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Reserve Bank

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The Business Services Sector

Josef Manalo and David Orsmond*

The business services sector has become increasingly important in the Australian economy. The strong growth in its output and employment has been largely driven by demand for the professional, scientific and technical inputs that firms in this sector provide to other businesses. This, in turn, has reflected increased demand for the output of highly skilled labour by the mining industry and other parts of the economy, the increased use of outsourcing, and a range of technological developments.

Introduction

The business services sector has grown strongly for an extended period and it now accounts for one-quarter of Australia's output and one-fifth of total employment. However, despite its size, developments in the business services sector tend to attract less attention than those in other parts of the economy. Using data from the Australian Bureau of Statistics as well as information gathered through the Bank's liaison with firms, this article discusses the composition of the business services sector and outlines the factors that lie behind its recent growth. The article focuses on structural changes that have affected the business services sector – notably, the expansion of the mining industry, shifting patterns of production and demand within the economy, and technological advances.

Recent Output and Employment Trends

Business services firms provide a range of assistance to other companies, such as technical and financial advice, leasing of equipment and temporary administrative support. The output of the business services sector is used by a wide range of other industries so they can undertake their day-to-day operations efficiently. As a consequence, trends within the business services sector are affected by the strength of demand and changing production processes within other industries. Technological changes across the economy also play a major role.

There is no straightforward definition of industries that comprise the business services sector. This reflects challenges in identifying businesses that provide services that are used in-house by other companies (such as consulting and information technology support) from those businesses that provide storage and distribution services for other companies' goods (such as wholesale and transport services, which are classified under the goods distribution sector).[1] It is also difficult to classify firms that in practice serve both the business and household sectors (such as telecommunications and financial services providers). And finally, it is hard to classify some firms that employ staff directly to undertake business services activities in-house but which are primarily focused on other activities such as goods production (like manufacturing companies that employ accounting staff). While acknowledging these difficulties, in this article we focus on developments in five industries that provide

* The authors are from Economic Analysis Department.

1 Apart from the business services sector, the other main sectors are: goods production (agriculture, mining, manufacturing, utilities and construction, which together account for around 30 per cent of output); goods distribution (retail, wholesale and transport, around 15 per cent of output); and household services (accommodation & food, education, health, arts and other services, also around 15 per cent of output). Ownership of dwellings and public administration & safety make up the balance of the output shares.

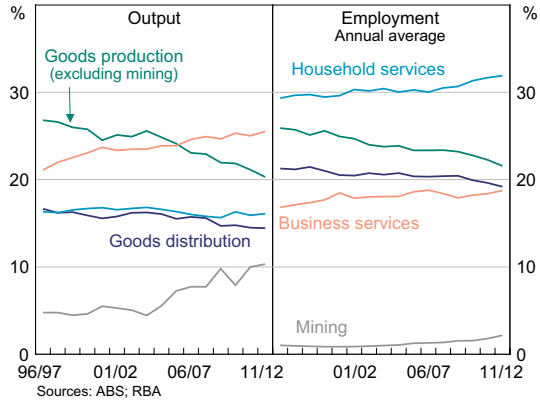
non-distribution services to other companies, namely:

- *Professional, scientific & technical services*: firms that provide highly skilled services to other companies such as engineering, architecture, legal, accounting, consulting, research, advertising and computer systems design.
- *Administrative & support services*: firms that help with building maintenance, labour hire operations, travel arrangements, packaging and outsourced office process services.
- *Rental, hiring & real estate services*: firms that lease equipment and transport vehicles, and firms that provide property management and real estate services.
- *Information media & telecommunications*: firms that manage telecommunications, internet and data management infrastructure, as well as those that create, manage, broadcast or provide information (including newspapers, magazines, books, television, radio, cinemas and music publishing).
- *Financial & insurance services*: firms that facilitate financial and insurance-related transactions and provide financial advice.[2]

Taking these five industries together, business services output has grown strongly, with growth averaging 5 per cent a year over the past 15 years and its share in nominal output increasing from 21 per cent in 1997 to 26 per cent by 2012 (Graph 1). Employment in these industries has also increased strongly, with growth averaging 3 per cent a year over the same period and its share in total employment rising from 17 per cent to 19 per cent. While growth of business services output slowed during the global financial crisis in 2008, trends in the business services sector have generally been less cyclical than in industries associated with goods production, such as mining, manufacturing and construction (Graph 2).[3]

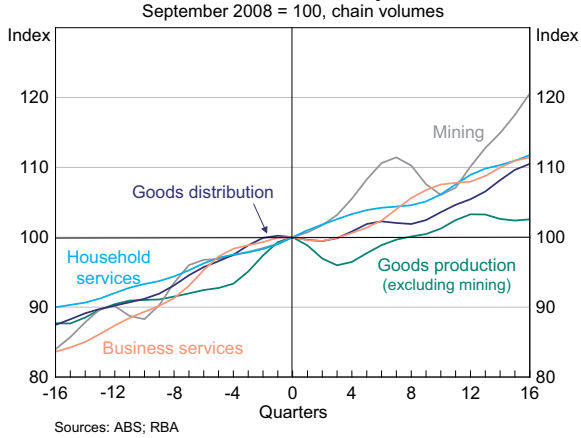
The large increases in the output and employment shares of the business services sector mask considerable variation within the sector. The rise in the output share of business services has primarily reflected growth in its two largest industries – the professional, scientific & technical services industry and the financial & insurance services industry –

Graph 1
Sector Output and Employment
Share of national output and employment, current prices



Sources: ABS; RBA

Graph 2
Trend Sector Output
September 2008 = 100, chain volumes



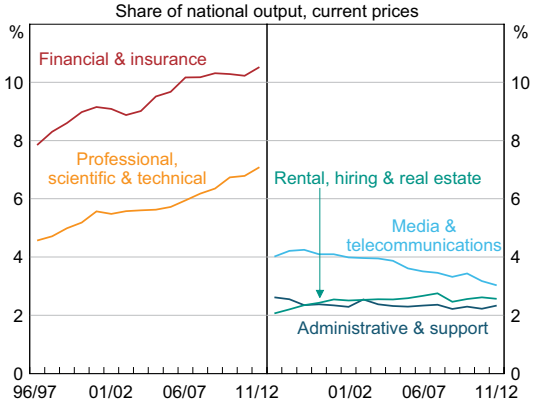
Sources: ABS; RBA

2 See Appendix A for a more detailed description of the type of activities reflected in these groups.

3 Nonetheless, some parts of the business services sector fared better than others; administrative & support services output fell sharply during the downturn and employment in that industry declined, financial & insurance services output flattened noticeably after a period of very strong growth, but the rapid growth of professional, scientific & technical services output was largely unaffected.

which together comprise around two-thirds of the sector (Graph 3). In contrast, the output shares of the administrative & support services and the rental, hiring & real estate industries have been relatively stable over time while that of the media & telecommunications industry has declined.

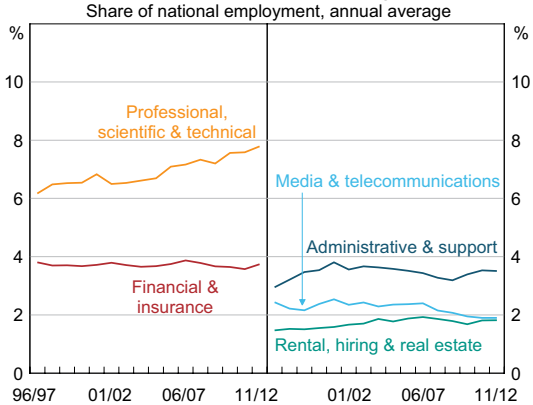
Graph 3
Business Services Output
Share of national output, current prices



Sources: ABS; RBA

The rise in the business services employment share has been driven by growth in just the professional, scientific & technical services industry (Graph 4). The employment shares of the financial & insurance, administrative & support and rental, hiring & real estate services industries have remained little changed, while the media & telecommunications industry has seen a slight decline over an extended period.

Graph 4
Business Services Employment
Share of national employment, annual average



Sources: ABS; RBA

Factors Affecting the Growth of the Business Services Sector

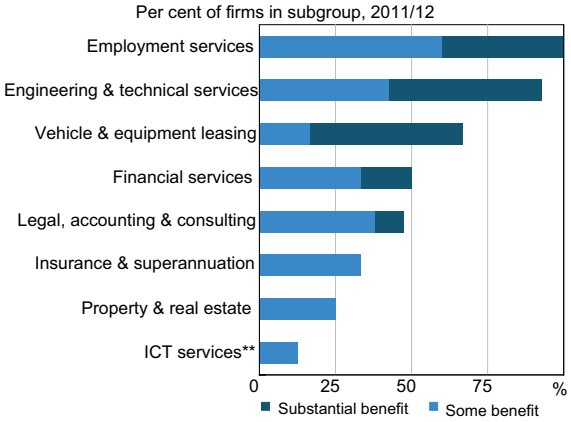
The output and employment trends within the business services sector reflect four interrelated factors: the growth of the mining sector; the trend increase in the demand for the output of skilled labour within the economy; the increased use of outsourcing by firms to acquire business services inputs; and technological developments. The impact of these factors on specific industries within the business services sector has varied, and some of these factors have been important for an extended period while others have been more recent phenomena.

Growth of the mining sector

The rise in global commodity prices from the mid 2000s and the associated growth of mining investment and export activity have had a positive effect on many business services industries. Major beneficiaries have been employment services firms, engineering & technical services firms, and vehicle & equipment leasing providers (all of which are subsets of the five broad industries discussed above). Indeed, two-thirds or more of the firms in these areas that participate in the Bank's business liaison cite a substantial, or at least some, benefit from the growth of the mining industry over the year to mid 2012 (Graph 5). While the reappraisal of mining investment prospects towards the end of last year has weighed on demand for business services in the coal and iron ore industries – especially for exploration and construction-related services – demand for these types of business services from the liquefied natural gas (LNG) industry and for current mining production has continued to be strong.

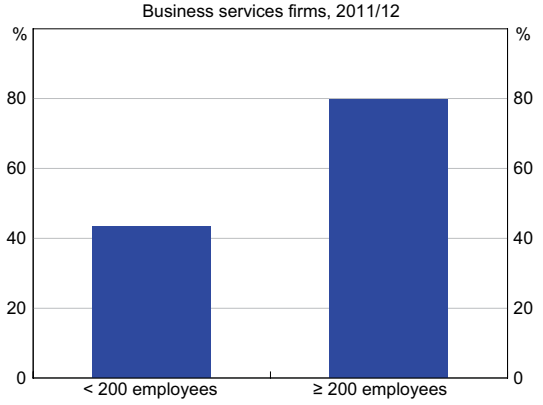
The boost to activity from the mining sector has reportedly been less substantial for other firms within the business services sector. Such firms generally have a wider client base in the non-mining sector and also tend to be smaller companies, which in general report fewer benefits from the expansion of the mining industry than larger companies (Graph 6). Nonetheless, some firms do report a

Graph 5
Firms Benefiting from the Mining Boom*



* Includes business services firms contacted by the RBA; the shares and responses of firms may not represent the entire sector
** Information and communication technology services
Source: RBA

Graph 6
Firms Benefiting from the Mining Boom*



* Either some or substantial benefit from the mining boom; includes business services firms contacted by the RBA; the shares and responses of firms may not represent the entire sector
Source: RBA

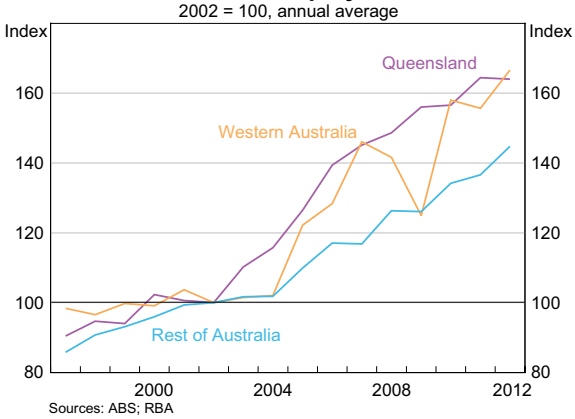
substantial effect from the mining industry on their demand. Legal, accounting & consulting firms that have an exposure to mining-related firms have, until recently, generated strong revenue growth. Similarly, some property & real estate firms have benefited through their exposure to the commercial property market, especially in the states with substantial mining activity. The mining industry has also created demand for financial services such as capital raising and mergers & acquisitions services, partly offsetting weaker demand for these types of services from the non-mining sector.

The strong growth in mining-related business services output has had an important regional dimension. The concentration of mining in Western Australia and Queensland and the labour-intensive nature of the business services sector has led some business services firms to relocate staff from New South Wales and Victoria to their offices in Brisbane and Perth, and some firms have opened or expanded offices in specific towns and cities with high levels of mining activity, such as Gladstone, Karratha and Port Hedland. As a consequence, professional, scientific & technical employment has increased significantly in the states with substantial mining activity relative to levels in the late 1990s/early 2000s, although there is tentative evidence that demand for this type of labour has flattened in Queensland of late (Graph 7).[4] Still, while recent data suggest that current labour shortages are lower than in the period prior to the onset of the global financial crisis, shortages in some specific skilled professions remain across the country – especially for engineering professionals (Graph 8). These shortages have until recently been a commonly reported constraint on the ability of business services firms to increase their exposure to the mining industry.

Overall, the expansion of the mining industry has provided a boost to activity in different parts of the business services sector. As the mining boom matures, the nature of the mining industry's demand for the output of the business services sector is likely to change. For example, engineering firms that currently provide services during the construction phase may not be as heavily in demand – nor have the suitable skills – to service mining production operations. And employment services firms may derive less benefit since the move from the investment to the production phase of the mining boom requires a more permanent and generally smaller workforce. In contrast, equipment leasing services are likely to remain in demand.

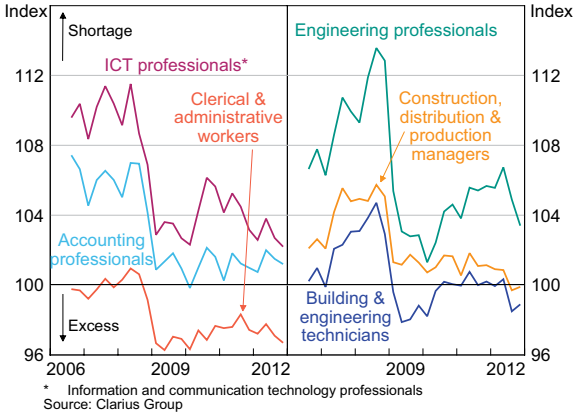
4 However, the mining industry still employs a relatively low share of all the professional services workers employed in Australia. The number of professional services workers in the rest of Australia has continued to grow strongly as well.

Graph 7
Professional, Scientific & Technical Services Employment
2002 = 100, annual average



Sources: ABS; RBA

Graph 8
Clarius Skills Index
100 = balanced labour market



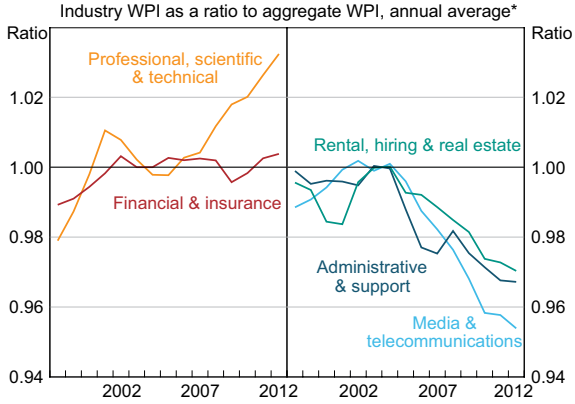
* Information and communication technology professionals
Source: Clarius Group

Rise in skilled labour demand and wages

While the mining sector has increased the demand for specialised skilled labour over recent years, more broadly, production in the Australian economy has become increasingly high-value and service-based over time. This has involved a shift in demand away from lower-value output for which Australia does not have a comparative advantage. As in many other developed economies, this partly reflects the strong growth in demand for services rather than goods output as real incomes increase. Because of the lower degree of tradability of services internationally, this demand has to be met through the production of more services locally. It also reflects longstanding technological developments that have tended to favour demand for highly skilled labour. The consequence of both of these trends has been an increase in the wages of highly skilled labour relative to those of less skilled labour.

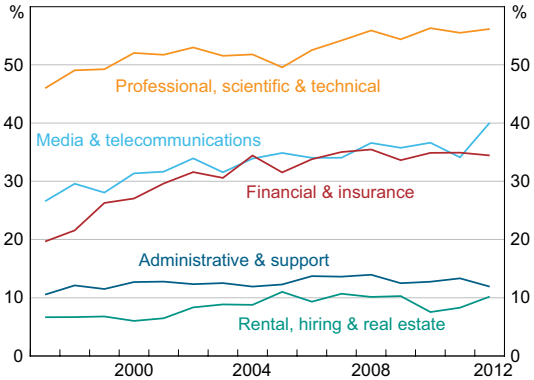
Different industries within the business services sector employ varying shares of both skilled and less skilled labour. This has meant that, while average wages in the business services sector – as measured by the wage price index (WPI) – have grown at around the same pace as those in the rest of the economy, there has been considerable divergence in the average wage growth in different industries within the sector. In particular, in the professional, scientific & technical services industry – where close to 60 per cent of total employment is skilled labour – wages have grown much faster than those in other business services industries and in the overall economy (Graphs 9 and 10). The rise in demand for the output produced by the professional, scientific & technical services industry, combined with the associated strong growth in the wages of its professionals, is consistent with the large increase in its share in output over time.

Graph 9
Changes in Business Services Wage Levels
Industry WPI as a ratio to aggregate WPI, annual average*



* 2003–2004 average = 1.0
Sources: ABS; RBA

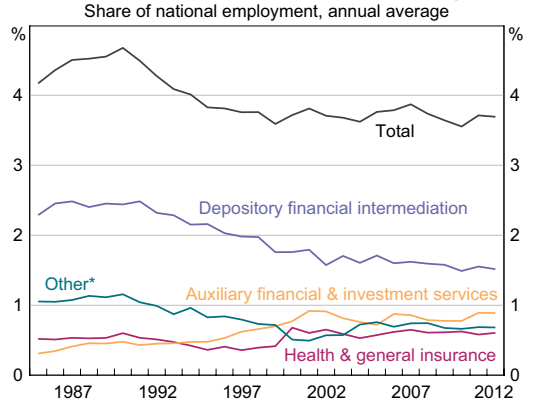
Graph 10
Professionals in Business Services
Share of total industry employment, annual average



Sources: ABS; RBA

The share of professionals in the financial & insurance services industry has also increased over time, and presently stands at around one-third of its total employment. However, overall wages in the financial & insurance services industry have tended to grow at around the same rate as the economy as a whole. Structural changes associated with technological developments – including the introduction of automatic teller machines, internet banking and electronic payment methods – have seen a decline in demand for clerical staff within bank branches (Graph 11). This has been partially offset by employment of auxiliary financial advisory and brokerage services, as well as in the health & general insurance sub-sector.[5]

Graph 11
Financial & Insurance Services Employment
Share of national employment, annual average



* Includes superannuation, life insurance, auxiliary insurance services, central banking, non-depository financing and financial asset investing

Sources: ABS; RBA

In contrast, the rental, hiring & real estate and the administrative & support services industries have a relatively high share of labourers, sales, clerical and administrative staff, and their average wages have grown more slowly than those of the economy overall. Finally, although the media & telecommunications industry employs around the same share of professionals as the financial & insurance services industry, Bank liaison suggests that strong competitive and cost pressures, combined with significant changes in digital technology (outlined below), have seen average wages and output in the media & telecommunications industry grow more slowly than in the economy overall.

Increase in outsourcing

For some time, activities that had been conducted in-house by many firms – such as accounting, computing and cleaning – have been increasingly contracted to business services companies that specialise in the provision of these types of activities. This has enabled firms to better focus on their core expertise and has provided them with an opportunity to lower the per-unit cost of ancillary services. This reallocation of employment across firms within the economy has tended to boost the output and employment of the specialised firms within the business services sector that provide these services, notably those providing professional, scientific & technical services and administrative & support services. At the same time, it has reduced employment in the firms that previously generated these services in-house (e.g. firms within the manufacturing sector).[6]

5 These trends have primarily been led by households rather than businesses, in response to rising demand for wealth management services and changes in government health policies in 1999–2000. The rise in the share of the financial & insurance services industry in total output has in part reflected strong profit growth in that industry as well.

