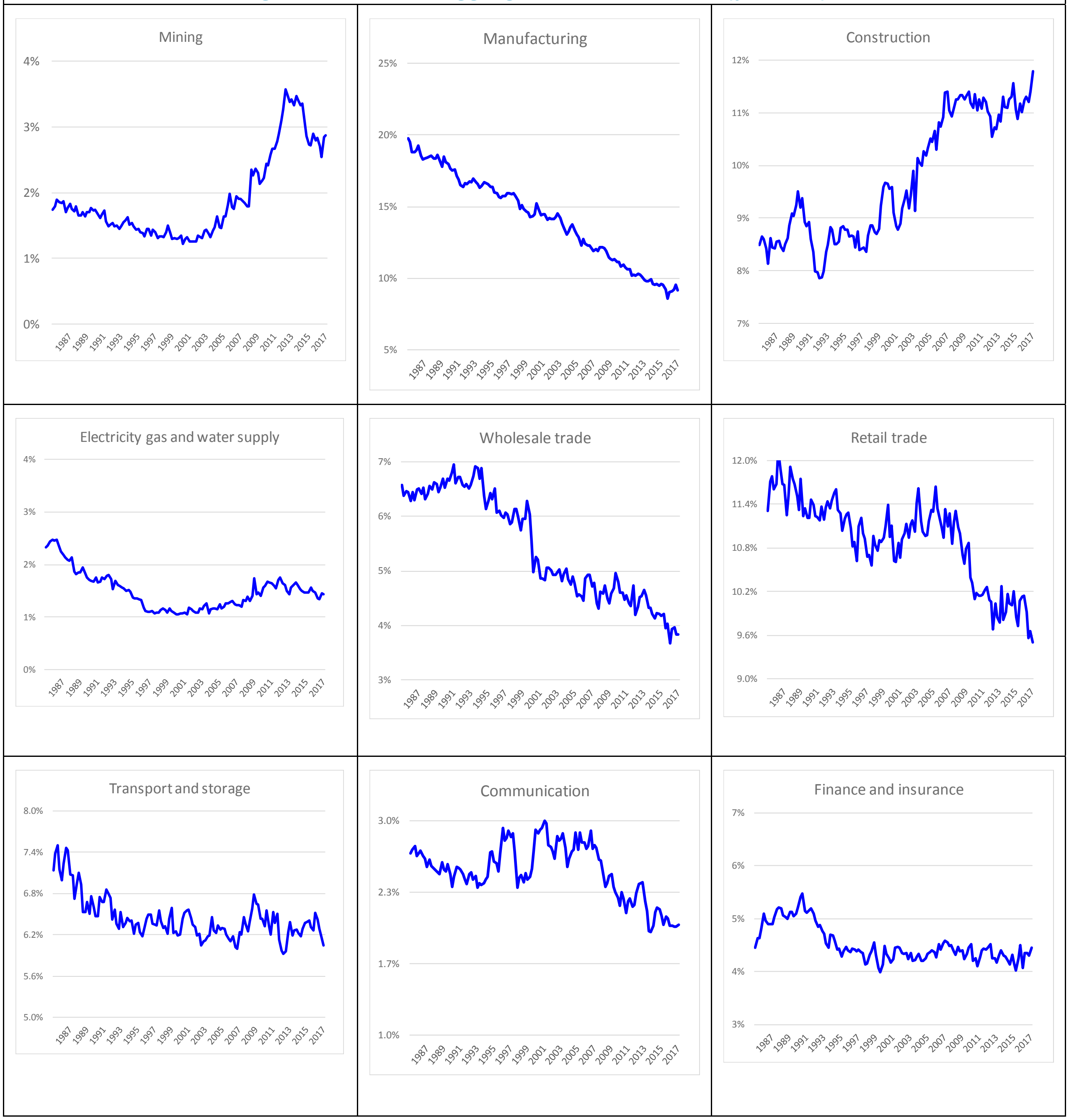