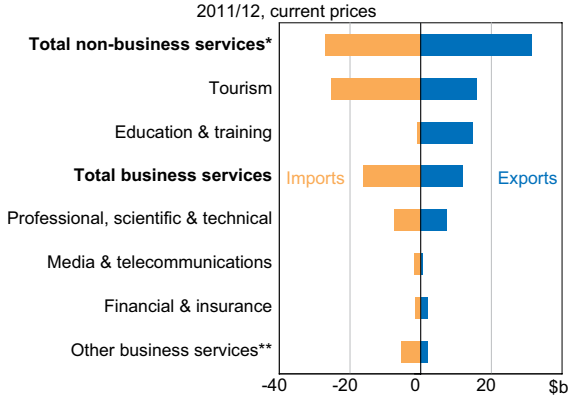
6 For more details, see Productivity Commission (2012), *Annual Report 2011–12*, Annual Report Series, Productivity Commission, Canberra. Available at <http://www.pc.gov.au/__data/assets/pdf_file/0018/120258/annual-report-2011-12.pdf>.

The drive for increased efficiency in the face of strong competitive pressures as well as advances in communication technologies have also underpinned efforts to shift parts of the internal operations of some business services firms offshore, especially for larger firms. For example, some engineering firms have moved parts of their design & drafting work overseas and some advertising firms have offshored parts of their digital production; more broadly, various business services firms have shifted back-office jobs offshore while keeping higher-skilled jobs in Australia. In addition, skill shortages in Australia have encouraged some firms to move operations offshore where certain engineering and information technology skills are more abundant. These activities have enabled business services firms to offer their activities to other Australian businesses at a lower cost than would otherwise be the case.

While the increase in global commodity prices since the mid 2000s has been associated with a large appreciation of the Australian dollar, Bank liaison with business services firms suggests that their efforts to move some parts of their internal operations offshore have mostly been motivated by the desire for longer-term cost reductions rather than in direct response to the higher exchange rate.[7] Compared with other service industries – such as tourism and education – the output of Australia's business services sector is not especially trade exposed, with most firms neither exporting nor facing a high degree of import competition (Graphs 12 and 13). However, some activities are more exposed than others and the tradability of some business services appears to be rising over time. Currently, the most trade exposed part of the business services sector is the professional, scientific & technical services industry. Looking at activities within that industry, exports and imports of legal, accounting & consulting services in particular have been rising over time. Imports of architectural, engineering & scientific services have also increased strongly since the mid 2000s, in line with the rise in demand from the mining industry.

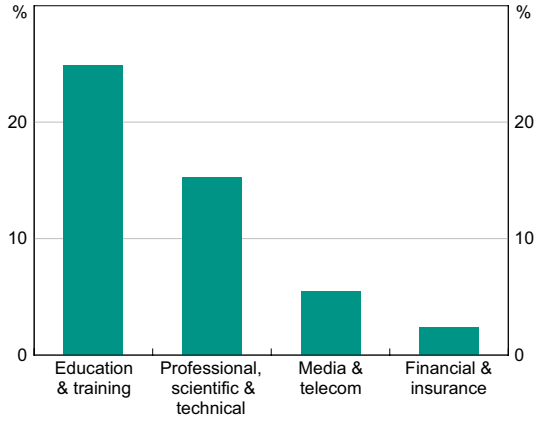
7 Nonetheless, the appreciation of the currency has reduced import costs for the business services sector, which has benefited firms such as those providing engineering services.

Graph 12
Service Import and Export Values
2011/12, current prices



* Includes household services
** Mainly includes intellectual property, trade-related and leasing services
Sources: ABS; RBA

Graph 13
Tradability of Services*
2011/12, current prices



* Measured as the sum of imports and exports as a proportion of output
Sources: ABS; RBA

Advances in information technology

Advances in information technology are having a marked effect on the size and growth of different firms within the business services sector. In recent years, two key developments have helped facilitate rapid advancements in digital technology: information and internet connections have become faster and more reliable, and mobile internet has become increasingly widespread due to the rollout of 3G and 4G wireless internet networks and the popularity of smartphones and tablet computers. These technological advances have been both a

challenge and an opportunity for businesses. On the one hand, the freer flow of information has intensified the competitive environment that many businesses face, particularly those in the retail sector. On the other hand, the technological advances are providing businesses with new means to change their internal processes in order to raise efficiency and remain competitive. For example, the growth of cloud computing services is enabling both small and large businesses to outsource some of their information systems requirements and thereby lower costs.

Accordingly, businesses are increasingly seeking professional consulting services to help make better use of new technology. Demand for consulting services is being generated from the uncertainty resulting from the rapid pace of technological advancement; since utilising new technology may entail a large scale of investment, companies seek advice from business service specialists on whether new products will be able to meet their information technology needs now and in the future.

Developments in digital technology are having a marked effect on print media and television broadcasting firms as households and businesses access information and entertainment media via the internet rather than through more traditional channels. Print media has seen a fall in advertising revenue and, in response, print media business services firms are investing in digital content delivery, such as the development of mobile device applications and paid content websites. Costs are also being lowered, including through reductions in the labour force and shrinking the size of newspapers. Television networks are also trying to increase their internet revenues by, for example, offering advertising on programs that can be streamed on demand from the internet.

In addition, the growth of digital media has increased the demand for some advertising services firms, since advertisements need to cover a wider range of media. As demand for digital advertising has grown, both media and advertising services firms have reported difficulty finding staff with online digital expertise, which is limiting the pace of expansion of these parts of the business services sector. As noted earlier, however, strong competitive and cost pressures within that industry have contained the pace of wages growth and the output share of the media & telecommunications sector has declined.

Conclusion

The business services sector has been one of the fastest growing sectors in the economy in terms of both its output and employment. The expansion of the mining industry and the increased outsourcing of auxiliary services to specialised firms have been important drivers of this growth, though its impact has varied across different firms within the sector. Technological developments and the general rise in the demand for skilled labour have led to the growth of some firms in the business services sector – especially in the professional, scientific & technical services industry – but also to a relative decline in some others. These trends are likely to see further increases in the output and employment shares of the relatively higher-skilled parts of the business services sector. At the same time, the shift from the investment to the production phase of the mining boom and the increasing ability to trade some services internationally are likely to see ongoing changes in the nature of the demand for domestically produced business services.

Appendix A

Table A1: Detail on Industry Classifications
(*continued next page*)

ANZSIC 2006 Division (2011/12 share of output, employment)	ANZSIC 2006 Group
Professional, scientific & technical services (7 per cent, 8 per cent)	Computer system design and related services
	Scientific research services
	Architectural, engineering and technical services
	Legal and accounting services
	Advertising services
	Market research and statistical services
	Management and related consulting services
	Veterinary services
	Other professional, scientific and technical services
Administrative & support services (3 per cent, 4 per cent)	Building cleaning, pest control and gardening services
	Packaging services
	Employment services
	Travel agency and tour arrangement services
	Other administrative services
Rental, hiring & real estate services (2 per cent, 2 per cent)	Property operators
	Real estate services
	Motor vehicle and transport equipment rental and hiring
	Other goods and equipment rental and hiring
	Farm animal and bloodstock leading
	Non-financial intangible assets (except copyrights) leading
Information media & telecommunications (3 per cent, 2 per cent)	Telecommunications services
	Internet service providers and web search portals
	Data processing, web hosting and electronic information storage services
	Newspaper, periodical, book and directory publishing
	Software publishing
	Motion picture and video activities
	Sound recording and music publishing
	Radio broadcasting
	Television broadcasting
	Internet publishing and broadcasting
	Libraries and archives
	Other information services

Table A1: Detail on Industry Classifications
(*continued*)

ANZSIC 2006 Division (2011/12 share of output, employment)	ANZSIC 2006 Group
Financial & insurance services (11 per cent, 4 per cent)	Depository financial intermediation
	Non-depository financing
	Financial asset investing
	Superannuation funds
	Auxiliary finance and investment services
	Health and general insurance
	Life insurance
	Auxiliary insurance services
	Central banking

Source: ABS

GDP Revisions: Measurement and Implications

James Bishop, Troy Gill and David Lancaster*

Gauging economic conditions in real time is challenging, in part because economic data are difficult to measure and subject to subsequent revision as more information becomes available. This article investigates the pattern and size of revisions to real gross domestic product (GDP) over the past decade or so. Revisions to early estimates of GDP can be large and, over the past 15 years, have tended to increase measured growth, although the extent of revision is in line with international experience. This article also examines the feasibility of adjusting real-time estimates of GDP for apparent patterns in revisions, predicting future revisions and calculating confidence intervals around the historical data. The uncertainty around real-time GDP estimates highlights the importance of monitoring a wide range of information when assessing current economic conditions.

Introduction

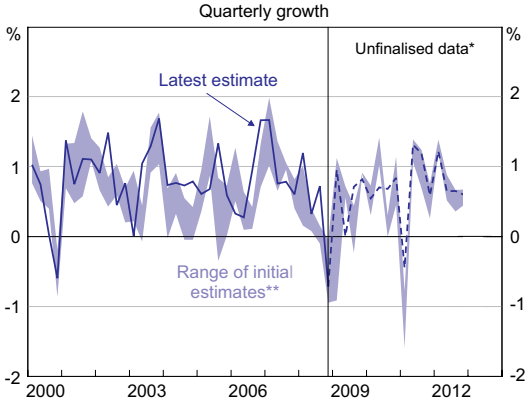
Assessments of current economic conditions have an important bearing on near-term forecasts of activity and inflation. However, making these assessments in real time is a challenging task for macroeconomic policymakers. One issue is that economic data are difficult to measure and subject to revision as more information is obtained. There is typically a trade-off between timeliness and reliability and so, in order to produce timely estimates, statistical agencies publish data before all information sources are available. As a result, early estimates of many economic aggregates may differ from subsequent, more informed estimates. Gross domestic product (GDP) is one important economic aggregate that is frequently subject to revision, reflecting the large amount of information used in its construction, some of which is not available on a timely basis. GDP measures the total value of final goods and services produced within an economy over a given period of time, and provides a comprehensive summary of the current state of the economy.

In Australia, GDP data are published at a quarterly frequency by the Australian Bureau of Statistics (ABS), around two months after the end of the reference quarter. Real GDP is measured using three different approaches, based on expenditure (GDP(E)), income (GDP(I)) and production (GDP(P)).[1] The ABS considers the average of these three measures (GDP(A)) to be the most reliable estimate of final output, in part because independent errors in the underlying measures are often offsetting (Aspden 1990; ABS 2011). The choice between the available GDP measures in real time would be inconsequential if the discrepancy between them was small. However, typically this is not the case; the range of initial quarterly growth estimates over the past two decades has averaged around half a percentage point (Graph 1).

* The authors are from Economic Group.

1 GDP(E) is calculated as the sum of all expenditures by households, businesses and governments on final production, plus exports and the change in inventories, less imported goods and services. GDP(I) measures the income received for providing labour and capital services as inputs to production. GDP(P) measures the value of production in the economy as the difference between the value of outputs and the value of intermediate inputs consumed in production. Conceptually, the three measures should be equal, but in practice the measures differ because they are constructed from different data sources and have varying degrees of measurement error. For more detail on the ABS's data construction methods, see ABS (2007, 2011, 2012). The ABS is one of only a few statistical agencies in the world to compile and publish all three measures of GDP.

Graph 1
Gross Domestic Product
Quarterly growth



* Estimates which have undergone fewer than 16 revisions
** From the expenditure, income and production measures of GDP
Sources: ABS; RBA

Revisions to GDP are driven by several things. First, they can reflect the incorporation of newly available data, as many data that feed into the national accounts are not available in a timely fashion; for example, some taxation data are only available at an annual frequency from the Australian Taxation Office, whereas initial GDP estimates are published around nine weeks after the end of each quarter. Second, once a year, the ABS undertakes a more detailed reconciliation of each measure of GDP, which generally results in further revisions. Third, regular re-estimation of seasonal patterns, and the rebasing of volume estimates, can also lead to revisions. Finally, revisions can result from methodological changes in the compilation of the national accounts or the correction of errors.

This article examines the extent to which early estimates of GDP are revised, and considers which measure of GDP may give the best read of economic conditions in real time. A range of metrics are employed, such as the average size and direction of revisions for each GDP measure and its components. The article concludes with an assessment of the broader implications of this uncertainty for the presentation and interpretation of real-time GDP data.[2]

2 For a comprehensive review of the literature on revisions to macroeconomic data, see Croushore (2011).

Measuring Revisions to GDP Growth

Analysis of revisions is complicated by the fact that 'final' estimates are never directly observed because revisions can continue indefinitely. It is necessary, therefore, to make a judgement about when estimates *approximate* final values. In this article, the 'final' value for GDP growth in a given quarter is assumed to be the estimate four years following the initial release, and this 'final' value of GDP(A) growth is treated as the best estimate of GDP growth. The analysis in this article draws on initial estimates, that is real-time vintages, of the national accounts, beginning in the September quarter 1998, following the introduction of the 1993 System of National Accounts, and finishing in the December quarter 2008 (leaving four years of data following the end-point to allow the last observation to reach its assumed final value). All analysis is conducted using quarterly or year-ended growth in GDP.

A common metric for assessing the size of revisions is the 'mean absolute revision', which measures the average size of revisions regardless of sign (Table 1). Since 1998, the first estimate of growth in GDP(A) has been revised, on average, by more than 0.3 percentage points in quarterly terms and 0.5 percentage points in year-ended terms. To put this into perspective, the average quarterly growth rate of real GDP was 0.8 per cent during this period, with a standard deviation of 0.4 percentage points. The average size of revisions to a particular quarter decreased with subsequent releases, as new data became available and the estimates were refined, but even after three years, quarterly growth estimates of GDP(A) diverged from their 'final' values on average by around 0.2 percentage points. In quarterly terms, revisions to early estimates have been largest for the expenditure measure of GDP, while revisions have tended to be smaller for the production measure. This suggests that GDP(P) arguably has been a more reliable indicator of activity in real time than either GDP(E) or GDP(I), in the sense that initial growth estimates of GDP(P) have tended to be closer to

Table 1: Mean Absolute Revisions[a]
Percentage points

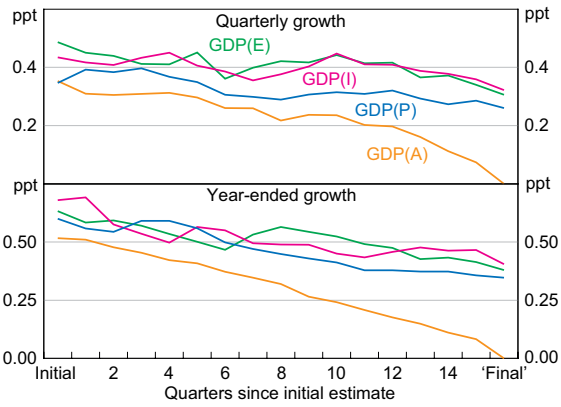
	Initial	One year	Two years	Three years
Quarterly growth:				
GDP(A)	0.35	0.31	0.22	0.20
GDP(E)	0.60	0.49	0.32	0.30
GDP(I)	0.45	0.43	0.36	0.29
GDP(P)	0.33	0.23	0.19	0.18
Year-ended growth:				
GDP(A)	0.52	0.42	0.32	0.18
GDP(E)	0.63	0.50	0.38	0.24
GDP(I)	0.73	0.59	0.51	0.27
GDP(P)	0.58	0.51	0.34	0.22

(a) Mean absolute difference between growth estimate after four years and growth estimate at given horizon
Sources: ABS; RBA

'final' growth estimates than for the other measures. In a similar vein, quarterly growth in GDP(P) has historically also been less variable than the other measures of GDP growth, suggesting that it is subject to less measurement error (ABS 2011).

While reliability is one useful metric for judging the quality of early GDP growth estimates, it does not indicate which measures are more accurate in real time, in terms of their closeness to the 'final' estimate of growth in GDP(A).[3] Graph 2 shows the mean absolute error of each measure of GDP compared with final GDP(A).[4] Both in quarterly and year-ended terms, initial estimates of GDP(P) have tended to be closer to that of final GDP(A) than either GDP(E) or GDP(I). On a quarterly basis, initial estimates of GDP(P) have been as close as initial estimates of GDP(A), suggesting that initial estimates of GDP(P) have, on average, provided a real-time read on 'final' GDP growth as accurate as the ABS's preferred measure (although this is not the case for initial estimates of year-ended growth). On the other hand, initial

Graph 2
Error Relative to 'Final' GDP(A)*
Mean absolute error



* Mean absolute difference between growth estimate for GDP(A) after 16 quarters and growth estimate at given horizon
Sources: ABS; RBA

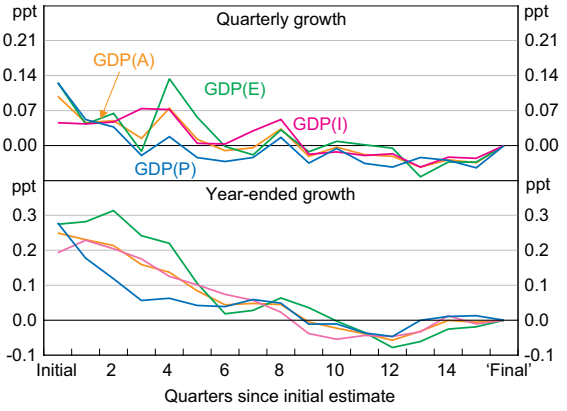
estimates of GDP(E) and GDP(I) have been somewhat less accurate predictors of 'final' GDP(A), on both a quarterly and year-ended basis.

Another gauge of the quality of real-time estimates is whether they tend to overstate or understate 'final' estimates, that is, whether they are biased. A simple average of revisions at each horizon is shown in Graph 3. The first estimate of quarterly GDP(A) growth has tended to be revised upwards by around 0.1 percentage points, although the mean revision

3 A GDP figure that is never revised would not, in practice, indicate high quality.

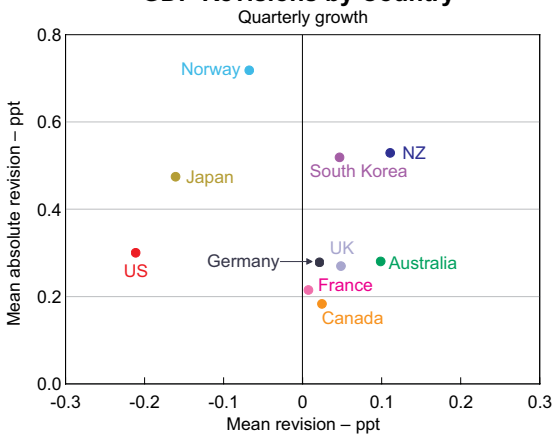
4 While the annual reconciliation process conducted by the ABS equalises the GDP measures in annual terms (for financial years prior to the latest complete year), discrepancies typically remain between the measures on a quarterly basis.

Graph 3
Mean Revisions*



* Mean difference between growth estimate after 16 quarters and growth estimate at given horizon
Sources: ABS; RBA

Graph 4
GDP Revisions by Country*



* For comparability, initial estimates are those published in the OECD's *Main Economic Indicators* four months following the end of the quarter; sample period covers March quarter 2000 to September quarter 2008
Source: OECD (2013)

falls close to zero relatively quickly.[5] In year-ended terms, initial estimates have been revised upwards by 0.2 percentage points on average. Early estimates have tended to be revised up for each of the three GDP measures, although the mean revision for GDP(P) approaches zero quite quickly. GDP(E) generally had a relatively large (positive) mean revision until around the fifth estimate in year-ended terms. Revisions to a *given* quarter through time have tended to be negatively correlated, suggesting that if GDP growth for a particular quarter was revised up in one release of the data, it was more likely to be revised down in the next release (although the negative correlations were typically small).

While the revisions to Australian GDP, including the average upward revision to initial GDP growth estimates, have been non-trivial in size, they have been consistent with international experience (Graph 4). The mean absolute size of revisions in Australia has been similar to that for a number of large advanced economies, and smaller than that for some smaller economies.[6] The mean revision to initial estimates in Australia has been somewhat larger than in some other economies, though in line with New Zealand and smaller in absolute size than in the United States and Japan.

Revisions around Turning Points

The effectiveness of macroeconomic policy in part relates to the ability of policymakers to respond quickly to changing economic conditions. It is important, therefore, to consider how measures of GDP growth are revised around turning points in the economy. Because initial GDP growth estimates are produced without all the information that will eventually become available, business cycle turning points may not be fully apparent in real time. For example, during a downturn estimates of GDP growth may be initially overstated if it takes time for the ABS to be informed of business closures. For this reason, one could expect downward revisions to growth during a downturn and upward revisions to growth during an upswing.

5 The mean revision for the first estimate of GDP(A) growth is statistically different from zero at the 10 per cent significance level, using standard errors which are robust to heteroscedasticity and autocorrelation. The results may be somewhat dependent on the sample (September quarter 1998 to December quarter 2008), which spans a period of relatively strong economic growth.

6 A measure of absolute revision that adjusts for the difference in average rates of economic growth across countries shows a broadly similar pattern, albeit with Germany, France, Japan and the US recording relatively larger mean absolute revisions.

The dates of peaks and troughs in the business cycle can be estimated using growth in GDP(A) and a Bry-Boschan algorithm.[7] This method identifies five peaks and four troughs in the business cycle between 1991 and 2012; Table 2 presents the average size of revisions around these peaks and troughs.[8] GDP(I) and GDP(E) growth estimates have indeed tended to be revised down following peaks in the cycle, while all GDP measures have tended to be revised up following troughs in the cycle during the past 20 years. More striking perhaps is the fact that peaks and troughs have typically been much less apparent in real time. Revisions to GDP(P) have been relatively more stable around turning points than revisions to the other measures of GDP.

One challenge when conducting analysis only around turning points is that the business cycle tends to move slowly, and so the sample of peaks and troughs is limited. One way to take advantage of the full sample of revisions when assessing the relationship between revisions and the business cycle is to look at the correlation between revisions to GDP growth ($X_t^{final} - X_t^{initial}$) and an 'acceleration factor' ($X_t^{final} - X_{t-1}^{final}$), which captures the speed at which the economy is expanding (similar to Dynan and Elmendorf 2001). A positive correlation suggests that there is a tendency for revisions to become more positive when the economy is speeding up and less positive (or even negative) when the economy is slowing down. The results support the proposition that the pattern of revisions to GDP has been related to the business cycle, with correlations of 0.24 for GDP(P), 0.54 for GDP(I) and 0.72 for GDP(E). The relatively low correlation for GDP(P) is consistent with the finding above that revisions to GDP(P) have been less affected by business cycle turning points.

Revisions to GDP Components

To further explain the patterns in revisions to GDP growth, the size and direction of revisions to the underlying components of GDP can be examined. An analysis of revisions at the component level is also important in its own right, given that policymakers examine GDP components to understand the economy more deeply. For example, the household saving ratio – which is the residual of household consumption and household disposable income, expressed as a share of income – is typically used as an indicator of households' propensity to spend.

Table 2: Mean Revisions and the Business Cycle[a]
Quarterly growth, percentage points

	Peaks[b]			Troughs[c]		
	Two prior quarters	Peak	Two subsequent quarters	Two prior quarters	Trough	Two subsequent quarters
GDP(A)	0.13	0.67	0.01	0.17	–0.36	0.22
GDP(E)	0.17	0.96	–0.07	0.22	–0.86	0.24
GDP(I)	0.12	0.75	–0.00	0.18	–0.28	0.20
GDP(P)	0.12	0.31	0.11	0.12	0.07	0.21

(a) Business cycle dated by running a quarterly Bry-Boschan algorithm over the latest estimates of GDP growth for the period 1991–2008
(b) Peaks dated at 2007:Q1, 2003:Q4, 2002:Q2, 1999:Q4 and 1997:Q2
(c) Troughs dated at 2008:Q4, 2006:Q1, 2003:Q1 and 2000:Q4
Sources: ABS; RBA

7 Because peaks and troughs can move across vintages, in this section 'final' GDP is defined as the latest published vintage. For an example of the use of the quarterly Bry-Boschan algorithm to date cycles in economic data, see Harding and Pagan (2002).

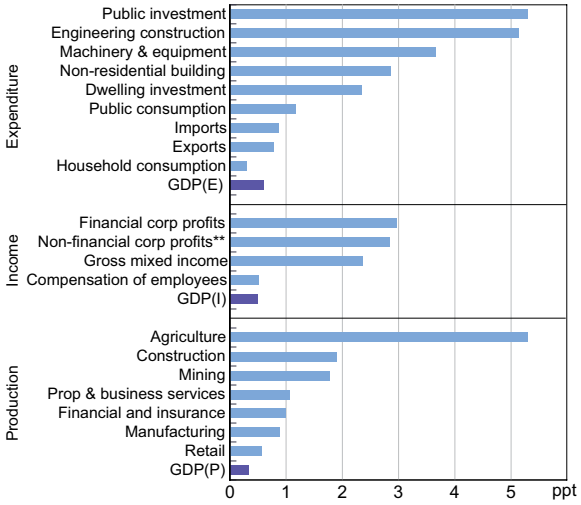
8 Troughs and peaks prior to 1991 are excluded because the four measures of GDP were not concurrently published before that time.

Size of revisions

An analysis of mean absolute revisions to quarterly growth indicates that revisions to the components have tended to be larger than the revisions to GDP itself (Graph 5).[9] This is because GDP is inherently 'smoother' than its components (see below) as the growth rate of its various components is not perfectly correlated and some of the measurement errors in the GDP components offset each other when they are aggregated. Some revisions also involve a reallocation of growth between components. The size of revisions varies substantially; for expenditure components, revisions to quarterly growth ranged from 0.3 percentage points for household consumption, to more than 5 percentage points for public investment and engineering construction.

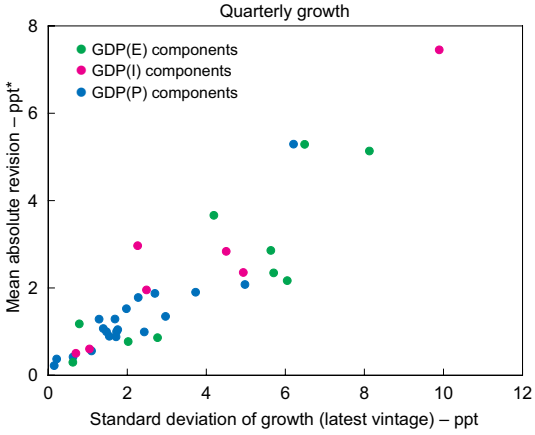
However, the substantial variation in the size of revisions between the components of GDP needs to be viewed in the context of the relative volatility of each series. A volatile series, such as public investment, is much more likely to be subject to larger percentage point revisions on average than a smoother series, such as household consumption. The data show that indeed there has been a strong positive relationship between the absolute size of revisions and the volatility of growth in the components of GDP (Graph 6).

Graph 5
Mean Absolute Revisions*
Selected components, quarterly growth



* Mean absolute difference between growth estimate after 16 quarters and initial growth estimate
** Excludes public corporations
Sources: ABS; RBA

Graph 6
Revisions and the Volatility of Growth
Quarterly growth



* Mean absolute difference between growth estimate after 16 quarters and initial growth estimate
Sources: ABS; RBA

Once adjustments are made to account for differences in the volatilities of the components, public consumption is the component of GDP(E) with the largest revisions. The 'signal' provided by these data in real time has often been obscured by 'noise', which is consistent with the ABS's own assessment that initial estimates of public consumption have been a 'relatively poor indicator of later estimates' (ABS 2007, p 63).

Main drivers of GDP revisions

To estimate which components make the largest contribution to GDP revisions, the mean absolute revision statistics for each component are weighted by their shares of nominal GDP. This takes into account the fact that a 1 percentage point revision to household consumption results in a much larger revision to GDP than a 1 percentage point revision to public investment, owing to the larger share of household consumption in GDP. This method

9 Graphs 5, 7 and 9 exclude several components of GDP. The statistics for a larger group of components of GDP are listed in Table A1. The components of GDP(I) are in nominal terms.

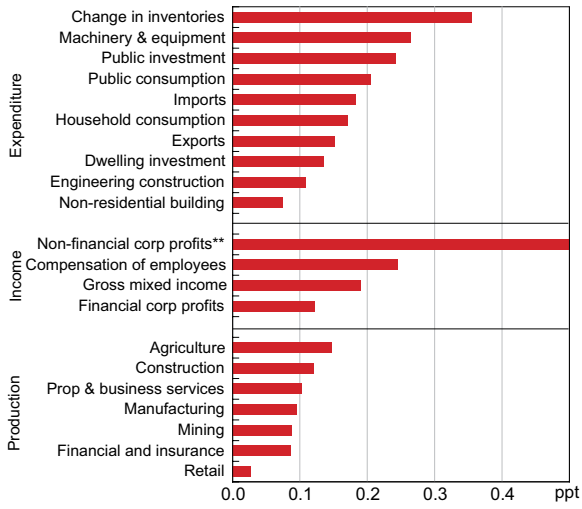
of weighting revisions by GDP shares – which is similar to calculating revisions to *contributions to real GDP growth* – also allows the relative importance of revisions to the change in inventories to be estimated, for which meaningful growth rates could not otherwise be calculated.[10]

The largest contributor to GDP revisions on the expenditure side of the accounts has been the change in inventories (Graph 7). This is an extremely volatile series that is calculated as the difference between estimates of opening and closing inventory levels in each quarter, and it is very difficult to measure accurately (ABS 2007). Other major contributors to GDP(E) revisions include public consumption and public investment. Revisions to household consumption have typically played a smaller role in GDP(E) revisions, despite its large weight in GDP. Nevertheless, revisions to consumption have still had important implications for macroeconomic assessments; in late 2010, the ABS revised the estimates of household saving, which reflected both a downward revision to consumption and an upward revision to household income. This revision lifted estimated household saving by $45 billion in 2009/10, or about 5½ per cent of income, which suggested that households had changed their saving propensity by more than earlier thought (Graph 8).

The largest contributor to revisions to growth in GDP(I) has been private non-financial corporate profits, reflecting the series' large propensity for revision and sizeable share of GDP. In contrast, on the production side of the accounts no particular component stands out as having been a significant driver of overall GDP(P) revisions.

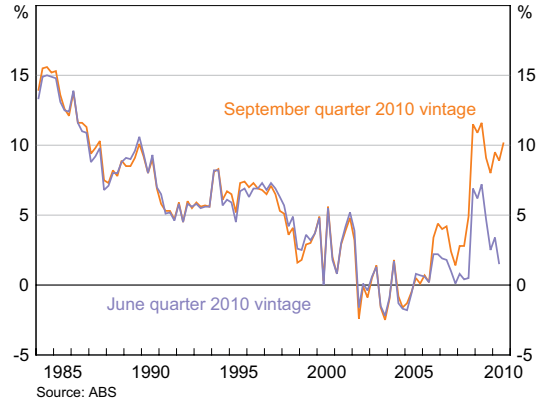
It is important to note, however, that revisions to GDP components in any given quarter will be offsetting to some degree, thereby mitigating the overall revision to GDP growth. For example, an upward revision to imports in a quarter may be matched, in both an accounting and conceptual sense, by corresponding upward revisions to other expenditure components such as household consumption.

Graph 7
Mean Absolute Revisions Weighted by Size*
Selected components, quarterly growth



* Mean absolute difference between nominal GDP-weighted growth estimate after 16 quarters and nominal GDP-weighted initial growth estimate
** Excludes public corporations
Sources: ABS; RBA

Graph 8
Household Saving Ratio



Source: ABS

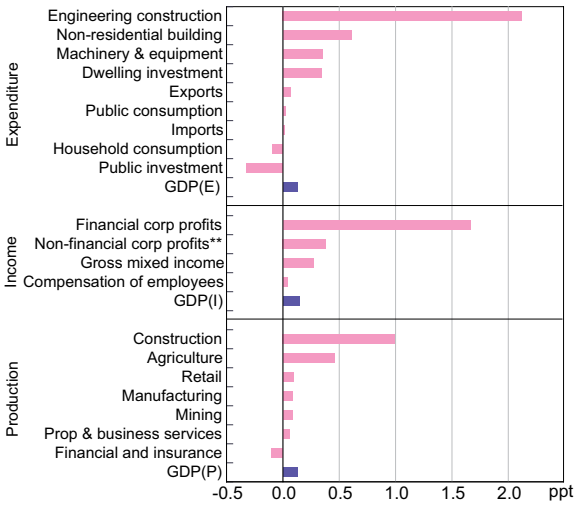
Direction of revisions

The source of the average positive revision to early estimates of GDP can be better understood by

10 Since the change in inventories can take positive or negative values, the growth rate of the change in inventories can become arbitrarily large in magnitude, or vary perversely in sign, if stocks cease being accumulated or actually decline. For this reason, in Graph 7 the mean absolute contribution of the change in inventories to GDP growth is calculated directly.

examining the mean revisions to each of the GDP components (Graph 9). The upward revisions to early estimates of GDP growth over the period from 1998 to 2008 reflected upward revisions to most GDP components: for the 39 components analysed across the three measures of GDP, 29 tended to be revised higher over time. However, this tendency was only statistically significant at the 10 per cent level for three of the components (engineering investment, construction gross value added and financial corporations' profits).

Graph 9
Mean Revisions*
Selected components, quarterly growth

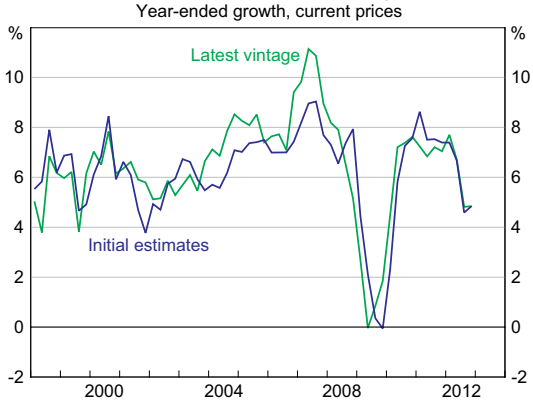


* Mean difference between growth estimate after 16 quarters and initial growth estimate
** Excludes public corporations
Sources: ABS; RBA

On the expenditure side, early estimates of the investment components have been particularly prone to subsequent upward revision over our sample period at least. First estimates of engineering investment growth were revised up by 2.1 percentage points on average. Residential and non-residential building construction estimates have also tended to be revised up over time, partly owing to upward revisions to building approvals flowing through to higher investment.[11] On average, the tendency for the investment components to be revised upwards typically dissipated after around one to two quarters, with the exception of machinery & equipment investment, with real-time estimates having tended to understate 'final' values for several years.

On the income side, along with corporate profits, gross mixed income and compensation of employees have also tended to be understated in real time. Initial estimates of compensation of employees noticeably understated growth between the mid 2000s and late 2007 (Graph 10), and indicated a smaller pick-up in labour costs than in the latest vintage. Such data revisions can complicate the assessment of inflation pressures in the economy. Since the income components are published on a nominal (value) basis rather than on a real (volume) basis, these revisions can also be a result of upward revisions to prices. Consistent with this, nominal GDP has tended to experience larger upward revisions on

Graph 10
Compensation of Employees
Year-ended growth, current prices



Source: ABS

11 Revisions to building approvals data flow through to the data for residential and non-residential building investment in the national accounts because the sample frame that is used for the ABS Building Activity Survey (which provides the quarterly indicators for the national accounts components) is based on building approvals details. Using monthly data over the period 2006–2012, initial estimates of the number of residential building approvals were revised up by 5 per cent on average, while the value of non-residential building approvals were revised up by 10 per cent on average.

average than real GDP, reflecting upward revisions to the GDP deflator.

Implications

The above analysis illustrates that real-time estimates of GDP growth are subject to significant revisions, so users should be careful not to over-interpret quarterly changes based on early vintages of data. It also highlights the importance of gathering and monitoring a wide range of other timely data and information.

Over the sample used in this article, early estimates of GDP growth tended to understate 'final' GDP growth to some degree. In principle, users can take this into account when considering the latest GDP data, but it is not clear that such a tendency will persist in the future. In particular, methodological improvements may reduce this tendency over time. The observed positive average revisions to early estimates may also have been driven by the nature of shocks affecting the economy during the sample period, which may not be repeated in coming years. For example, the impact of the sharp increase in the terms of trade on activity and profits may not have been fully apparent until the receipt of detailed tax data, which are only available with some delay. To the extent that the direction of revisions is somewhat related to the economic cycle, it is also relevant that the sample predominantly covers a period of relatively strong growth without any significant downturns.

Considering the different measures of GDP, when judged on the various metrics in this article, real-time estimates of GDP(P) performed almost as well as the real-time estimates of GDP(A) and better than the real-time estimates of GDP(E) and GDP(I).[12] Accordingly, for early GDP estimates, there seems to be some merit in placing relatively more weight on the early estimates of GDP(P).[13] However, once again, historical patterns may not necessarily persist in the future.

Given the extent of revisions to early estimates, it would be useful if data users could explicitly predict revisions in order to improve real-time estimates. In principle, this would be possible as subsequent data are published that either feed directly into the measurement of GDP or are correlated with revisions. Given that initial GDP estimates in Australia incorporate most of the regularly available monthly and quarterly data for the given quarter, this approach seems less likely to be fruitful than in countries in which preliminary or 'flash' GDP estimates are published using data for only the first two months of the quarter (such as in the United States), which can then be revised by users as the final month's data are subsequently published.[14]

Another approach is to consider the *distribution* of likely 'final' values by constructing confidence intervals around the early estimates of GDP.[15] Confidence intervals can be constructed using the historical root mean squared error of past estimates compared with 'final' estimates (and assuming errors are normally distributed), with an adjustment also being made for the tendency for estimates to be initially understated. This approach is illustrated in Graph 11, and suggests that, based on past experience, the 'final' estimate of GDP(A) growth in

12 In a similar vein, Nalewaik (2010, 2011) suggests that in the United States GDP(I) may be a better measure of GDP than the more commonly used GDP(E). Auroba *et al* (2011) also argue that in the United States, GDP(I) and GDP(E) should be combined to produce a better measure of GDP (akin to GDP(A) in Australia).

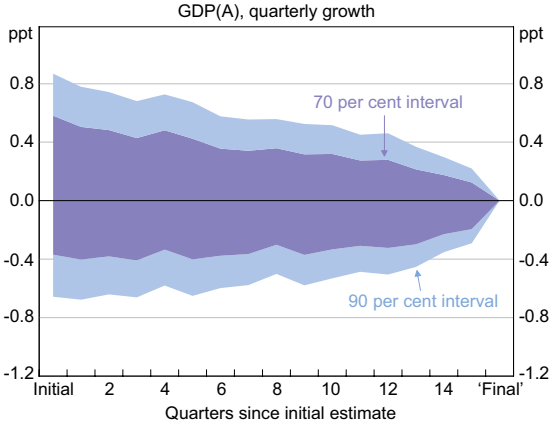
13 As each of the three measures has an equal weight in GDP(A), this raises the question of whether a different weighting scheme for early estimates might provide a more accurate estimate of 'final' GDP(A). One approach is to estimate a regression of 'final' GDP(A) growth on the initial GDP growth estimates for each of the three measures, which suggests a weighting scheme of 0.5 for GDP(P), 0.4 for GDP(I) and 0.1 for GDP(E) (where the coefficients are constrained to sum to 1). However, this alternative measure of GDP did not outperform the initial estimate of GDP(A) as an indicator of 'final' GDP(A) over the 1998–2008 sample period.

14 It might be possible to predict revisions to some degree using a broad range of timely economic indicators (on the basis that such indicators may contain information not yet captured by the available data underpinning the national accounts); however, such predictions would rely on relationships that may not necessarily hold in the future.

15 This approach is employed by the Bank of England, which uses state-space modelling techniques to construct confidence intervals that are routinely presented as fan charts in its quarterly *Inflation Report*.

any given quarter can be as much as 0.8 percentage points away from early estimates, with a 90 per cent confidence level. This serves to highlight the considerable uncertainty around published GDP estimates in real time.

Graph 11
Uncertainty around Estimates of Gross Domestic Product
GDP(A), quarterly growth



Sources: ABS; RBA

Conclusion

Policymakers not only face uncertainty about the future, but also about the present and the past, since real-time data are subject to revision. This article illustrates the pattern and size of revisions to Australian GDP growth and its underlying components over the past decade or so. Revisions to early estimates of GDP growth have tended to be sizeable and in an upwards direction, though these characteristics are not unusual by international standards. Of the three measures of GDP growth, the production measure has performed as well, or better, than the other measures as a real-time indicator of the 'final' GDP growth estimate. Policymakers and other users of GDP data could attempt to anticipate revisions or use devices such as confidence intervals to illustrate the uncertainty around the data. The uncertainty also highlights the importance of gathering and monitoring a wide range of data and information when assessing current economic conditions.