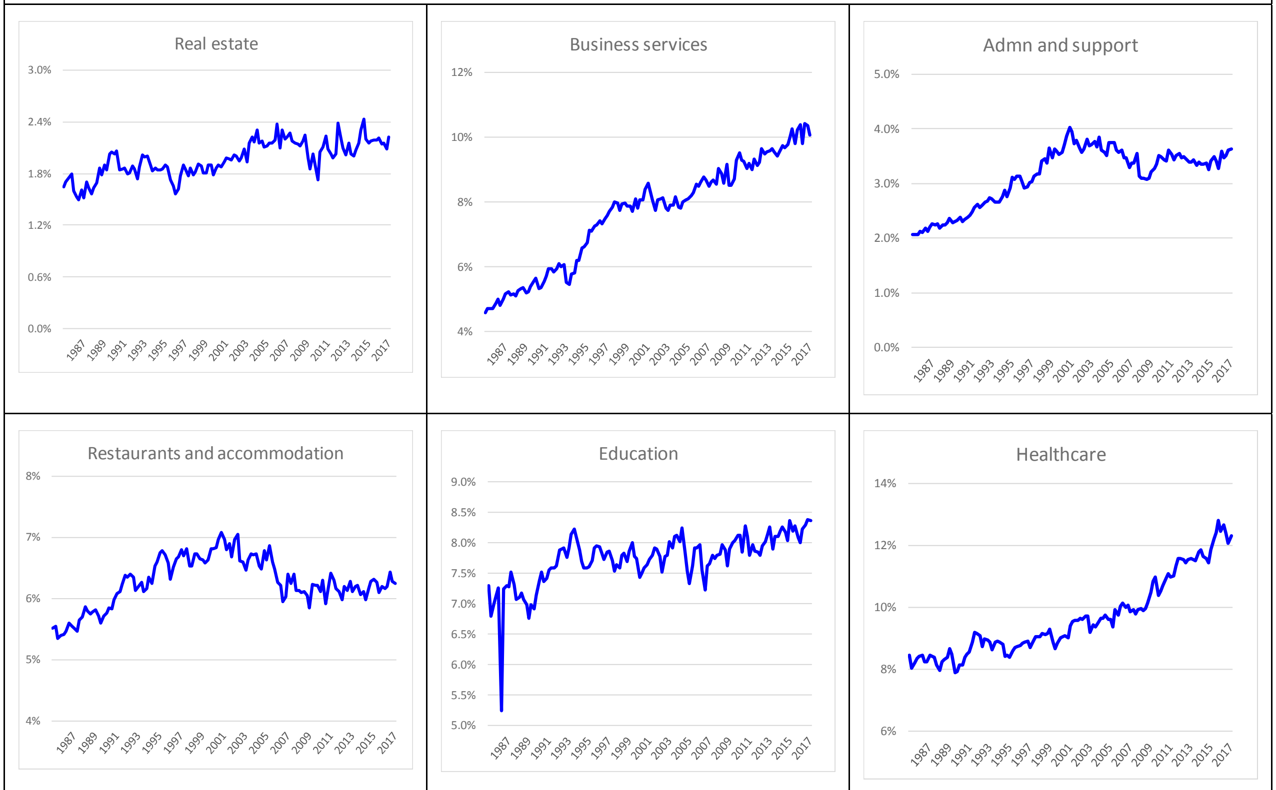