Appendix A

Table A1: Revisions to GDP Components

Quarterly growth

(*continued next page*)

	Share of GDP in 2011/12[a]	Mean absolute revision	Mean absolute revision weighted by size[b]	Mean revision
	Per cent	Percentage points	Percentage points	Percentage points
Household consumption	54	0.3	0.2	–0.1
Dwelling investment	5	2.3	0.1	0.3
Machinery & equipment	6	3.7	0.3	0.4
Non-residential building	3	2.9	0.1	0.6
Engineering construction	6	5.1	0.1	2.1
Public consumption	18	1.2	0.2	0.0
Public investment	5	5.3	0.2	–0.3
Exports	21	0.8	0.2	0.1
Imports	21	0.9	0.2	0.0
Change in inventories[c]	na	na	0.4	na
GDP(E)	100	0.6	0.6	0.1
Compensation of employees	48	0.5	0.2	0.0
Non-financial corp profits (private)	20	2.8	0.5	0.4
Non-financial corp profits (public)	1	7.5	0.2	–1.2
Financial corp profits	5	3.0	0.1	1.7
General government GOS[d]	2	0.4	0.0	0.1
Dwellings GOS[d]	7	0.6	0.0	0.1
Gross mixed income	8	2.4	0.2	0.3
GDP(I)	100	0.5	0.5	0.0
Agriculture	2	5.3	0.1	0.5
Mining	10	1.8	0.1	0.1
Manufacturing	7	0.9	0.1	0.1
Utilities	2	1.0	0.0	0.1
Construction	7	1.9	0.1	1.0
Wholesale	4	1.0	0.0	–0.2
Retail	4	0.6	0.0	0.1
Accommodation & food	2	1.3	0.0	0.1
Transport	5	1.0	0.0	0.3
Media & telecommunications	3	1.5	0.1	0.0
Financial & insurance services	10	1.0	0.1	–0.1
Property & business services[e]	11	1.1	0.1	0.1

Table A1: Revisions to GDP Components
Quarterly growth
(*continued*)

	Share of GDP in 2011/12[a]	Mean absolute revision	Mean absolute revision weighted by size[b]	Mean revision
	Per cent	Percentage points	Percentage points	Percentage points
Public administration	5	1.3	0.1	0.3
Education	4	0.4	0.0	0.2
Health	6	1.3	0.1	0.4
Arts & recreation	1	2.1	0.0	0.2
Other services	2	1.9	0.0	–0.2
Ownership of dwellings	8	0.2	0.0	0.0
GDP(P)	100	0.3	0.3	0.1
Memo:				
Nominal GDP	100	0.5	0.5	0.2
GDP implicit price deflator	na	0.4	na	0.1

(a) The shares of GDP(E) do not sum to 100 per cent due to the exclusion of several smaller investment components; the shares of GDP(I) and GDP(P) do not sum to 100 per cent due to the exclusion of taxes less subsidies
(b) Mean absolute difference between nominal GDP-weighted growth estimate after 16 quarters and nominal GDP-weighted initial growth estimate
(c) Contribution of the change in inventories to quarterly GDP growth is calculated directly
(d) GOS refers to gross operating surplus
(e) Property & business services include rental, hiring & real estate, professional, scientific & technical and administrative & support services
Sources: ABS; RBA

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Changes to the RBA Index of Commodity Prices: 2013

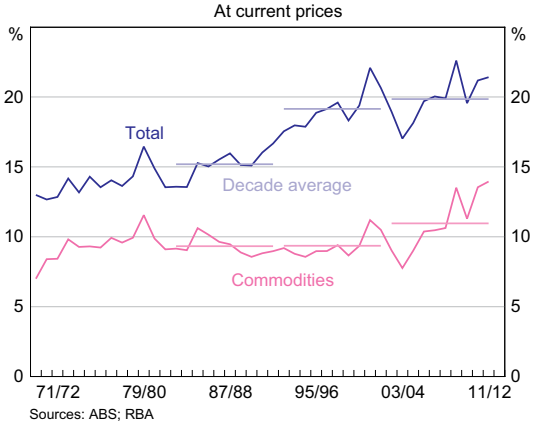
Tim Robinson and Hao Wang*

This article summarises changes to be made to the RBA Index of Commodity Prices (ICP). In line with developments in export values over recent years, the weight of iron ore in the index will increase, while the weights for coal, gold and base metals will be reduced. Overall, these changes will result in minimal revisions to the ICP. Given the greater attention being paid to bulk commodities in economic assessments, the Bank will publish additional indices that will capture movements in the spot prices and average export prices of these commodities.

Introduction

Commodity exports are an important source of income for the Australian economy. Over the past decade, commodity exports have on average accounted for more than 55 per cent of total export values and 11 per cent of GDP, well above the levels over the preceding decade (Graph 1). Because changes in export prices explain approximately three-quarters of the fluctuations in the growth of export values since 1990, developments in export prices can have a significant impact on export earnings and economic activity in Australia.

Graph 1
Exports Share of GDP
At current prices



Sources: ABS; RBA

The ICP is intended to provide a timely indicator of the prices received by Australian commodity exporters. The ICP is a Laspeyres index, which means that it is a weighted average of recent changes in commodity prices, where the weight given to each commodity reflects its importance in total commodity export values in a base period.[1] The Bank periodically updates the base-period weights to maintain their relevance. In addition, the Bank also reviews the index to ensure that the commodities that are of importance to the Australian export market are included and that the price measures used for these commodities are appropriate.

Bank staff have recently completed such a review, updating the review conducted in 2009.[2] Commencing with the release of the index for March on Monday, 1 April 2013, the following changes will be made to the ICP:

- the index will be reweighted according to an average of export values in 2010/11 and 2011/12
- the index will be rebased so that the 2011/12 average is 100 (previously it was 2008/09)
- the price measure for crude oil will be changed from Tapis to Brent
- copper ore and lamb prices will be added and milk powder will be removed from the index.

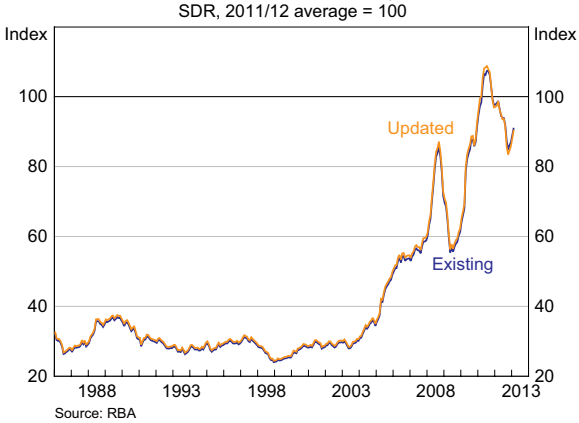
* The authors are from Economic Analysis Department.

1 For a detailed discussion of the construction of the ICP, see RBA (1998).

2 See Noone and Park (2009) for details.

The index will be revised back to July 1982 incorporating these changes (Graph 2). The updated ICP will include 21 major commodities presently exported by Australia; these accounted for over 90 per cent of Australia's commodity export earnings in 2011/12. The relative importance of some commodities included in the index has changed and this has also resulted in revisions to the index. The effect of the revisions on the overall index is minor. The ICP continues to reflect the sharp run-up in commodity prices from 2004, peaking in 2011 and declining subsequently.

Graph 2
RBA Index of Commodity Prices
SDR, 2011/12 average = 100



Source: RBA

Reflecting the relative importance of bulk commodity exports to the Australian economy, the Bank will commence publishing an additional ICP based on spot price movements for the bulk commodities (namely iron ore, metallurgical coal and thermal coal). The Bank will also publish two bulk commodity subindices: one using the spot price movements for these commodities; and the other using their average export price movements. These subindices are described further below.

Reweighting and Rebasing the ICP

The updated weights for the ICP, shown in Table 1, are based on average export values in 2010/11 and 2011/12. The rationale for selecting two years of data for the weights calculation is to lessen the effect of temporary changes in export values on the ICP (e.g. resulting from extreme weather conditions). This approach is consistent with that used by the Australian Bureau of Statistics (ABS) in the calculation of its Export Price Index (ABS 2011).

The bulk commodities have experienced the largest changes in their relative importance in the index since 2008/09. The weight for iron ore has increased significantly over recent years, reflecting a sharp increase in both the price of iron ore and the volumes of iron ore exports. The decline in the weights for metallurgical coal and thermal coal largely reflects falls in their prices. Other notable changes include a decline in the weight of gold (due to a fall in its export volumes, which more than offsets the increase in its price). The weight for the base metals included in the ICP has also fallen, while those for the rural commodities which are included in the index have increased slightly.

Changes to the Price Measures Included in the Index

The prices included in the existing ICP for the bulk commodities are based on average export prices data from the ABS, which are a weighted average of the spot and contract prices. Average export prices also reflect variations in the quality of commodities exported, whereas spot and contract prices hold quality fixed; for example, a widely used spot price for iron ore is based on an iron content of 62 per cent. While the average export price is appropriate for measuring the actual prices received by Australian exporters, in recent years spot prices have become more relevant as Australian bulk commodity exporters have moved away from longer-term contract pricing arrangements to shorter-term arrangements, particularly for iron ore (RBA 2012). Average export prices may also be revised over time as more information about recent transactions becomes available to the ABS.[3] Consequently, in

3 The Bank makes preliminary estimates on the average export prices of iron ore, metallurgical coal and thermal coal based on spot prices and other market information before the actual data are available from the ABS. For further discussion, see Noone and Park (2009).

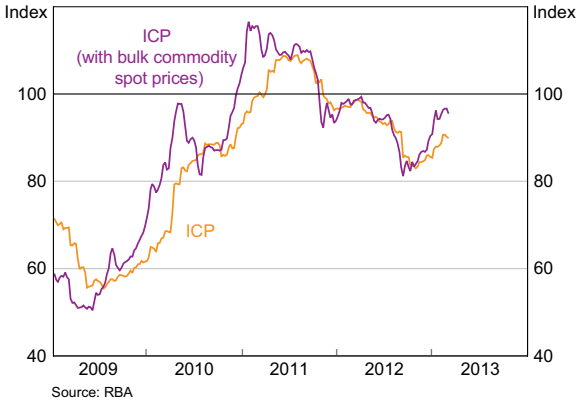
Table 1: Changes in ICP Weights and Commodity Exports
All items index; per cent

	ICP weights[a]		Change[b] 2008/09 to 2010/11–2011/12	
	Existing (2008/09)	Updated (2010/11–2011/12)	Price[c]	Volume[d]
Rural commodities[e]	**10.3**	**10.9**	**7**	**19**
Wool	1.1	1.4	46	–4
Beef and veal	3.2	2.5	–3	–2
Wheat	3.2	3.2	–18	50
Barley	0.6	0.7	–10	44
Canola	0.4	0.6	4	95
Sugar	0.7	0.7	49	14
Cotton	0.3	1.1	54	189
Milk powder	0.8	na	4	–9
Lamb and mutton	na	0.8	20	–14
Base metals[e]	**6.8**	**5.8**	**7**	**–7**
Aluminium	3.4	2.4	–9	–2
Lead	0.6	0.5	16	–16
Copper	1.8	2.1	29	8
Zinc	0.6	0.5	13	–4
Nickel	0.4	0.3	22	–19
Bulk commodities[e]	**56.5**	**57.5**	**–5**	**22**
Iron ore	21.8	32.7	29	33
Metallurgical coal	23.3	16.4	–28	14
Thermal coal	11.4	8.4	–22	10
Other resources[e]	**26.4**	**25.8**	**9**	**0**
LNG[e]	6.5	6.0	–5	16
Crude oil	5.3	6.0	16	11
Alumina	3.8	2.9	–13	–2
Gold	10.8	8.0	27	–31
Copper ore	na	2.8	48	–1
Total[e]	**100.0**	**100.0**	**0**	**14**

(a) Commodity weights may not sum to subindex weights due to rounding
(b) Changes in prices and volumes do not necessarily accord with changes in export values due to compositional differences
(c) Based on movements of the price measures used for the ICP; A$ terms; average export prices for the bulk commodities
(d) Based on tonnages data from the ABS and Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES)
(e) Changes in volumes are calculated as changes in export values divided by changes in the price index for the commodities included in the updated ICP
Sources: ABARES; ABS; RBA

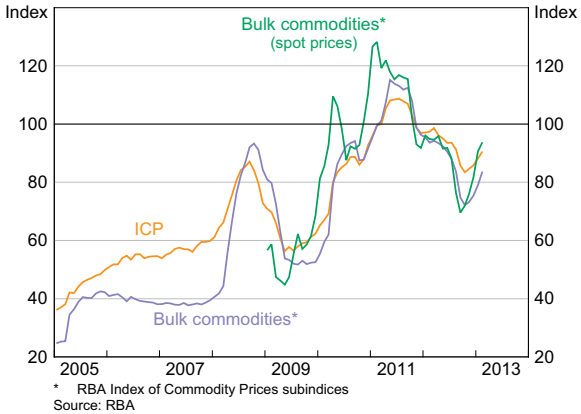
conjunction with the current ICP, the Bank will publish an additional index of commodity prices, which uses spot prices for the bulk commodities, commencing from January 2009 (Graph 3). This series generally moves closely with the current ICP, particularly since 2011, when shorter-term pricing arrangements became more prevalent. Nevertheless, there can still be periods of divergence, such as since late 2012,

Graph 3
RBA Index of Commodity Prices
SDR, 2011/12 average = 100, weekly



Source: RBA

Graph 4
RBA Index of Commodity Prices
SDR, 2011/12 average = 100



* RBA Index of Commodity Prices subindices
Source: RBA

owing to the spot price for iron ore increasing more strongly than the average export price.

The measure of crude oil prices that has been used in the existing ICP is the Malaysian Tapis. Over recent years there has been a gradual shift away from using Tapis as an oil price benchmark in the Asia-Pacific region towards using Brent, which is also widely used as a benchmark globally (Dunn and Holloway 2012). In line with this trend, Brent crude oil will replace Tapis in the updated ICP from July 2010. Brent and Tapis crude oil move together quite closely, so there will be very little effect from this change on the ICP.

Details of the price measures used in the ICP are available in Appendix A.

New Subindices for Bulk Commodities

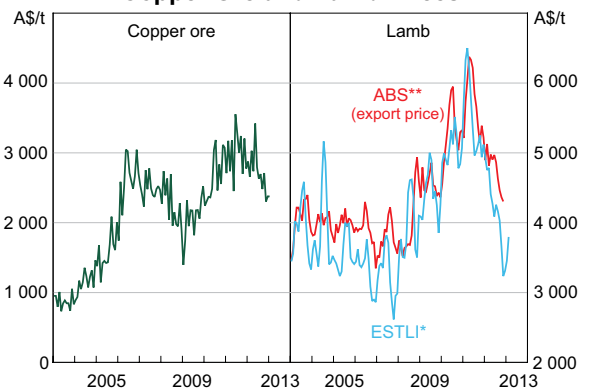
The share of the value of commodity exports accounted for by iron ore and coal has increased from 23 per cent in 2001/02 to 54 per cent in 2011/12; consequently the weight for the bulk commodities has also increased in the ICP. Reflecting the significance of the bulk commodities to Australian exports, two bulk commodity subindices will be published from April. One subindex is based on average export price movements since July 1982 (Graph 4). The other subindex is based on spot price movements from January 2009.

Changes to the Coverage of the Index

The Bank regularly reviews the composition of the ICP to ensure that it covers the major commodities exported by Australia. An input in determining whether a commodity is to be included in the ICP is its share of the total value of Australian commodity exports.

Australia exports a diverse range of metal ores and minerals. The value of copper ore exports has grown rapidly in recent years and it is now one of Australia's top 10 exported commodities. Given its increased importance, the copper ore price, using average export price data from the ABS, will be included in the index (Graph 5).

Graph 5
Copper Ore and Lamb Prices



* Eastern States Trade Lamb Indicator price
** Includes lamb, mutton and hogget
Sources: ABS; MLA; RBA

Lamb prices will also be added to the index. Over the past five years, the value of lamb and mutton exports has accounted for around 5 per cent of rural export receipts (lamb represents a large and increasing share of this category). The price of lamb to be used in the index is the daily Eastern States Trade Lamb Indicator (ESTLI) available from Meat and Livestock Australia (MLA). This is a timely benchmark price for Australian lamb and has similar trends over time to the ABS export price data. Lamb prices will also be included in the rural subindex.

The value of milk powder exports as a share of commodity exports has declined in recent years and now accounts for less than ½ per cent of the value of commodity exports. Consequently, milk powder will be excluded from the index.

Future Updates to the ICP

To maintain the relevance of the weights of the commodities included in the ICP, the Bank intends to update the ICP weights annually. This will be conducted in the March quarter of each year, and the updated weights will be published on the Bank's website. The weights will be calculated using export values in the preceding two financial years. The commodities included in the ICP will be reviewed approximately every five years.

Appendix A

Table A1: Sources of the Price Measures Used in the ICP

(*continued next page*)

Commodity	Sources	Data description
Rural commodities		
Wool	Australian Wool Exchange	National Price
Beef and veal	MLA	Average of beef prices to the United States and Japan
Wheat	ABARES	US Gulf price; HRW No 1
Barley	Confidential	
Canola	Bloomberg	Canada Par Region
Sugar	Bloomberg	Sugar No.11 ICE
Cotton	Bloomberg	Cotlook A Index
Lamb	MLA	Eastern States Trade Lamb Indicator
Base metals		
Aluminium	Bloomberg	London Metal Exchange (LME) spot price
Lead	Bloomberg	LME spot price
Copper	Bloomberg	LME spot price
Zinc	Bloomberg	LME spot price
Nickel	Bloomberg	LME spot price

Table A1: Sources of the Price Measures Used in the ICP
(*continued*)

Commodity	Sources	Data description
Bulk commodities		
Iron ore	ABS	Average export price
	Bloomberg	Spot price – 62 per cent Fe Chinese landed price, adjusted for freight
Metallurgical coal	ABS	Average export price
	Energy Publishing	Spot price – Queensland premium hard metallurgical coal
Thermal coal	ABS	Average export price
	Thomson Reuters	Spot price – Newcastle thermal coal
Other resources		
LNG	Confidential	
Crude oil	Bloomberg	European Brent Blend
Alumina	ABS	Average export price
Gold	Bloomberg	Spot price
Copper ore	ABS	Average export price

Source: RBA

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Value-added Trade and the Australian Economy

Gerard Kelly and Gianni La Cava*

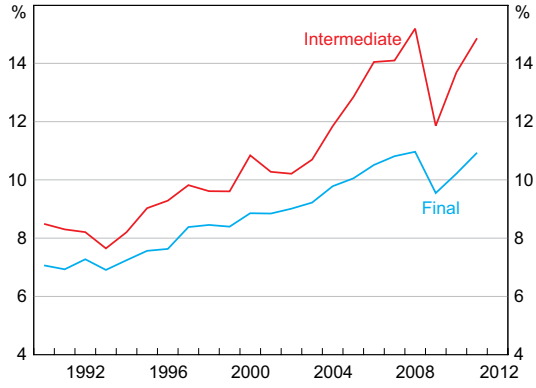
Australia's trade linkages have been affected by the expansion of global production networks, with Australia typically exporting commodities that are used to produce goods and services that are, in turn, exported to other markets. In this article, estimates of value-added trade are presented for Australia that complement conventional trade statistics. The value-added trade estimates suggest that the United States and Europe are more important for export demand than implied by conventional trade statistics, as some Australian content is exported to those locations indirectly via east Asia through global supply chains. The value-added trade estimates also highlight the importance of the services sector to Australian trade, as the services sector is integral to producing goods exports.

Introduction

The structure of international trade has changed dramatically in recent decades. A key feature of this structural change has been the emergence of global supply chains. Global supply chains are production networks that span multiple countries, with at least one country importing inputs and exporting output. The production of a single good, such as a mobile phone or television, typically now takes place across several countries, with each country specialising in a particular phase or component of the final product (Riad *et al* 2012).

The emergence of global supply chains has significantly affected both the level and composition of international trade. International merchandise trade has risen, as a share of world GDP, from around 15 per cent in the early 1990s to over 25 per cent more recently (Graph 1). The growth in trade has been dominated by trade in intermediate inputs – goods and services that are not consumed directly but are used to produce other goods and services. The rapid growth in trade and, in particular, intermediate goods and services trade, has been facilitated by factors that have lowered the cost of trade, such as advances in transportation and communication technologies, the liberalisation of trade, the removal of foreign capital controls and the growing industrial capacity of emerging economies.