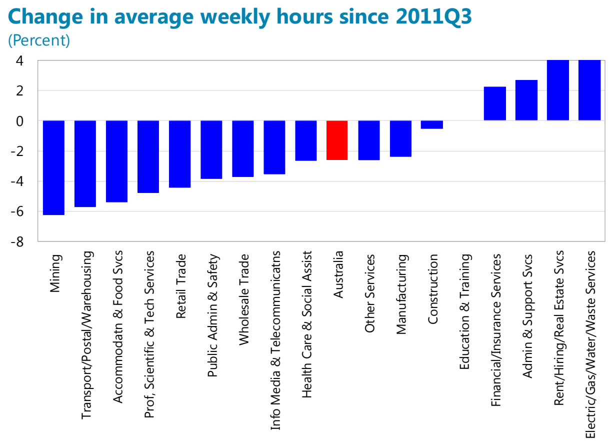
Figure 7. Share in Aggregate Hours Worked (percent) (concluded)



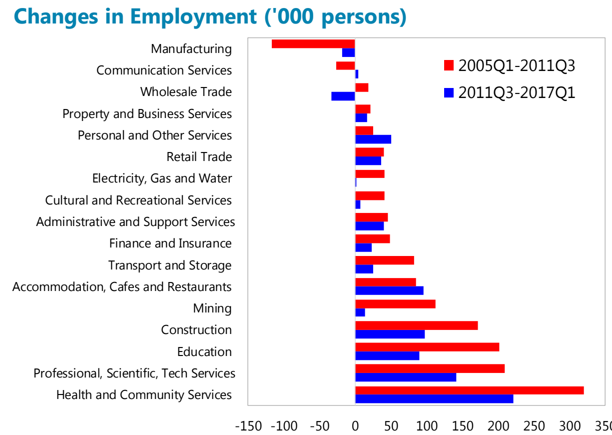
Sources: Haver Analytics database; and IMF staff calculations.

Figure 8. Sectoral Average Hours and Employment Changes

Average hours have declined across most sectors …

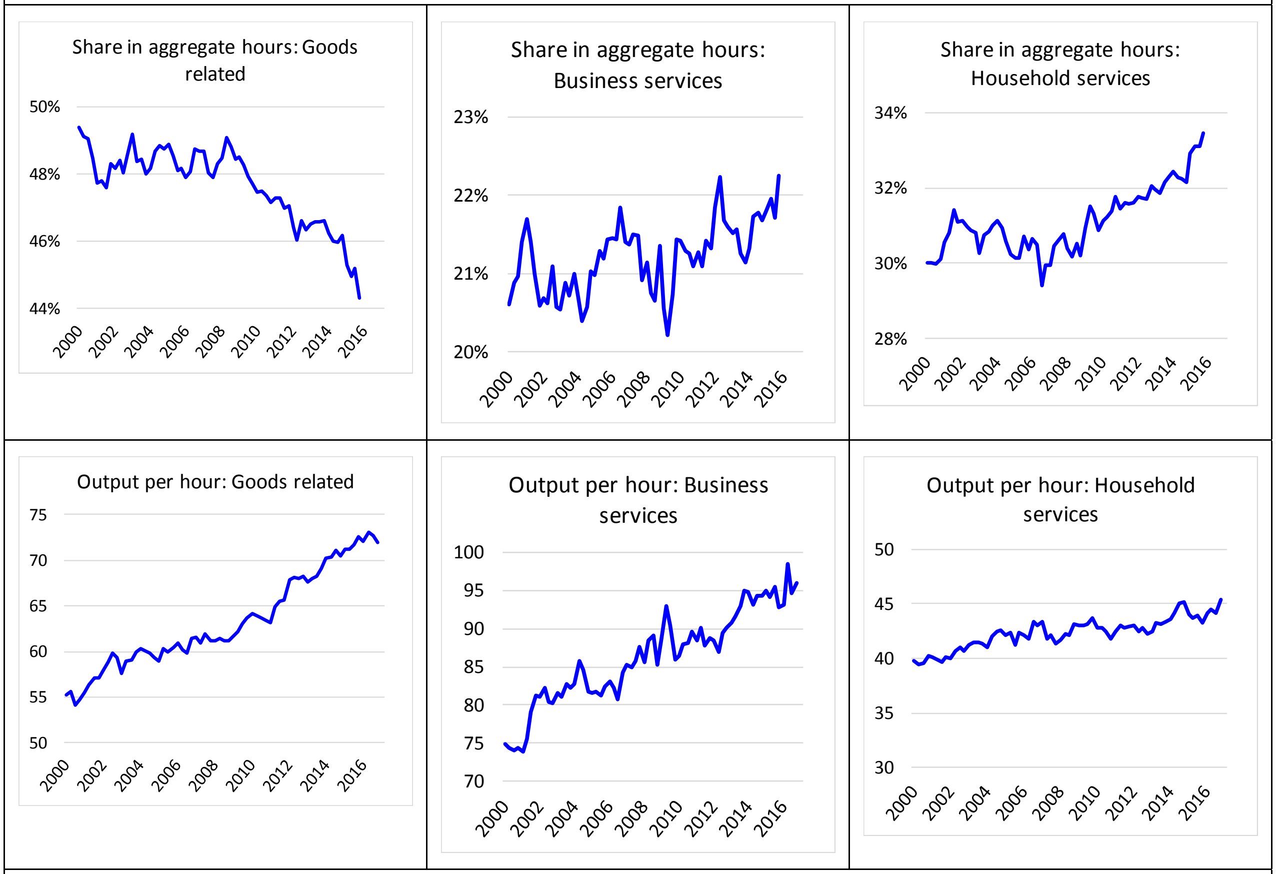


… and the contribution of mining to employment has shrunk following the decline.



Sources: Haver Analytics; and IMF staff calculations.

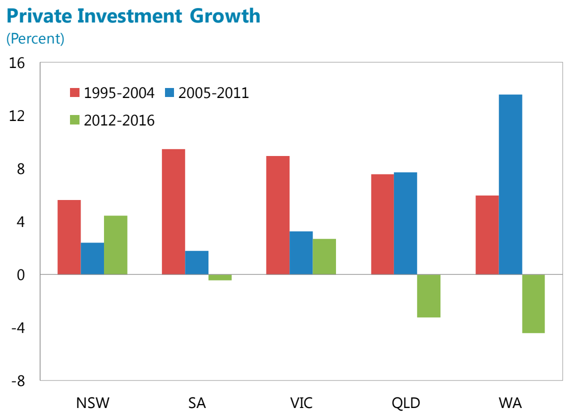
Figure 9. Share in Aggregate Hours and Labor Productivity ($ output per hour worked)



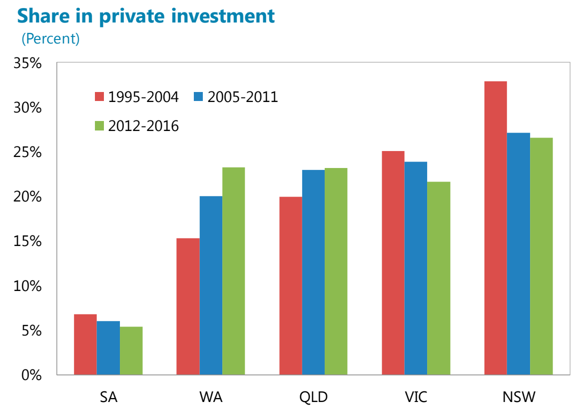
Sources: Haver Analytics; and IMF staff calculations.

Figure 10. Labor Market Developments in States

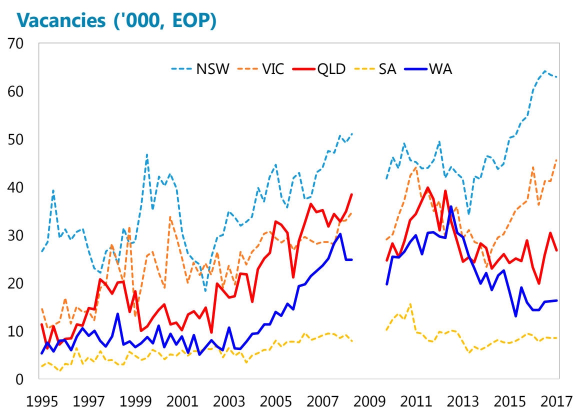
Private investment growth was much stronger in mining states during the boom…



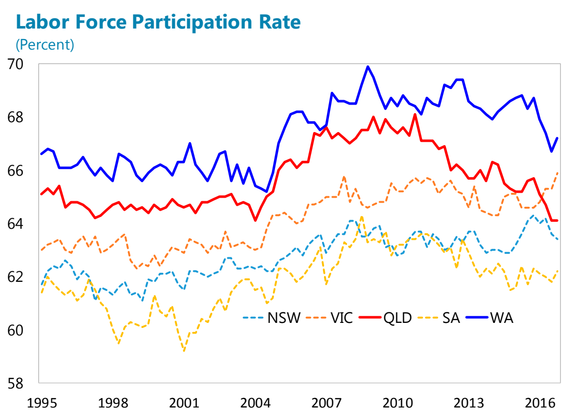
…increasing their share in aggregate private investment.