Graph 1
World – Merchandise Exports
Per cent of GDP, current prices



Sources: IMF; OECD

A related feature of this structural change in recent decades has been the growth in *intraregional* trade and the emergence of regional supply networks. This has been particularly apparent in east Asia. Between 1990 and 2011, east Asia's share of world intermediate

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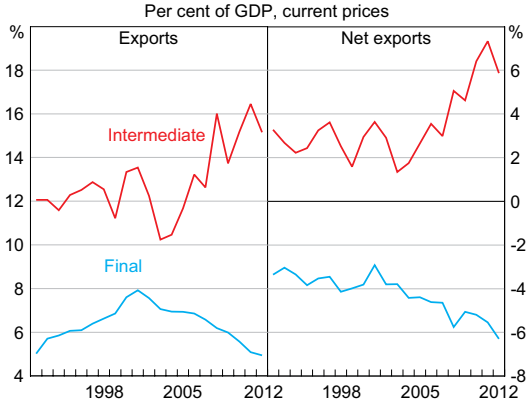
goods trade rose from about 17 per cent to over 50 per cent. This occurred as the region became highly engaged in global supply chains, especially those involving components for computers and other electronic devices (Craig, Elias and Noone 2011). China has played a central role in the development of this supply network, following its accession to the World Trade Organization (WTO) in 2001, as the country experienced large inflows of foreign direct investment and became a major destination for the outsourcing and offshoring of global manufacturing. China is now a core market for intermediate inputs, such as resource commodities from Australia and complex manufactured components from Asian countries. These intermediate inputs are used to produce final goods, some of which are exported to advanced economies.

The emergence of global supply chains, and the related rise of trade in intermediate inputs, has a direct bearing on the structure of Australian trade. Australian exports of intermediate goods and services have consistently exceeded exports of final goods and services over the past two decades (Graph 2, left panel). Moreover, the gap between the two types of trade has widened over recent years. This reflects the resources boom, as a significant share of Australia's resource commodities are exported to east Asia where they are used to produce goods and services that are either sold domestically in east Asia or re-exported to other parts of the world. Australia's growing integration into global supply networks is illustrated by the fact that Australia is increasingly a net exporter of intermediate goods and services, and a net importer of final goods and services (Graph 2, right panel).

Graph 2
Australia – Trade
Per cent of GDP, current prices



Sources: ABS; RBA

Conventional measures of international trade based on gross flows of exports and imports do not fully capture the impact of global supply chains on Australian trade. In this article, new estimates of 'value-added trade' are constructed for Australia, which complement conventional measures, and illustrate how the fragmentation of production across international borders has affected Australian trade. Unlike conventional trade statistics, value-added trade statistics identify the contributions of each country and each industry to the final value of an exported good or service. While conventional trade statistics identify the initial destination of a country's exports, value-added measures identify both the initial and effective final export destinations. A comparison of gross trade and value-added trade statistics provides a guide to the extent to which demand shocks stemming from final export destinations indirectly affect Australia. This will be increasingly important as countries become even more integrated into global production networks.

Measures of International Trade

Global supply chains challenge the conventional approach to measuring international trade based on gross flows of exports and imports. Conventional trade statistics typically measure the value of goods and services each time they cross a border. These estimates form the basis of international trade measured in the national accounts and balance of payments and are the most reliable and timely source of information on imports and exports. But gross trade flows do not necessarily identify the countries and industries that contribute to the production of the traded good or service; instead, the full value is attributed to the last country and industry that shipped the product. If a component

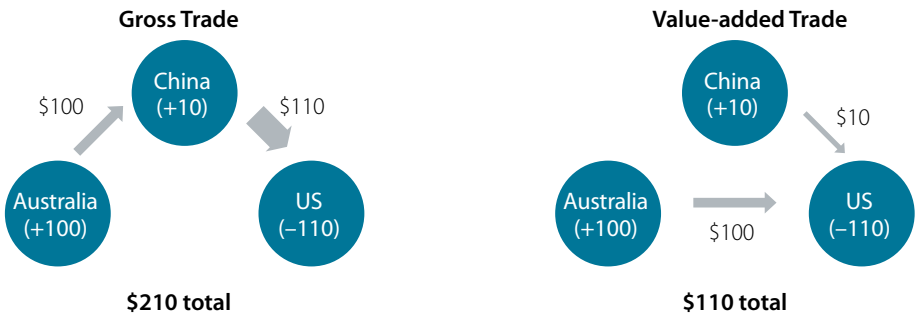
of an exported good crosses international borders multiple times in the process of becoming a finished good then the component is counted multiple times under conventional measures. This multiple counting can boost gross measures of trade flows relative to indicators of domestic output and can also overemphasise the importance of a country's bilateral trade flows.

These issues reflect the different way in which economic activity is measured within and across national borders. Gross domestic product (GDP), the most commonly used indicator of a nation's domestic economic activity, records only expenditures on final goods and services (or 'final demand') and excludes expenditures on intermediate goods and services (or 'intermediate consumption'). GDP therefore measures the value added in the production process. For example, suppose a steel manufacturer produces steel worth $100 (without any intermediate inputs) and sells it to another firm, which uses the steel as an intermediate input to produce a refrigerator, which is then sold domestically as a finished good for $110. The 'gross output' of the economy is equal to $210, while the 'value-added' (as measured by final expenditure) is equal to $110. The national accounts will record the value-added of the finished good ($110) as GDP, effectively avoiding counting the value of intermediate inputs multiple times.

In contrast, conventional measures of international trade do not make any distinction between trade in gross output and trade in intermediate inputs. To take a similar example, consider the trade flows depicted in Figure 1. Suppose a steel manufacturer exports steel, produced entirely within Australia, worth $100 to a firm in China. The firm in China then processes the steel (adding value of $10) to create a refrigerator which is exported to the United States, where it is sold as a finished good (for a full value of $110). The conventional measure of trade would record total global exports and imports of $210, despite only $110 of value-added being generated in production. The conventional measure would show that the United States has a trade deficit of $110 with China, and no trade at all with Australia, despite Australia being the chief beneficiary of the final demand of the United States. If, instead, the trade flows were measured in value-added terms, total trade would equal $110. Also, the trade deficit of the United States with China would be only $10 and it would run a deficit of $100 with Australia.

This example highlights the two main issues with the conventional measurement approach: gross trade relative to GDP provides an upper-bound estimate of the contribution of trade to economic activity, and the composition of each country's trade balance does not necessarily reflect value-added trade flows. However, while *bilateral* gross and value-added trade balances can differ, the aggregate level of each country's trade balance is the same when measured in either gross or value-added terms. In the example, Australia has an aggregate surplus of $100, China has an aggregate surplus of $10, and the United States has an aggregate deficit of $110 under either approach to measuring international trade.

Figure 1: Comparison of Gross Trade and Value-added Trade



Source: RBA

The World Input-Output Database and Measures of Value-added Trade

The recognition of these issues has led to the development of an alternative measure of trade known as 'value-added trade' (Johnson and Noguera 2012). Rather than allocating the total value of a final good or service to the last country (or industry) that shipped the product, value-added trade estimates attempt to identify the contribution of each country (or industry) in the production process to the overall value of a final good or service.

Gross trade can be measured relatively easily using customs data, but measuring value-added trade requires very detailed information on how exports and imports are used as intermediate inputs by various countries and industries. The European Commission recently published the World Input-Output Database (WIOD),[1] which combines information from national input-output tables with bilateral trade data to construct harmonised annual world input-output tables for 35 industries across 41 regions over the period 1995 to 2009. This database seeks to identify all the input-output linkages between countries and industries. The database can be used to construct measures of value-added trade. The WIOD can also be used to trace the path of a country's intermediate exports through a global supply chain and to identify the effective final destination for the domestic content of a country's exports.[2]

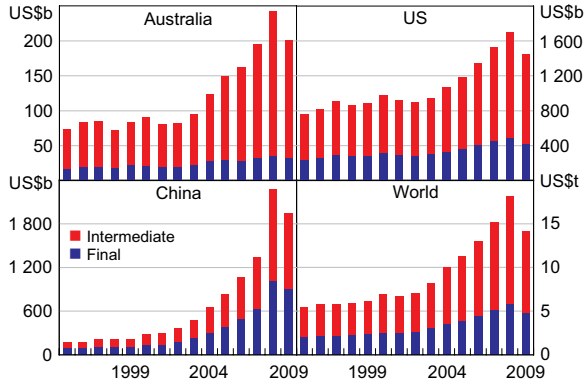
Value-added trade data provide information about where, and by whom, value is created in Australian trade. Value-added trade estimates complement, but do not replace, conventional trade statistics. Value-added trade statistics require detailed information on inputs and outputs that are typically produced with a significant publication lag. For example, the latest WIOD data only cover the period up to 2009. Gross trade statistics for Australia, on the other hand, are produced on a monthly basis with a very short publication lag. Gross trade statistics therefore provide a more timely indicator of trends in Australian trade. Furthermore, the construction of value-added trade statistics requires a number of assumptions to be made (discussed in more detail in Kelly and La Cava (forthcoming)) which can make these statistics less reliable than estimates based on customs data.

Graph 3 presents the value of both final and intermediate exports measured on a gross output basis for Australia, the United States, China and the world as a whole.[3] Exports of intermediate goods and services comprise a relatively high share of total exports for Australia. According to the WIOD, Australian intermediate exports have risen from around three-quarters of total exports in the mid 1990s to more than 80 per cent of exports more recently (Graph 3, top left panel). A similar pattern can be seen for both US and world exports (Graph 3, top and bottom right panels). In contrast,

Graph 3

Gross Exports

Current prices



Source: World Input-Output Database

1 More information about the World Input-Output Database can be found at <http://www.wiod.org>.

2 A joint OECD-WTO initiative has also recently developed a database of value-added trade indicators: see <http://www.oecd.org/trade/valueadded>. The OECD-WTO database has a similar coverage of countries and industries as the WIOD, but a much shorter sample period as it currently only covers the years 2005, 2008 and 2009. For these years, the estimates of value-added trade for Australia are very similar to those obtained from the WIOD.

3 Due to the aggregation of many countries into a 'rest of the world' region, the estimates for world exports understate the total level of world trade (as the estimate does not record trade between countries within this particular region).

final goods and services comprise a much higher share of Chinese exports, reflecting China's role as an assembly point in many global supply chains (Graph 3, bottom left panel).

To compare estimates of value-added trade with conventional estimates of gross trade, it is useful to construct a summary indicator known as the 'VAX ratio' (Johnson and Noguera 2012). The VAX ratio is the ratio of value-added exports to gross exports and is an approximate measure of the domestic value-added content of exports. The VAX ratio can be constructed for each bilateral trading partner, or each industry of a given country. The bilateral VAX ratio with a particular trading partner can be less than or greater than one. The bilateral VAX ratio is less than one when gross exports exceed value-added exports, which can occur either because some of the value of the exports is imported from another country or because the trading partner re-exports the content to another destination.[4] The bilateral VAX ratio is greater than one when value-added exports exceed gross exports. This can occur when the country's exports reach the trading partner directly (as measured by gross exports) *and* indirectly (when domestic value-added is embodied in a third country's exports to that partner). A similar logic applies to understanding variation in the measured VAX ratio across individual sectors of the economy. The VAX ratio for a sector can be less than one if intermediate inputs from other sectors, or from imports, contribute more to the value of the sector's exports than it contributes to the exports of other sectors. Conversely, the VAX ratio for a sector can be greater than one if the sector contributes more as an intermediate input to the value of exports of other sectors than those sectors contribute to the value of its own exports.

Australian Value-added Trade by Trading Partner and Sector

Table 1 compares Australia's exports to various trading partners on a gross and value-added basis. In terms of trading partners, the main difference between Australia's gross and value-added exports is the importance of emerging economies relative to the advanced economies. According to the WIOD,

Table 1: Australian Exports by Trading Partner
2000–2009 average

Trading partner	Share of value-added exports	Share of gross exports	Difference	VAX ratio
	Per cent	Per cent	Percentage points	
North America[(a)]	16.2	10.6	5.6	1.31
European Union	15.8	12.2	3.6	1.11
Japan	15.3	16.0	–0.6	0.82
China	12.9	15.9	–2.9	0.70
South Korea and Taiwan	7.6	11.1	–3.5	0.59
Other trading regions	32.1	34.3	–2.1	0.80
Total	**100.0**	**100.0**	**0.0**	**0.86**

(a) Canada, Mexico and the United States
Source: World Input-Output Database

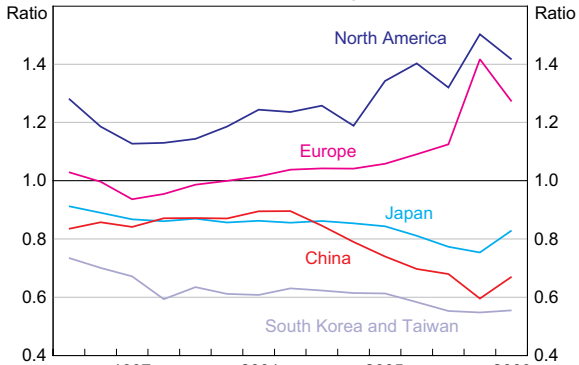
4 A country's total value-added trade cannot exceed its gross trade, which implies that the overall VAX ratio cannot be greater than one; only bilateral (or sectoral) value-added trade can exceed gross trade.

between 2000 and 2009, gross exports to China, Indonesia, Korea and Taiwan together accounted for about 30 per cent of Australia's gross exports, but around 23 per cent of value-added exports. Conversely, North America and Europe accounted for about 23 per cent of Australia's gross exports, but about 33 per cent of value-added exports. Australian value-added exports to the advanced economies are higher than gross exports because some Australian production is exported there indirectly via supply chains in Asia. Correspondingly, Australia's value-added exports to Asia are less than gross exports because some of the exports are used as intermediate inputs in those regions to produce final goods and services for re-export to other countries.[5]

Graph 4 shows the ratio of value-added to gross exports by bilateral trading partners for Australia. Looking at how the bilateral VAX ratios have evolved over time, there has been a steady increase in the value-added content of Australia's trade with North America and Europe but a gradual decline in the value-added content of Australia's trade with east Asia. The volume of both gross and value-added exports to east Asia, and particularly China, has grown markedly, but an increasing share of Australian exports to the region are processed and re-exported rather than being consumed domestically, which has caused the VAX ratio to trend down. These trends mainly reflect the increasing integration of east Asia into global supply chains, with the effect being particularly pronounced during the 2000s.

The sectoral mix of Australia's trade is also different when measured in value-added terms rather than gross terms (Table 2). The sectoral breakdown of Australian exports in value-added terms indicates which sectors ultimately benefit from trade. For this purpose, Australian exports are divided into broad

Graph 4
Australia – VAX Ratio by Destination



Source: World Input-Output Database

sectors based on the WIOD data: the resources, manufacturing, services, and construction and utilities sectors.[6]

Services exports account for a much higher share of Australia's exports in value-added terms (42 per cent) than in gross terms (23 per cent) (Table 2). Australia's exports therefore include a higher share of services than conventionally measured. Most services are non-tradable and so the services sector produces a small share of direct exports, which are captured by gross trade statistics. However, services are used extensively as inputs to produce manufactured and resource exports. For example, services, such as marketing and distribution, account for a relatively large share of the final value of manufactured goods. Furthermore, service industries tend to be labour intensive, requiring relatively few intermediate inputs in their own production.

Conversely, the manufacturing sector comprises a much smaller share of value-added trade (21 per cent) than of gross trade (40 per cent) (Table 2). These estimates indicate that about half of the

5 These estimates assume that, for each industry, the import content of production is the same for exported and non-exported products. But, due to China's use of export-processing trade zones, Chinese exports tend to have higher imported content than goods and services produced for domestic consumption. This implies that the WIOD estimates may overstate China's share of Australian value-added exports. This issue is discussed in more detail in Kelly and La Cava (forthcoming).

6 The WIOD classification of industries is very similar to the classification based on the 2-digit Australian and New Zealand Standard Industrial Classification (ANZSIC) system, which is used by the Australian Bureau of Statistics (ABS). Australian gross exports of resources and manufacturing goods are slightly higher, on average, based on the WIOD measure compared with the ABS measure, but these differences are unlikely to have a significant effect on the sectoral measures of the VAX ratios. Reclassifying industries into the manufacturing and resources sectors based on the split used by Rayner and Bishop (2013) has little effect on the measured VAX ratios.

Table 2: Australian Exports by Sector
2000–2009 average

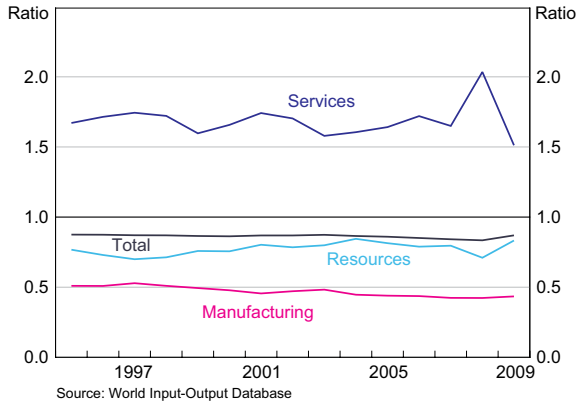
Sector	Share of value-added exports	Share of gross exports	Difference	VAX ratio
	Per cent	Per cent	Percentage points	
Services[a]	42.3	22.9	19.4	1.58
Resources[b]	33.8	36.7	–3.0	0.79
Manufacturing	20.9	40.1	–19.3	0.44
Construction and utilities	3.1	0.2	2.9	12.37
Total	**100.0**	**100.0**	**0.0**	**0.86**

(a) Includes the transportation industry
(b) Includes the agriculture, forestry and mining industries
Source: World Input-Output Database

value-added in Australia's manufacturing exports comes from either imported inputs or the inputs of other domestic sectors. For the resources sector, the share of value-added trade (34 per cent) is similar to the share of gross trade (37 per cent). Production in the resources sector extensively uses intermediate inputs from other sectors, but the resources sector also produces a large share of the intermediate inputs used by other sectors, in the form of raw materials. These two effects largely offset each other. The sectoral VAX ratios have been fairly constant over time, although there has been a slight decline in the manufacturing VAX ratio over the past couple of decades (Graph 5).

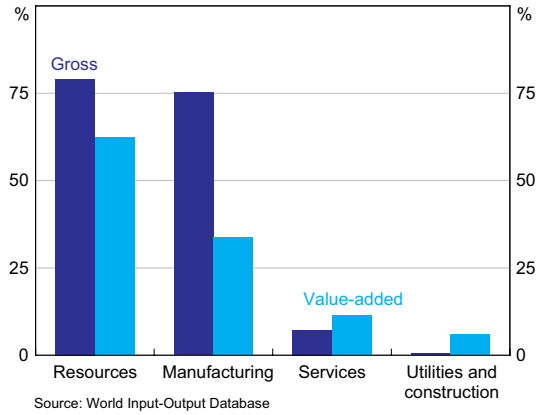
The value-added trade estimates also affect measures of each sector's export dependence, such as the exports-to-GVA (gross value added) ratio. For instance, the share of manufacturing production that is exported is much lower on a value-added basis than on a gross basis (Graph 6). Conversely, the Australian services sector is more export dependent than implied by conventional estimates, although its overall level of exports is still low. The value-added trade estimates also indicate that sectors, such as utilities, are more exposed to trade than indicated by conventional estimates. For example, electricity is not exported directly as a product, but is used extensively to produce manufacturing and resource exports.

Graph 5
Australia – VAX Ratio by Sector



Source: World Input-Output Database

Graph 6
Australia – Exports-to-GVA Ratio by Sector
2000–2009 average, current prices

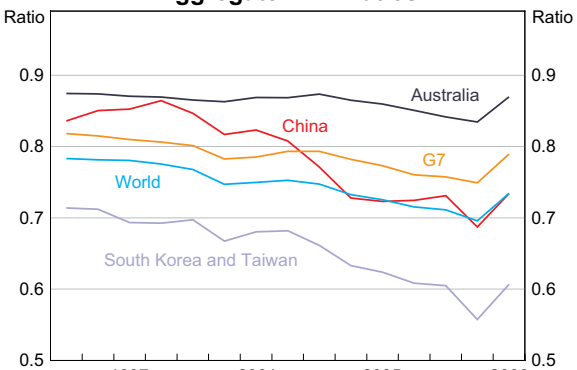


Source: World Input-Output Database

Aggregate Value-added Trade

The VAX ratio can also be constructed for Australia's aggregate trade by comparing total value-added exports to total gross exports. The aggregate VAX ratio implies that the share of value-added in Australian exports was about 87 per cent in 2009 (Graph 7).[7] The value-added content of Australian exports is relatively high by international standards; the share of value-added in world exports was about 73 per cent in 2009. The high share of value-added content in Australia's trade reflects several factors, including its large endowment of natural resources and its geographic isolation, which contribute to the country's relatively low level of trade as a share of GDP (Guttmann and Richards 2004). The high share of resources in Australia's export base implies a low dependence on imported inputs so most of the value-added of Australian exports is due to domestic production. Australia's geographic isolation also means that it is rarely involved in the intermediate processing stages of most global supply chains. In contrast, the value-added content of trade is typically low for countries close to production hubs that are heavily involved in production sharing, such as those in Europe, east Asia and North America. These factors also largely explain why the value-added content of Australian trade has declined by much less than most other countries since the mid 1990s.[8]

Graph 7
Aggregate VAX Ratios



Source: World Input-Output Database

Conclusion

The emergence of global supply chains has caused significant structural changes in Australian trade that are not fully reflected in conventional measures of gross trade flows. The WIOD allows the construction of value-added measures of trade that can identify Australia's underlying trade linkages. The estimates suggest that the United States and Europe comprise a larger share of Australia's value-added exports than gross exports, while China comprises a smaller share of value-added exports. The services sector also constitutes a higher share of Australia's value-added exports than gross exports because of its indirect exposure to trade, as services are extensively used as inputs to produce goods exports.

The value-added content of Australian trade is high by international standards, mainly due to Australia's large endowment of natural resources and its geographic isolation. These factors contribute to Australia exporting a relatively high share of resource commodities and a low share of manufactured goods. Globally, manufactured exports typically embody relatively little value-added as their production involves the extensive use of intermediate inputs, which are increasingly sourced from imports. These compositional differences also explain why the value-added content of Australian trade has been relatively stable while the value-added share of trade for most countries has fallen over the past two

7 Total value-added exports are not simply the domestic content of total gross exports, but the amount of domestic content that is ultimately consumed as final demand outside the country. Value-added exports exclude 'reflected exports' – that is, the estimates exclude domestic content that is processed outside the country and then imported (e.g. Australia importing a Japanese car that contains Australian steel). But reflected exports represent only a small share of Australia's overall trade, so the VAX ratio provides a reasonable guide to the proportion of domestic content in overall exports.

8 The VAX ratio is measured in nominal terms and can therefore be affected by changes in the prices of intermediate inputs and gross outputs. For example, there is a clear downward spike in the aggregate VAX ratios of most countries over 2008 and 2009. This pattern is, at least in part, due to large fluctuations in commodity prices around that time. For instance, commodity prices rose sharply in 2008, which would have boosted the relative price of intermediate inputs, and hence reduced the value-added content of exports, for most countries and industries.

decades, as they increasingly source intermediate inputs from overseas.

Australia has increasingly become a net exporter of intermediate inputs and a net importer of final products over the past two decades. This reflects the growing fragmentation of production across borders, as the emerging economies in Asia become major importers of Australian resource commodities.

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The Resources Boom and the Australian Economy: A Sectoral Analysis

James Bishop, Christopher Kent, Michael Plumb and Vanessa Rayner*

The increase in Australia's terms of trade since the mid 2000s gave rise to a surge in resource investment, an appreciation of the exchange rate, and a reallocation of labour and capital in the economy. This article examines the impact of the resources boom on the Australian economy in terms of three broadly defined sectors: the resources sector, the 'other tradable' sector and the non-tradable sector. While not all parts of the economy have benefited, the process of adjustment has proceeded much more smoothly than has been the case in previous terms of trade booms.

Introduction

Strong global demand for commodities, much of which has come from Asia, has driven commodity prices and Australia's terms of trade to historically high levels. The overall process of macroeconomic adjustment to the terms of trade boom has proceeded much more smoothly than has been the case in previous terms of trade booms;[1] over the past eight years, inflation has remained within the target range, or not too far from it, and growth has generally not been too far from trend. This is perhaps all the more notable given the difficult economic conditions internationally over recent years, with incomes in Australia growing faster than in most other advanced economies and the unemployment rate remaining relatively low.

A key contributor to the relatively smooth adjustment of the macroeconomy to the rise in the terms of trade has been the flexibility of the exchange rate. The high nominal exchange rate has acted as a timely mechanism for facilitating the reallocation of labour and capital across industries, notwithstanding that this has made conditions difficult in some industries. Other factors contributing to the relatively smooth macroeconomic adjustment include inflation expectations remaining well anchored and greater flexibility in the labour market relative to earlier terms of trade booms. The combination of these factors means that while demand for labour, and the growth of wages, was higher in the resources sector, this did not lead to a significant increase in wage inflation across the economy as a whole.

Not all parts of the economy have benefited from this change in relative prices. While the resources sector has benefited greatly, those parts of the tradable sector not directly exposed to the terms of trade boom have experienced a reduction in competitiveness due to the exchange rate appreciation. Further, all industries have faced increased domestic cost pressures due to competition for domestic factors of production (which has been offset to some extent by lower costs of imported inputs due to the exchange rate appreciation). This has created challenges for industries that have not been directly exposed to the resources sector and have not experienced a significant increase in the price of their output.

* The authors are from Economic Group. This article draws on two RBA Research Discussion Papers: Rayner and Bishop (2013) and Plumb, Kent and Bishop (forthcoming) (which is based on Plumb, Kent and Bishop (2012)).

1 See Battellino (2010) for a discussion of earlier terms of trade booms in Australia. There have been a number of speeches and papers in recent years on the adjustments of the macroeconomy to the boom in the terms of trade (Henry 2006, 2008; Gruen 2006, 2011; Banks 2011; Connolly and Orsmond 2011; Stevens 2011; Sheehan and Gregory 2012).

In this article we examine the impact of the resources boom on the Australian economy in terms of three broadly defined sectors: the resources sector, the 'other tradable' sector and the non-tradable sector. We discuss developments in each of these sectors through the three (overlapping) phases of the resources boom:[2] the boom in the terms of trade and the appreciation of the exchange rate; the surge in resource investment; and the subsequent growth in the production and export of resources.

Defining the Resources, 'Other Tradable' and Non-tradable Sectors

We adopt a broad measure of the resources sector that includes not only the resource extraction sector, but also 'resource-related' activity. The purpose of this broader definition is to include all activity that has a direct relationship with the extraction of resources and investment in the resources sector, thereby capturing those parts of the economy most directly affected by the higher prices of resource commodities. The methodology used to measure the resources sector is from Rayner and Bishop (2013) and is summarised in Box A.

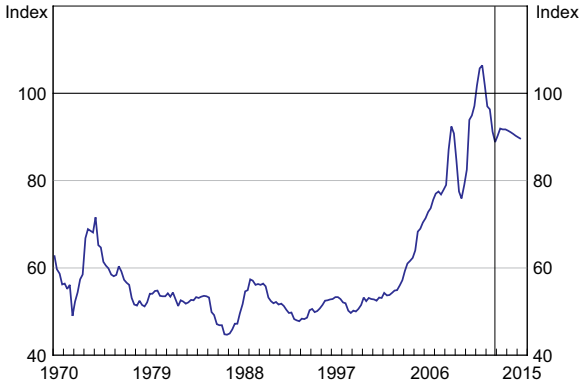
The remainder of the economy – the non-resources sector – can usefully be divided into two parts:[3]

- 'Other tradable' sector: comprises industries (or parts of industries) that are significantly exposed to international trade but not directly related to the resources sector, namely agriculture, manufacturing, transport, wholesale trade and accommodation & food services. For each of these industries, exports or competing imports are significant as a share of gross output (greater than 10 per cent).[4]
- Non-tradable sector: comprises industries that typically do not have a significant exposure to international trade, and for which production is not directly linked to the resources sector.

Phase I: The Rise in the Terms of Trade and the Exchange Rate

The rapid urbanisation and industrialisation of emerging economies in Asia – particularly China – has led to a dramatic increase in the global demand for commodities used in steel and energy production. With global supply responding only gradually to the surge in demand, this led to sharp increases in the prices of commodities of which Australia has significant endowments. Consequently, Australia experienced a large increase in its terms of trade, rising by 82 per cent since 2003/04 to reach their highest level on record in September 2011; they have subsequently declined by around 17 per cent (Graph 1).

Graph 1
Terms of Trade*
2010/11 average = 100



* The forecast for the terms of trade is that presented in the February 2013 *Statement on Monetary Policy* (*SMP*); the latest reading for the terms of trade is December quarter 2012, which was published after the February *SMP*.
Sources: ABS; RBA

2 To our knowledge, Gregory (2011) was the first to cast the current resources boom as one that takes place in three distinct phases. See also Sheehan and Gregory (2012), which is forthcoming in the *Australian Economic Review*.

3 In the following definitions of the 'other tradable' and non-tradable sectors, the share of each industry's gross value added and employment directly related to the resources sector is removed. For a more detailed description of the resources, 'other tradable' and non-tradable sectors, see Plumb *et al* (forthcoming).

4 More precisely, an industry is classified as tradable if more than 10 per cent of its production is exported, or if competing imports account for more than 10 per cent the industry's total supply in 2008/09. The 'other tradable' sector in this article differs slightly from that in Plumb *et al* (2012). In this article, the wholesale trade industry is also included in the 'other tradable' sector, reflecting updated information from the 2008/09 input-output tables.

Box A
Measuring the Resources Sector

Our measure of the resources sector is taken from Rayner and Bishop (2013), which builds on the methodology developed by Kouparitsas (2011). This broad measure of the resources sector comprises:

- **Resource extraction.** This includes mineral and gas extraction, and also resource-specific manufacturing (such as the production of metals and refined petroleum). This is very close to the ABS' definition of the mining industry, the only difference being that it also includes resource-specific manufacturing.
- **Resource-related activity.** This includes the provision of intermediate inputs that are used in the current extraction of resources as well as investment that supports the future extraction of resources. In other words, it captures activities that are directly connected to resource extraction, such as constructing mines and associated infrastructure, and transporting inputs to, and taking extracted resources away from, mines. It also captures some activities less obviously connected to resource extraction, such as engineering and other professional services (legal and accounting work, for example).

To estimate the size and industry composition of the resources sector, it is necessary to first estimate all of the final demand (or expenditure) in the economy that is related to resource extraction and investment, and then identify the industries that produce these *final* goods and services. Industries that produce a final good (or service) are those that are responsible for the final steps in the production chain for a given product. For example, resource exports are produced by the resource extraction sector, and resource-related construction investment (net of capital imports) is assumed to be undertaken by the heavy and civil engineering construction industry.

Input-Output (I-O) tables can then be used to calculate the value and industry composition of *intermediate inputs* required to meet this final demand. For example, I-O tables can be used to calculate the value and industry composition of intermediate inputs required by the resource extraction sector to produce each $1 of resource exports, and the value and industry composition of intermediate inputs required by the heavy and civil engineering construction industry to undertake each $1 of resource-related construction investment. After making some simplifying assumptions, this information from I-O tables can then be used to transform the final demand related to resource extraction and investment into a measure of resources sector gross value added (GVA) that can be decomposed by industry. The GVA of an industry is the gross output of that industry less the intermediate inputs it uses to produce that output.

Table A1 summarises some of the key information derived from I-O tables used to estimate the size and industry value-added composition of the resources sector. The GVA requirements matrix reveals the distribution of industry GVA generated for every $1 of final demand for a particular industry's output. For example, take column 1 in Table A1: the coefficients in this column can be thought of as the industry value-added content of resource exports. These coefficients will differ for each type of resource

Table A1: GVA Requirements Matrix[a]
Value of GVA generated for every $1 of final demand for industry output, 2008/09

	Resource extraction	Construction	Manufacturing	Business services	Transport	Other industries
Resource extraction	0.70	0.07	0.11	0.02	0.07	0.03
Construction	0.02	0.42	0.01	0.01	0.02	0.02
Manufacturing	0.04	0.11	0.45	0.04	0.06	0.06
Business services	0.13	0.25	0.18	0.82	0.22	0.18
Transport	0.03	0.03	0.05	0.02	0.51	0.03
Other industries	0.07	0.11	0.19	0.08	0.11	0.68
Total[b]	**0.99**	**0.99**	**0.99**	**0.99**	**0.99**	**0.99**

(a) Resource extraction is mining and resource-specific manufacturing; construction is residential building, non-residential building, heavy & civil engineering and construction services; other industries is agriculture, forestry & fishing, manufacturing (excluding resource-specific manufacturing), electricity, gas, water & waste services, transport, postal & warehousing, wholesale trade, retail trade and household services
(b) Total does not equal $1.00 due to taxes less subsidies on intermediate goods and services
Sources: ABS; Rayner and Bishop (2013)

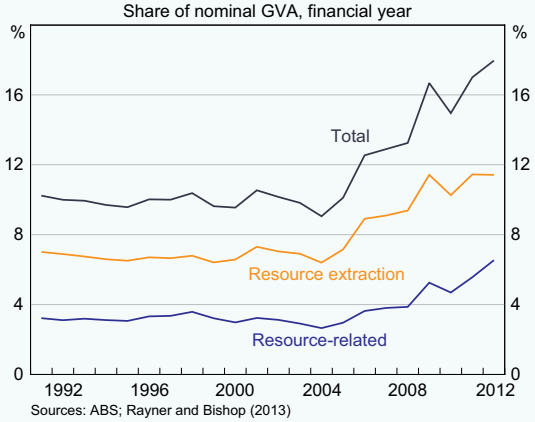
export but, on average, for $1 of resource exports in 2008/09:

- The resource extraction sector contributed $0.70 of value added.
- The business services industry contributed $0.13 of value added.
- The manufacturing, transport and construction industries each contributed around $0.02–$0.04 of value added, while the remaining $0.07 was contributed by other industries, such as utilities and wholesale trade.

These estimates suggest that there are non-trivial spillover effects from demand for Australia's natural resources to activity in domestic industries, outside of the resource extraction industry itself.

Using GVA requirements matrices calculated from I-O tables published at different points in time, it is then possible to transform final demand related to resource extraction and investment into a measure of resources sector GVA (Graph A1). This broader measure of the resources sector accounted for around 18 per cent of nominal GVA in 2011/12, which is double its share of the economy in 2003/04. Resource extraction is estimated to have accounted for around two-thirds of the value of the resources sector in 2011/12 (11½ per cent of GVA). This includes the extraction of the resources themselves and also

Graph A1
GVA – Resources Sector
Share of nominal GVA, financial year

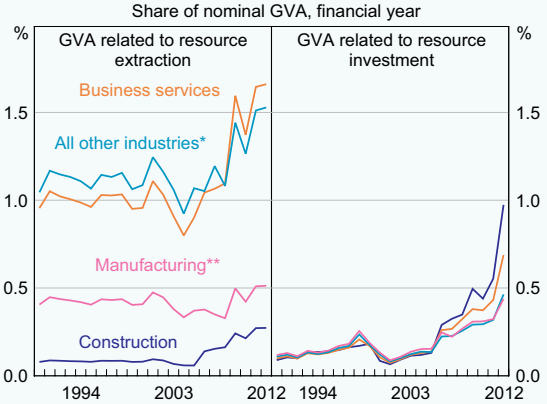


Sources: ABS; Rayner and Bishop (2013)

the processing and refinement of those resources. The large rise in resource extraction as a share of nominal GVA largely reflects higher export prices for resource commodities over the past decade. As the terms of trade boom gathered pace, resource-related activity picked up sharply, rising from an estimated 3 per cent of nominal GVA in the mid 2000s to around 6½ per cent in 2011/12.

Graph A2 decomposes resource-related activity (the lower line in Graph A1) by the industries that contribute to resource extraction and investment. The largest contributions to resource-related activity in 2011/12 came from the business services, construction, manufacturing, transport and wholesale trade industries. While construction and transport have obvious connections to the resources sector, business services (e.g. engineering, legal and accounting services) account for a larger share of resource-related activity. Business services are key inputs to both resource extraction and resource investment. In part, the relatively small share of construction reflects the fact that the construction industry itself draws on a relatively high share of intermediate production from other industries, and that a large share of construction-related resource investment is imported. However, consistent with the significant increase in resource investment since the mid 2000s, resource-related construction increased sharply as a share of nominal GVA.

Graph A2
GVA – Resource-related
Share of nominal GVA, financial year



* Includes agriculture, forestry & fishing; electricity, gas, water & waste services; wholesale trade; retail trade; transport, postal & warehousing and household services
** Excludes resource-specific manufacturing
Sources: ABS; Rayner and Bishop (2013)

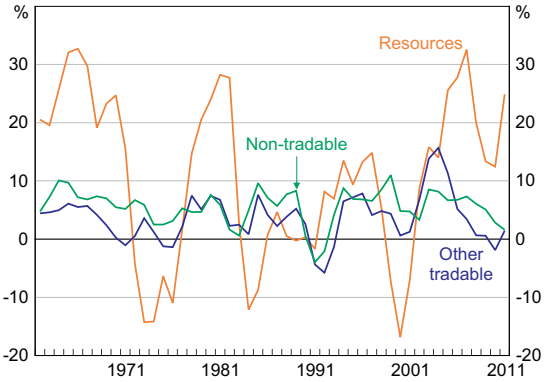
This run-up in the terms of trade has provided a significant boost to the real purchasing power of domestic production, given that a larger volume of imports can be purchased with a given volume of exports. The increase in purchasing power flowing from a rise in the terms of trade can be estimated by comparing real GDP to real gross domestic income (GDI). Since the mid 2000s, growth in real GDI exceeded that in real GDP by around 10 percentage points. However, Australians did not receive all of this transfer of income from the rest of the world, given that part of the resources sector is foreign owned. The distribution of these real income gains across the economy depends, crucially, on how much the exchange rate appreciates in response to the increase in world commodity prices (RBA 2005). Since the terms of trade started to rise in 2003/04, the nominal exchange rate has appreciated by around 25 per cent in trade-weighted terms. The appreciation of the exchange rate means that: the increase in the domestic currency price of commodity exports was less than the increase in world commodity prices; the income of the 'other tradable' sector declined; and real income gains flowed to the broader economy via the associated decline in the price of imports.

Phase II: The Surge in Resource Investment

The resources sector globally has responded to the large rise in commodity prices by expanding its productive capacity. In Australia, the growth in investment in iron ore, coal and liquefied natural gas (LNG) extraction has been exceptionally strong over recent years (Graph 2). In aggregate, it appears that around half of the value of these resource investment projects is imported, although this varies somewhat depending on the nature of the project, with LNG projects tending to have a higher imported component.

In contrast, investment growth in the 'other tradable' and non-tradable sectors has slowed over recent years. Growth in 'other tradable' productive capacity has been particularly soft, which may reflect, in part, the high level of the exchange rate, whereas the slowing in growth in non-tradable capacity may reflect other forces acting on demand and confidence in this sector (see below).

Graph 2
Real Investment Growth by Sector
Three-year-centred moving average, financial year

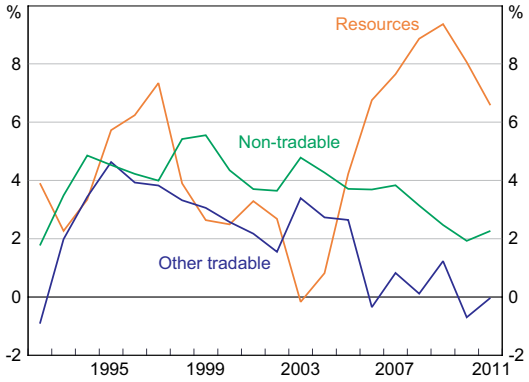


Sources: ABS; Plumb *et al* (forthcoming)

The impact of the surge in resource investment on the output of other sectors

As the surge in resource investment gathered pace, the output of the broader resources sector, as measured by its total GVA, increased strongly (Graph 3). This is particularly notable for the resource-related construction and business services industries, which have supplied a large quantity of inputs required for resource investment and extraction.