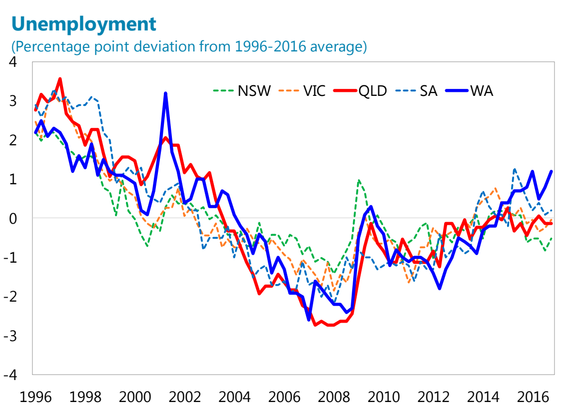
Labor demand increased more sharply in mining states…



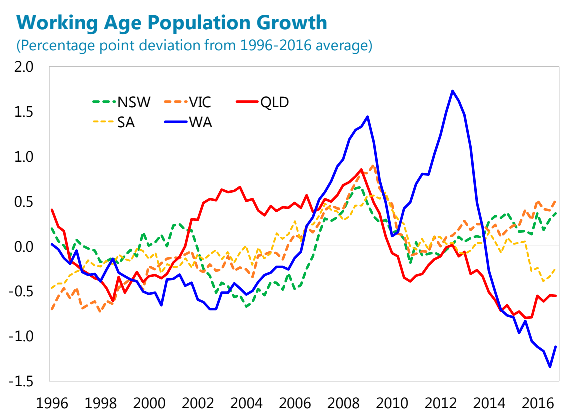
…producing a stronger response in participation rates…



… steeper declines in unemployment …



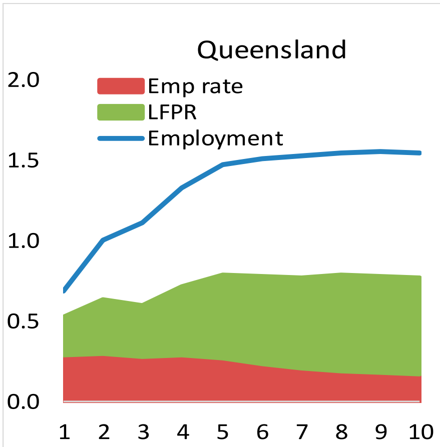
… and stronger working age population growth.



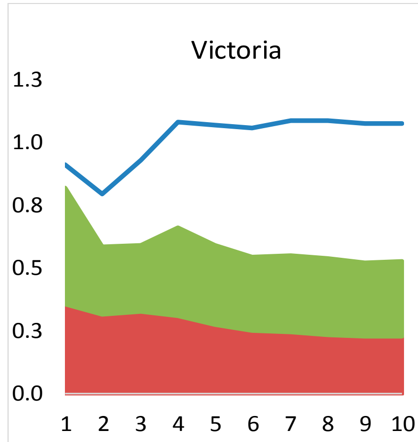
Sources: Haver Analytics; and IMF staff calculations.

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

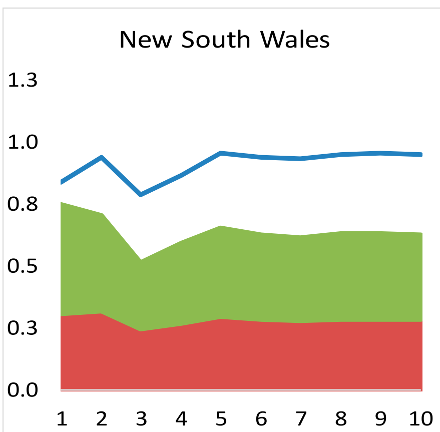
Migration plays a bigger role in Queensland…



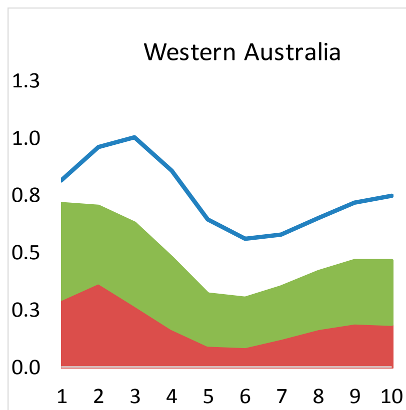
…and Victoria…



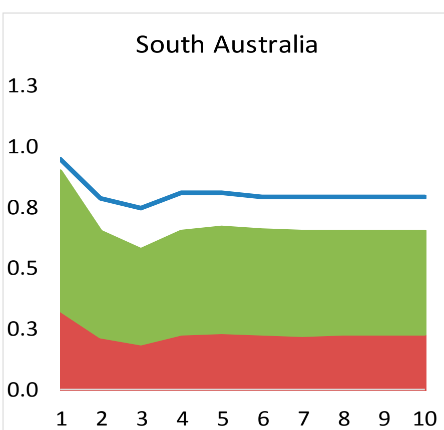
… but a smaller role in New South Wales…