Graph 3
Real GVA Growth by Sector
Three-year-centred moving average, financial year



Sources: ABS; Plumb *et al* (forthcoming); Rayner and Bishop (2013)

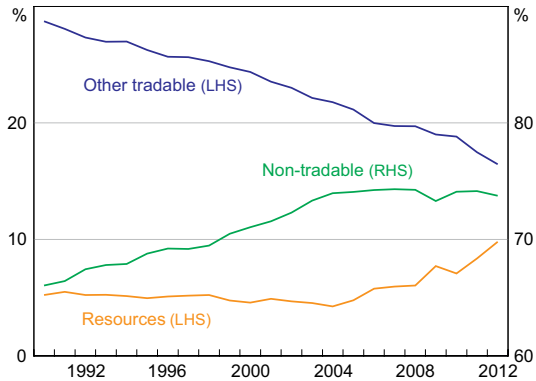
To sustain the growth in the resources sector, factors of production were drawn from the 'other tradable' and non-tradable sectors, and GVA growth in those sectors slowed. In the case of the 'other tradable' sector, total GVA even declined in some years, with particular weakness in parts of manufacturing that do not supply many inputs to the resources sector, such as textiles, clothing & footwear and wood & paper manufacturing. Growth in GVA of the non-tradable sector also slowed, but by less than the 'other tradable' sector. This suggests that the 'income effects' generated by the higher terms of trade (which tend to boost demand for non-tradable goods and services) outweighed the 'substitution effects' created by the fall in the price of tradables goods and services relative to the price of non-tradables (which tend to diminish demand for non-tradables relative to tradables).

It should also be noted that there have been factors other than the large increase in commodity prices and the high exchange rate that have had an effect on economic activity in Australia. For example, the global financial crisis caused significant disruption to financial markets and economic activity, albeit to a much lesser extent in Australia than in the north Atlantic economies. There was also an increase in the rate of household saving from the early 2000s, a slowing in credit growth and a transition to more stable levels of indebtedness and housing prices (relative to incomes). Furthermore, there was a relatively broad-based slowing in Australia's productivity growth from the early 2000s; some but certainly not all of this can be explained by developments in the resources sector (D'Arcy and Gustafsson 2012).

Employment

Following the onset of the terms of trade boom, aggregate employment grew at an above-trend pace. The composition of employment growth also changed significantly (Graph 4). The share of total employment accounted for by the resources sector doubled since the mid 2000s, to be around

Graph 4
Employment by Sector
Share of total employment, financial year



Sources: ABS; Plumb *et al* (forthcoming); Rayner and Bishop (2013)

9¾ per cent in 2011/12.[5] Around two-fifths of this growth reflected the expansion in resource investment, which increased the demand for labour in resource-related construction and other industries that provide inputs to these investment projects (such as some types of machinery manufacturing and engineering services). The share of workers employed in the resource extraction sector accounted for only about one-quarter of the overall increase in the resources sector's share of employment since 2004/05, while the remainder has been due to an increase in employment in industries that service the operations of mines (such as transport of output from the mine site to ports, business services and power generation). Once the peak in resource investment has passed and the extraction of resources increases, the share of labour employed in the more labour-intensive resource-related industries is likely to decline and the share employed in the less labour-intensive resource extraction sector is likely to rise further.

In contrast to the strong employment growth in the resources sector, employment growth slowed in the non-tradable sector (particularly in retail and the parts of construction not exposed to the resources

5 These estimates for employment assume that the productivity of a worker who works in a particular industry will be the same if they supply their labour to the resources or non-resources sectors (see Rayner and Bishop (2013)).

sector). This is consistent with labour moving to the resources sector in response to the higher relative wages on offer (see section below), but could also reflect other factors such as the weakness in the housing sector over recent years. The share of employment in the 'other tradable' sector has fallen since the mid 2000s (particularly in manufacturing), though this is a continuation of a longer-run structural shift since the 1960s.

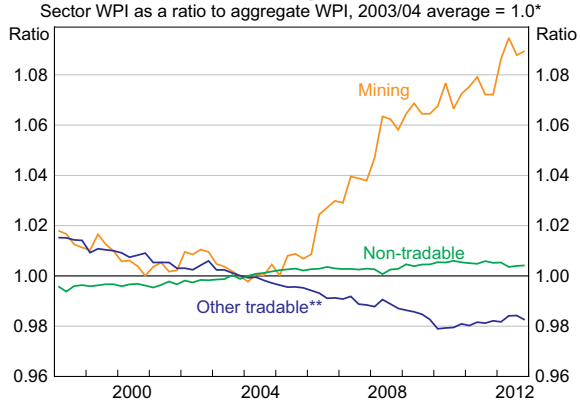
Wages

The pace of aggregate wage growth picked up between 2003 and 2008. This reflected considerable pressure on capacity in the economy prior to the global financial crisis, with the unemployment rate declining to its lowest level in more than three decades. When the slowdown associated with the global financial crisis occurred, these pressures on capacity eased and there was a significant moderation in wage growth. Aggregate wage growth subsequently picked up from these earlier low levels as activity recovered.

Wages have risen more rapidly in the mining sector than in the rest of the economy since the beginning of the terms of trade boom, with much of this adjustment occurring between 2004 and 2008. As a result, the relative wage in mining increased by about 9 per cent over the eight years to 2012.[6] This was by far the largest increase of any single industry, after having trended lower over the decade leading up to the boom (Graph 5). It also appears that relative wages increased in industries complementary to resource extraction, principally resource-related construction and business services.[7]

There was very little movement in the relative wage in the non-tradable sector overall and a decline in the 'other tradable' sector. This has been a key mechanism facilitating the reallocation of labour between sectors, whereby sectors benefiting from output price increases can afford to pay the higher wage rate and so draw labour away from other sectors.

Graph 5
Relative Wage Levels
Sector WPI as a ratio to aggregate WPI, 2003/04 average = 1.0*



* WPI refers to the wage price index
** Excludes agriculture
Sources: ABS; Plumb *et al* (forthcoming)

This change in relative wages and the modest adjustment in overall wage growth were helped by the combination of well-anchored inflation expectations and a flexible labour market, particularly in comparison to earlier terms of trade booms. During these earlier booms, inflation was more variable and Australia's centralised wage-setting system had the effect of spreading wage increases across the economy to occupational categories for which the value of marginal product had not increased. Not surprisingly then, the result was a rise in inflation and unemployment (Gruen 2006; Battellino 2010; Banks 2011). While the adjustment of relative wages during the current boom has been substantial, the need for relative wages to adjust may have been lessened by a number of factors that have increased the supply of labour to the resources sector, such as: the adjustment in participation rates across different regions; the utilisation of skilled labour sourced from offshore by the resources sector; interstate migration; and employment practices such as fly-in fly-out and drive-in drive-out arrangements (see D'Arcy *et al* (2012) for details).

6 In this section, mining is defined as resource extraction excluding resource-specific manufacturing.

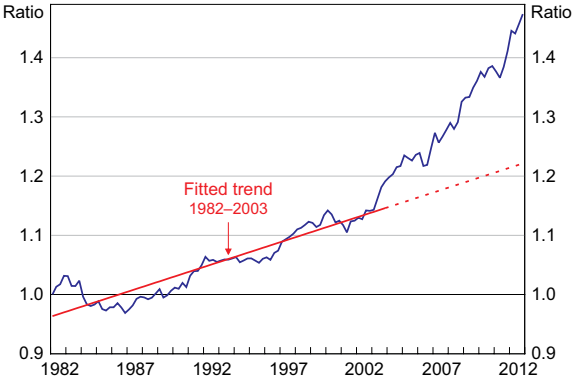
7 Wages in construction and professional services increased strongly between the mid 2000s and 2012, relative to other industries. While ABS data on wages cannot be disaggregated into resource- and non-resource-related construction and business services, the RBA's liaison program suggests that the wage data by industry are likely to mask stronger growth in resource-related construction and services and weaker outcomes in construction and services not exposed to the resources sector.

Consumer prices

Consumer price inflation has averaged around 2¾ per cent since the mid 2000s. This is within the inflation target of 2–3 per cent, but marginally higher than the average of 2½ per cent over the preceding decade. Even so, this can be considered as a relatively good outcome given the magnitude of the shock to the terms of trade, and also the much higher inflation outcomes associated with previous resources booms in Australia.

While inflation has been well contained, there were large shifts in relative consumer prices. Non-tradables inflation throughout the period of the terms of trade boom was stronger relative to its pre-boom average, as higher domestic cost pressures fed through to prices. At the same time, the higher exchange rate contributed to a noticeable decline in tradables inflation. Hence, the ratio of non-tradable to tradable prices rose much more rapidly after 2003 compared with the trend of the previous two decades (Graph 6).[8]

Graph 6
Ratio of Non-tradable to Tradable CPI
March quarter 1982 = 1.0



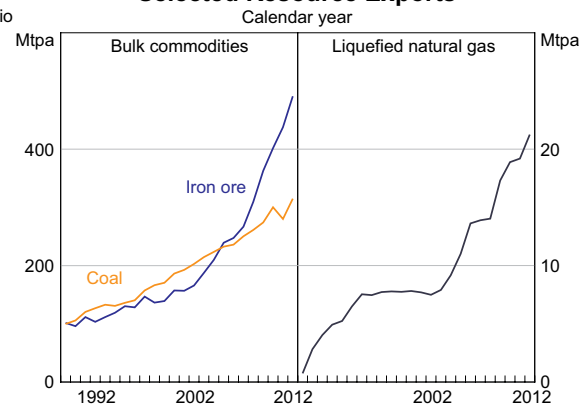
* Adjusted for the tax changes of 1999–2000; non-tradable CPI is also adjusted for interest chargers prior to the September quarter 1998 and deposit & loan facilities to June quarter 2011
Sources: ABS; Plumb *et al* (forthcoming)

8 Other factors have also contributed to higher non-tradables inflation in recent years, such as the significant pick-up in utilities prices (Plumb and Davis 2010) and a slowing in productivity growth during the 2000s. The picture is broadly similar if utility prices are excluded from the calculation. The earlier underlying trend reflects the Balassa-Samuelson effect, whereby productivity tends to rise more rapidly in the tradable sector than the non-tradable sector. So, even though wages will tend to equalise across the sectors over the longer run, unit labour costs rise more rapidly in the non-tradable sector (Balassa 1964; Samuelson 1964).

Phase III: Mining Production and Exports

The response of mining production and exports to the increase in commodity prices followed with some delay, reflecting the time needed to plan, gain approval for, and reallocate scarce productive inputs to enable construction of new infrastructure. For some commodities, there has already been a significant pick-up in production and exports. Since the onset of the terms of trade boom, the volume of iron ore extracted and exported has risen at an annual rate of 11¼ per cent (Graph 7). LNG production has also risen strongly. Coal production has expanded, but at a broadly similar pace to its pre-boom average, in part reflecting a sluggish recovery in coal production from the floods in early 2011. The production phase of the terms of trade boom is expected to gather momentum over the next few years, particularly for LNG, which is expected to increase much more rapidly starting from around 2015.

Graph 7
Selected Resource Exports
Calendar year



Sources: ABS; Bureau of Resources and Energy Economics; RBA

The strong growth in production and exports of these commodities over recent years has been offset, to a large extent, by weaker performance in other resource commodities, including oil production and ores for metals such as aluminium, copper, gold, lead, nickel and zinc (Connolly and Orsmond 2011). Reflecting these

offsetting developments, the volume of Australia's *total* resource exports increased at an annual rate of 3½–4 per cent over the course of the terms of trade boom. This is a notable slowing from its 1993–2003 average of 5½ per cent, notwithstanding a more than doubling of the capital stock and employment in the resource extraction sector. Nevertheless, the volume of Australia's resource exports is expected to increase at a faster pace in coming years as a result of the large volume of investment.

The high level of the exchange rate and the impact of the global financial crisis on external demand have weighed on exports of non-resource goods and services. Exports of manufactured products from Australia remain well below their 2008 peak, even though the volume of global trade has surpassed its 2008 level. Exports of services have also declined significantly over the past four years, although this also reflects the tightening of conditions for obtaining student visas, and more recently there has been some recovery in exports of tourism. How the economy adjusts in the years ahead will depend, in part, on how the exchange rate responds to economic developments; in particular, to the extent that the exchange rate does not depreciate in line with any unanticipated declines in the terms of trade, this will affect the adjustment in other sectors of the economy, notably the 'other tradable' sector.

Conclusion

Strong growth in Asia is expected to continue to provide significant benefits for the Australian economy. Most notable so far has been the resources boom. This boom is characterised by three overlapping phases. The first saw commodity prices and hence Australia's terms of trade rise significantly over a period of a number of years, and this was accompanied by a sizeable appreciation of the exchange rate. The phase of strongly rising commodity prices has passed, with the terms of trade having peaked in late 2011; although they still remain at a high level. The surge in investment in the resources sector has been in progress for some years and still has some way to run, with resource investment expected to peak as a share of GDP sometime over the course of this year, but remain quite high for a time. The third phase of increased production and export of resources has also commenced but has much further to run, especially in the case of LNG, for which investment takes place over a number of years before production comes on stream.

The overall process of macroeconomic adjustment to the rise in the terms of trade has occurred relatively smoothly compared with previous episodes; inflation has been consistent with the target, unemployment has remained relatively low and output has grown at close to trend rates. One critical element to the adjustment this time around has been the appreciation of the nominal exchange rate as the terms of trade were rising. The adjustment has also been helped by the anchoring of inflation expectations and the operation of the labour market, whereby wage pressures in industries or regions experiencing strong conditions associated with the resources boom have not spilled over to parts of the economy experiencing weaker conditions.

Not all parts of the economy have benefited from the resources boom. While the resources sector has benefited greatly, those parts of the tradable sector not directly exposed to the terms of trade boom have experienced a reduction in competitiveness due to the exchange rate appreciation. Further, all industries have faced increased domestic cost pressures due to competition for domestic factors of production (which has been offset to some extent by lower costs of imported inputs due to the exchange rate appreciation). This has created challenges for industries that have not been directly exposed to the resources sector and have not experienced a significant increase in the price of their output.

Looking further ahead, there will come a time when the demand for commodities will ease as development of economies in the Asian region continues and the focus of consumption shifts away from goods and towards services. Such a

transformation might appear to be disadvantageous for economies such as Australia that have hitherto been focused on supplying these economies with commodities. However, some Australian service industries, such as education and tourism, and parts of the rural sector have already experienced an increase in demand from Asia, notwithstanding the high level of the exchange rate. Rising demand for household, business and financial services more generally in Asia has the potential to be relatively advantageous for the Australian economy, in part because it is closer to this region than it is to most advanced economies, but also because of its well-developed and relatively open services sector.

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Funding the Australian Resources Investment Boom

Ivailo Arsov, Ben Shanahan and Thomas Williams*

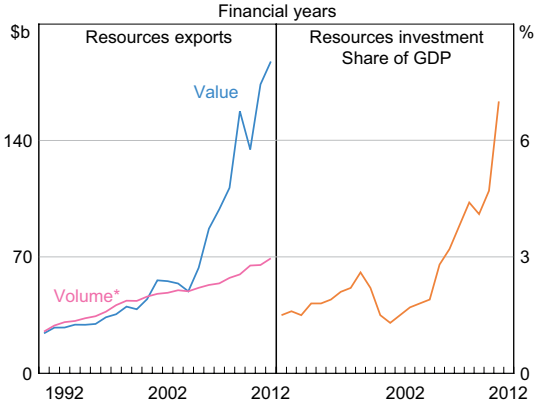
Investment by the Australian resources sector has risen steadily since the early 2000s to be at record levels. Most of the investment has been made by publicly listed companies, with contributions split evenly between Australian and foreign listed companies. The funding for this investment has overwhelmingly come from the profits generated by these companies. External funding sources, such as new debt and equity issuance, have played only a limited role.

Introduction

In the mid 2000s, the prices for commodities used in steel and energy production commenced a sharp and sustained increase driven by the rapid industrialisation and urbanisation of emerging economies, particularly China (Holloway, Roberts and Rush 2010). With global supply unable to match the unanticipated growth in demand, commodity prices reached very high levels. As a result, the value and profitability of Australia's resources exports rose substantially (Graph 1).

In response, resources producers increased their investment expenditure as they sought to boost output to satisfy the new sources of demand for their products and capitalise on their increased profitability. This has led to the largest resources investment boom in Australian history (Connolly and Orsmond 2011; Rayner and Bishop 2013). Investment spending in the Australian resources sector has risen from just under 2 per cent of GDP in 2002/03 to 7 per cent of GDP in 2011/12, thus driving a significant part of the economic growth over the past eight years. The Australian resources investment boom has been part of a broader global boom, as resources companies have sought to expand their production capacity.

Graph 1
The Australian Resources Boom
Financial years



* Chain volume measure, referenced to 2003/04 prices
Sources: ABS; RBA

Given the importance of the resources boom for the Australian economy, it is worth understanding how the resources investment has been funded. This article examines the funding of the resources boom in Australia using a bottom-up approach that combines publicly available project-level data on resources sector investments with information from listed companies' financial statements. The analysis focuses on investment in new projects and expansion of existing projects. The next section examines the type of entities that have been behind the resources sector projects undertaken in Australia during the resources boom. Since most of these entities are publicly listed companies, knowing how these

* The authors are from Domestic Markets Department. They would like to thank Rachael McCririck for her contribution. They would also like to thank Lynda Turnbull and Nicole Berroya for their capable research assistance.

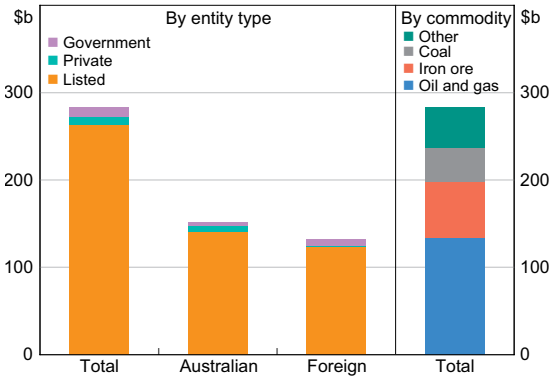
companies have funded themselves is equivalent to knowing how the resources investment boom has been funded. The subsequent section analyses how these publicly listed companies have funded their global physical investments since 2003. These findings are then combined to arrive at an overall understanding of how the Australian resources boom has been funded.

The Australian Resources Investment Boom

Between 2003 and 2012, investment in new projects and expansions of existing capacity in the resources sector is estimated to have totalled $284 billion.[1] Detailed analysis of project-level data on the projects completed since 2003 or still underway at the end of 2012 suggests that Australian listed companies and other Australian-based entities have accounted for 54 per cent of this, with the balance coming from foreign entities (see Appendix A for details on the methodology used to construct these estimates).[2] The overwhelming majority, over 90 per cent, of the investment has been by publicly listed companies, with private companies and government entities playing only a minor role (Graph 2).

Consistent with the global boom in demand for energy commodities and those used to produce steel, investment has been predominately in iron ore, coal, oil and gas, with these four commodities accounting for 84 per cent of the investment in physical infrastructure during the boom.[3] The remaining 16 per cent of investment has been across a relatively broad group of commodities, consisting primarily of base metals (including aluminium, alumina and bauxite) and gold.

Graph 2
Australian Resources Investment
Between 2003 and 2012



Sources: Australian Bureau of Agricultural and Resource Economics and Sciences; ABS; Bureau of Resources and Energy Economics; Deloitte Access Economics; RBA; company reports

The financial statements of publicly listed resources companies provide information about how the majority of entities involved in the resources boom have funded themselves.

Funding of Listed Resources Companies with Investments in Australia

The companies analysed in this article include all listed Australian resources companies and the 37 foreign resources companies with the largest investments in Australian resources projects since 2003.[4] The data for both the Australian and foreign companies include their operations in Australia and overseas. Financial statement data applicable to Australian operations only are not available because

1 This figure is based on the ABS measure of investment in buildings and structures in the resources sector for the financial years from 2004 to 2012 (ABS Cat No 5204.0) and estimates for the December half 2012 and the June half 2003 based on the quarterly ABS capital expenditure survey (ABS Cat No 5625.0). The buildings and structures component is used as it is the most comparable measure to the value of investment derived from the project-based estimates. The majority of spending on new resources projects should be reflected in their construction expenditure, which is captured in the ABS's measure of investment in buildings and structures. Relatively little of the spending on new projects is on machinery and equipment; most of what is reported in this category by the ABS is likely to be spending on the replacement of existing machines and equipment. Indeed, trends in the two categories since the start of the resources boom reflect this. Starting in 2003 from similar levels, the value of the annual investment in buildings and structures has increased nearly 14 times while the value of the annual investment in machinery and equipment has increased only 2½ times.