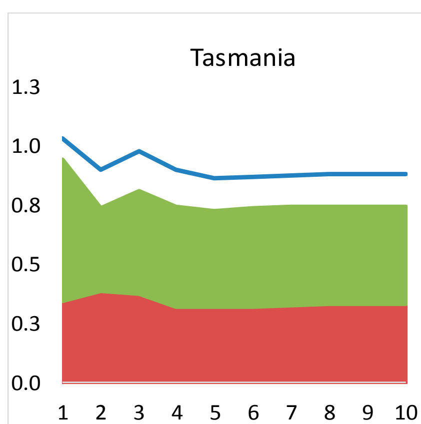
…and Western Australia…



…with the least in South Australia…



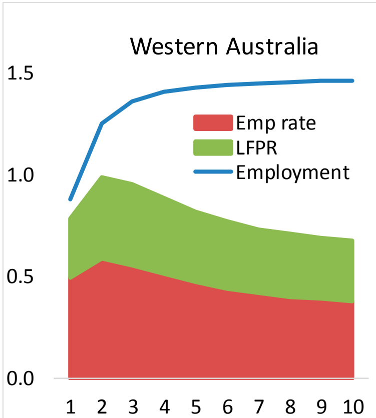
…and Tasmania.



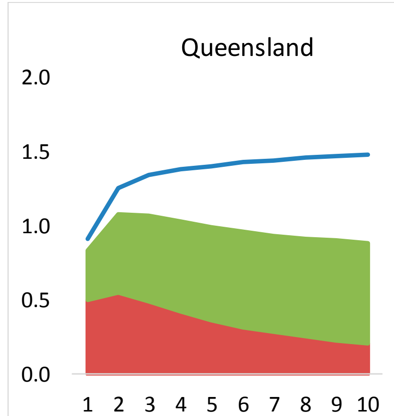
Source: Haver Analytics; and IMF staff estimates.

Figure 11B. Impulse Responses to 1% Employment Shock

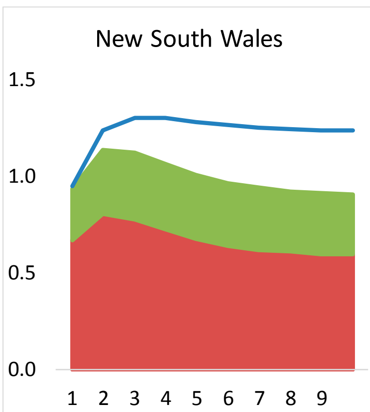
Including the aggregate cycle, migration shocks in WA are much larger…



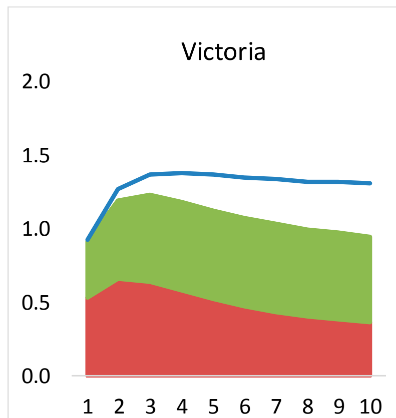
…and still sizeable in Queensland…



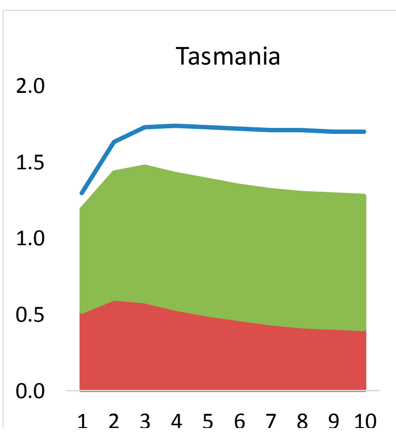
…but play a smaller role in NSW…



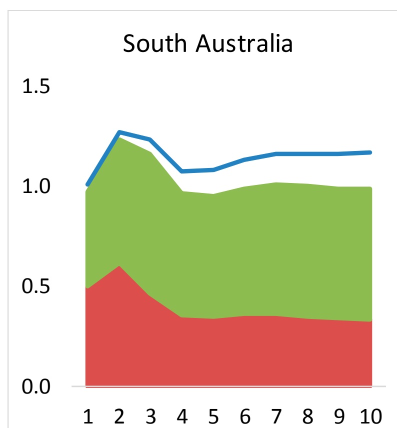
…Victoria…



…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:

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

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 year (available 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 decline 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

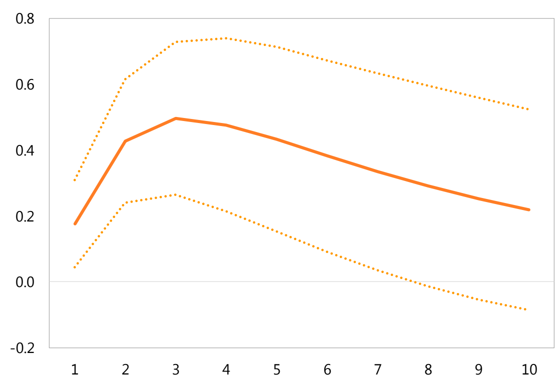
Sample: 1986 - 2011

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

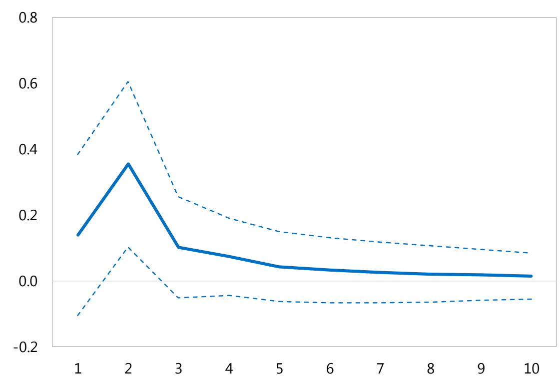
Appendix II. Cyclical Features of Labor Market Adjustment

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; noise in hours worked data may be a factor as noted in Jacobs and Rush (2015).

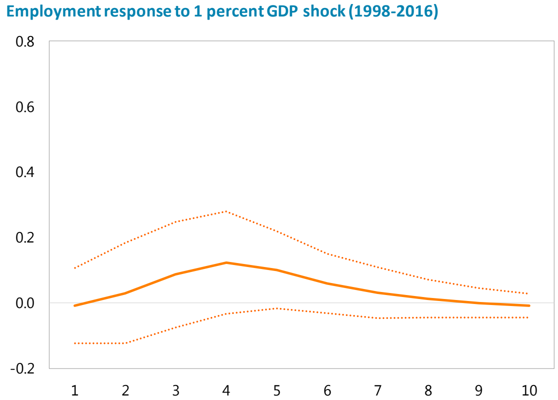
Employment response to 1 percent GDP shock (1985-1997)



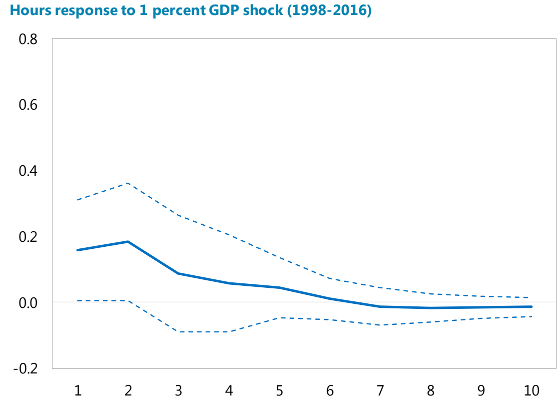
Hours response to 1 percent GDP shock (1985-1997)



Employment response to 1 percent GDP shock (1998-2016)



Hours response to 1 percent GDP shock (1998-2016)



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. We exclude agriculture, and exclude public administration and safety, education and training, and health and social assistance which are public or public-adjacent 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

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.

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 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 decline.

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 (2006), 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.

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)

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 (2006), 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. In the first set of VARs, 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. In the second set, the aggregate cycle is not removed from the state level data.