2 In this analysis, BHP Billiton and Rio Tinto, which have dual listings in Australia and the United Kingdom, are treated as Australian listed companies. A large share of the Australian listed resources sector is foreign owned and the impact of this is discussed later in this article.

3 Around 60 per cent of the investment in the oil and gas sector has been in major liquefied natural gas (LNG) projects that are currently under development.

4 These 37 companies account for 95 per cent of the investment by foreign listed companies.

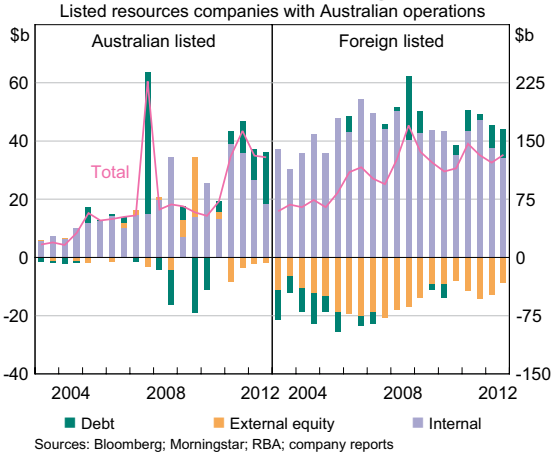
companies report on a consolidated basis. The analysis combines financial statements data with the ownership data on Australian resources projects since 2003.

Sources and uses of funds

The Australian and foreign listed companies have funded themselves primarily with internal funds, while debt has also been used but to a lesser extent (Graph 3).[5] Since the start of the resources boom, Australian companies have raised no equity in net terms, even though they raised substantial amounts of equity in 2009 in order to strengthen their balance sheets. Unlike earlier in the boom, the Australian companies have been returning greater amounts of capital to shareholders since 2011. The foreign companies have been consistently returning large amounts of capital to their shareholders, and, as a group, have not resorted to external equity funding at any time during the resources boom.

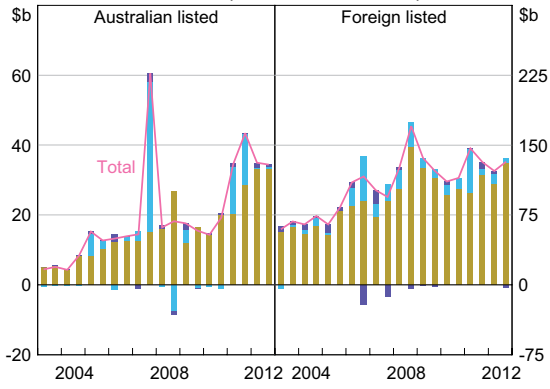
Funds raised by resources companies have typically been used to make new physical investments, with Australian and foreign companies using around 80 per cent of their funding for this type of spending (Graph 4). The rest of the funding has been used primarily to acquire existing assets from other companies, while funding for other investment purposes has been negligible.[6]

Graph 3
Sources of Funding
Listed resources companies with Australian operations



Sources: Bloomberg; Morningstar; RBA; company reports

Graph 4
Uses of Funding
Listed resources companies with Australian operations



Sources: Bloomberg; Morningstar; RBA; company reports

In general, companies' funding is fungible; however, certain types of funding are more suited to specific purposes. In particular, this is the case for acquisitions that are usually large relative to the acquirers' balance sheet, and require large one-off payments.[7] Acquisitions are essentially transfers of assets within the sector and as such do not generate new physical investment or economic activity. These types of transactions are often funded with syndicated loans as other sources of funds may be insufficient or take too long to arrange. Given their distinct funding requirements, funding for acquisitions is excluded from the analysis in this article (see Appendix B for more details on the methodology).[8]

5 Since 2003, internal funding has accounted for 86 per cent and 150 per cent of total net funding flows for Australian and foreign listed resources companies, respectively. The share of internal funding is higher than in non-resources sectors. For example, other non-financial Australian listed companies have typically sourced 68 per cent of their net funding internally.

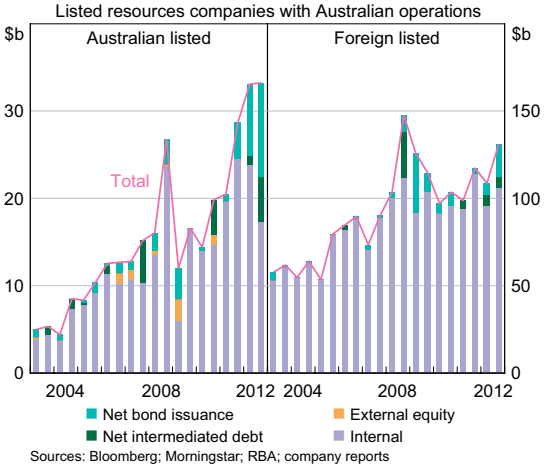
6 'Other investment' has accounted for just 3 per cent of total investment since 2003. It is comprised of a number of items that do not fall into the two main investment categories (acquisitions and physical investment) and it includes investments in financial assets.

7 For example, in the largest acquisition by an Australian listed resources company, Rio Tinto obtained around $40 billion in syndicated loans to fund its purchase of Alcan in the second half of 2007. Rio subsequently undertook a $19 billion equity capital raising in July 2009 as part of efforts to pay down this debt following the sharp fall in commodity prices at the end of 2008.

8 The analysis also abstracts from the 'other investments' category reported in companies' financial statements, although these investments tend to be small.

Australian and foreign resources companies have funded the majority of their physical investment from internal sources, 80 per cent and 92 per cent, respectively (Graph 5). Australian companies have accessed external funding somewhat more, although this is still relatively small. This reflects their higher physical investment spending relative to their internal funds compared to foreign companies (discussed below).

Graph 5
Resources Investment Funding Sources
Listed resources companies with Australian operations

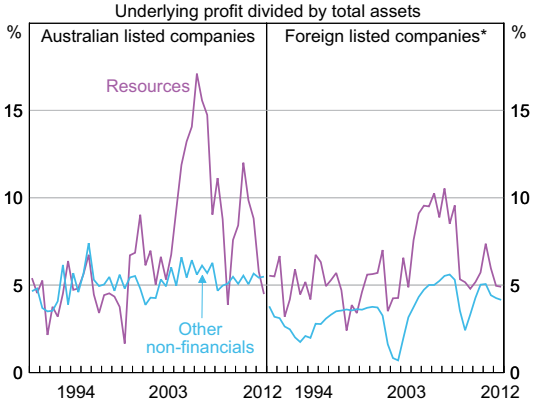


Sources: Bloomberg; Morningstar; RBA; company reports

Internal funding

Most of the internal funding has come from resources companies' operating cash flows rather than from drawing down of accumulated cash balances, reflecting the large amounts of ongoing cash flows generated by resources companies.[9] This reliance on internally sourced funds during the resources boom has been possible because of the large increase in commodity prices during the past decade, which has made resources companies very profitable. Australian and foreign resources companies have achieved an average annual return on assets (ROA) of 10 per cent and 7.2 per cent, respectively, since 2003, which has been significantly higher than the 4 to 5.5 per cent for other non-financial companies in Australia and overseas (Graph 6).

Graph 6
Return on Assets
Underlying profit divided by total assets



* The other non-financials series is based on the Datastream world index (with resources companies excluded and calculated with headline profit)
Sources: Bloomberg; Morningstar; RBA; Thomson Reuters

Resources companies' ROA was very high between 2004 and 2007, but has declined since; first with the downturns in commodity prices in late 2008 and early 2009 and then again since September 2011. Also, increasing operating costs appear to have contributed to the decline in resources companies' profitability.

Consistent with this, internal funding has declined since mid 2011, reflecting the sharp fall in the prices of a number of commodities over this period and the corresponding decline in profitability. However, physical investment has risen over this period because of the high level of already-committed projects. Companies have made more use of external sources to make up the shortfall.

External funding

Resources companies have used external funds to finance their physical investment during the boom to a much lesser extent than internal funds. Where they have accessed external funds, this has been mainly in the form of debt. Most of this debt funding has been raised in bond markets rather than from banks. This preference for bonds over intermediated debt to

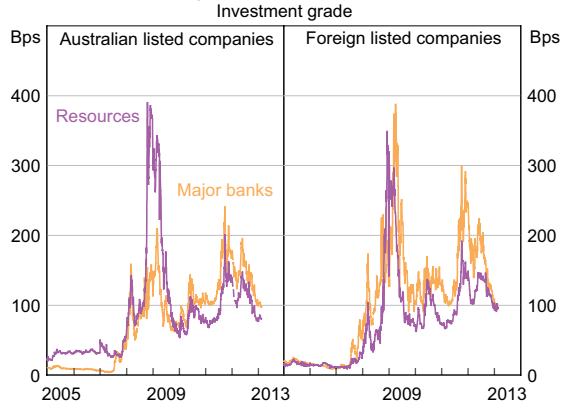
9 Operating cash flows represent cash flowing into a firm's accounts during the reporting period, whereas net income is based on accrual accounting and is affected by a number of non-cash items (such as depreciation, increases in accounts receivable, etc). Cash flow measures are more relevant for funding.

fund physical investment reflects the longer tenors available in bond markets, which more closely match resources companies' long investment horizons. The weighted average tenor of bond issuance by Australian and foreign resources companies has been around nine years since 2003. This is much longer than the typical tenor of syndicated loans extended to resources companies of four years. Another factor for the preference for bonds over bank loans is that some large resources companies have been able to borrow in bond markets more cheaply than banks. This is largely due to the global financial crisis, which caused investors to re-evaluate the risks associated with lending to banks and is evident in the pricing of credit default swaps (CDS); resources companies' CDS have generally traded at spreads lower than banks' CDS since late 2009 (Graph 7).[10]

The fact that resources investment has been such a significant contributor to economic growth in recent years, and that very little of this investment has been funded with bank debt, partly helps to explain why intermediated business lending in Australia has been lower in recent years than might be expected given the reasonable economic growth.

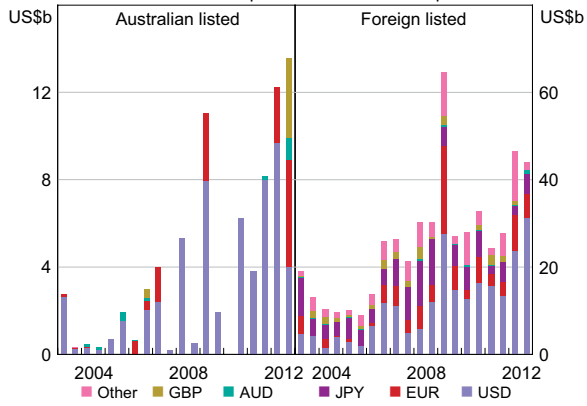
Resources companies' bond issuance has been conducted in a number of currencies, consistent with the diverse range of domiciles for the companies involved in the Australian resources boom. Nonetheless, nearly all issuance by the Australian resources companies, and around half of the issuance by the foreign companies, has been denominated in US dollars (Graph 8). This reflects the global nature of the products of these companies, which are usually priced in US dollars, and the depth of the US dollar bond market, which remains the largest and most liquid bond market globally. Around 20 per cent of issuance by foreign companies has been denominated in Japanese yen, which is broadly consistent with the share of foreign companies investing in resources projects in Australia that are domiciled in Japan. There has also been significant euro-denominated bond issuance (around 15 to 20 per cent of the total) by both Australian and foreign companies, reflecting the size and significance of this funding market. Only around 3 per cent of issuance by Australian resources companies has been in Australian dollars, while foreign resources companies have issued less than 1 per cent of their bonds in Australian dollars.

Graph 7
5-year CDS Premia
Investment grade



Sources: Bloomberg; RBA

Graph 8
Resources Companies Bond Issuance
Listed resources companies with Australian operations



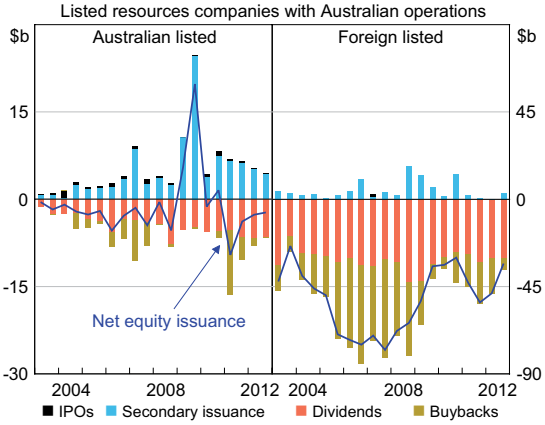
Sources: Bloomberg; Dealogic; RBA

10 This divergence in CDS premia has also been reflected in bond issuance spreads. For example, Rio Tinto (rated A-) issued a 5-year US$1.25 billion bond in August 2012 at an equivalent spread of 197 basis points over Commonwealth Government securities (CGS). Australian banks, despite being more highly rated at AA-, were issuing at similar tenors around this time at spreads of 250 basis points over CGS.

Very little physical investment has been funded with external equity. As noted above, in net terms Australian companies have raised no equity on average since 2003, while foreign companies have returned equity to their shareholders (Graph 9). Over this period, Australian resources companies have had a higher propensity to invest their operating cash flows in new physical investment than has been the case for non-resources companies. For Australian resources companies, the cash flow payout ratio – measured as dividends plus buybacks relative to cash flow from operations – has averaged 33 per cent since 2003, significantly lower than the 48 per cent payout ratio for other non-financial sectors.[11] While Australian resources companies issued equity in 2009 ($25 billion net), most of this was used to reduce debt levels, which had increased prior to the onset of the global financial crisis. The cash flow payout ratio of foreign resources companies has also been relatively low at 34 per cent, although in net terms they have been much more likely to return capital to their shareholders than Australian resources companies. This is because foreign resources companies have generated internal funding in excess of their physical investment and acquisition needs. The return of capital to shareholders by foreign companies has been driven primarily by a small number of large energy companies, with ExxonMobil, Chevron, Shell and BP returning a combined $600 billion in capital to shareholders in the form of dividends and buybacks since 2003.

The low level of external equity funding, and indeed the return of capital to shareholders, reflects the fact that a high proportion of the industry is made up of large, well-established and highly profitable resources companies that have been generating profits in excess of their funding needs.[12] In contrast,

Graph 9
Resources Companies Equity Cash Flows
Listed resources companies with Australian operations



Sources: ASX; Bloomberg; Morningstar; RBA; company reports

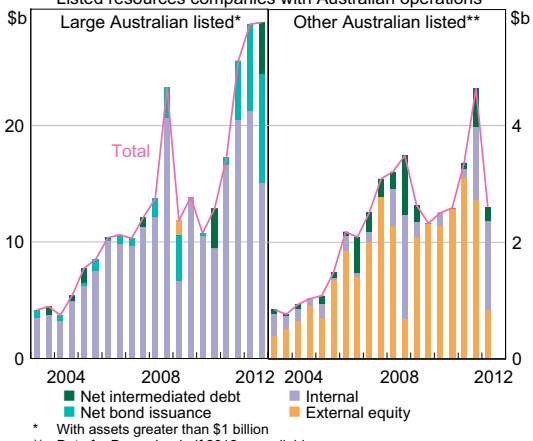
smaller resources companies are typically engaged in exploration activities and generally do not have established operations; therefore, these companies produce little or no internal funding (Williams 2012). Also, small companies, including the small resources companies generally, have limited access to debt financing, due to their inherent riskiness and their lack of cash flows to service debt. As a result, smaller resources companies have relied more heavily on external equity to fund their physical investment than have larger resources companies. The small resources companies have funded 73 per cent of their physical investment from external equity during the boom, which is significantly higher than the negligible funding from external equity of the larger companies (Graph 10).

Because Australian companies have funded most of their investment spending during the resources boom from internal sources, gearing in the sector has remained low. Book value gearing in the resources sector has averaged 41 per cent since 2003, much lower than the 62 per cent average for other non-financial corporations. Australian resources sector gearing reached a low of 24 per cent in 2010 but has risen since then as more of their physical investment has been funded with bond issuance. Despite the consistent return of capital to their shareholders, the book value gearing ratio of foreign

11 This measure is analogous to the more widely used dividend payout ratio – measured as dividends relative to net income – but is more consistent with the cash flow framework used throughout this article that is relevant to the analysis of funding.

12 This dominance of large companies may also explain the somewhat larger payouts to the shareholders of the foreign resources companies, because the foreign companies analysed include only the largest foreign companies with operations in Australia while all Australian listed resources companies are included.

Graph 10
Resources Investment Funding Sources
Listed resources companies with Australian operations



* With assets greater than $1 billion
** Data for December half 2012 unavailable
Sources: Morningstar; RBA

resources companies has remained low at 23 per cent on average since 2003. As discussed above, this is because these companies have generated internal funds well in excess of their physical investment requirements, so they have had little reason to raise debt.

Funding the Australian Resources Investment Boom

Combining the analysis from the two sections above provides insight into the funding of the Australian resources investment boom. Of the estimated $284 billion spent since 2003 on investments in new projects and expansions of existing projects in the Australian resources sector, the vast majority – around 80 per cent – has been funded from the profits generated by listed companies (Table 1). Most of the total funding – around three-quarters – has been generated by 'current period' operating cash flows of listed companies, with drawdowns of existing cash stocks (cash accumulated from earlier periods) just 2 per cent of total funding.

External funding has financed only a small part of the Australian resources boom, with a little over 10 per cent funded with new debt and equity. Most of the external funding has come in the form of debt, with the majority raised in bond markets. Bank loans have played a very limited role in

Table 1: Funding of the Australian Resources Investment Boom[(a)]
Per cent of total

	Australian entities	Foreign entities	All entities
Listed companies	49	43	93
Of which:			
Internal funding	40	40	79
– Current operations	38	39	77
– Existing cash	1	1	2
Debt funding	9	4	12
– Bonds	6	3	8
– Loans	3	1	4
Equity funding	1	0	1
Private companies	3	1	3
Government entities	1	2	4
Total	**54**	**46**	**100**

(a) Numbers may not add up exactly due to rounding
Sources: ABS; Australian Bureau of Agricultural and Resource Economics and Sciences; Bloomberg; Bureau of Resources and Energy Economics; Dealogic; Deloitte Access Economics; Morningstar; RBA; company reports

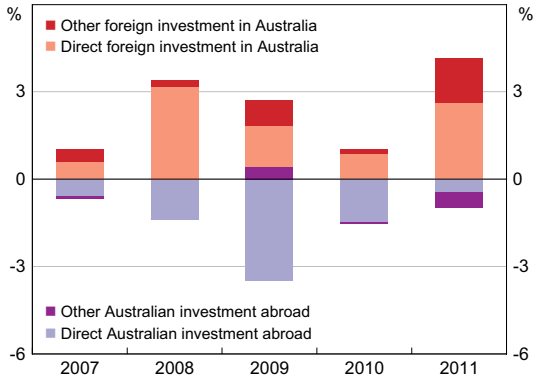
funding resources investment.[13] Similarly, external equity has contributed only marginally to the funding of the resources boom, with the majority of equity raisings by the resources sector aimed at strengthening companies' balance sheets following large debt-funded acquisitions rather than funding new physical investments. Outside the listed sector, private companies and government entities have also played only a limited role in funding the resources boom, contributing around 7 per cent of the funding.

Funding of the Australian resources boom has been sourced extensively from overseas. The analysis here suggests that, at face value, around half of the physical investment during the boom has been funded from overseas (i.e. the share of the foreign-based entities). However, the actual use of foreign sources of funds is much higher than that. This is because Australian resources companies have raised the majority of their debt funding through bond issuance in foreign markets, particularly the United States. And, more importantly, where companies have partial foreign ownership, funding from internal sources is equivalent to partial funding from foreign sources. Consequently, since the Australian listed resources sector is around three-quarters foreign owned, the same large proportion of internal funding is attributable to foreign sources.[14] Taking these factors into consideration suggests that around four-fifths of funding for physical investment has been sourced from offshore.

The inflow of foreign funding during the resources boom is reflected in the Australian balance of payments. Net foreign investment in the Australian resources sector has increased from around 0.5 per cent of GDP in 2007 to around 3 per cent of GDP in 2012.[15] The resources investment boom has contributed to the marked shift in the composition of capital inflows into the economy, with the increase in net capital inflows into the resources sector partially offsetting the decline in net capital inflows into the financial sector (Debelle 2010, 2011).

The balance of payments data also show that around three-quarters of all foreign investment in the resources sector has been in the form of foreign direct investment (FDI), which is broadly consistent with the findings from the analysis presented in this article (Graph 11). This has contributed to the increase in net FDI inflows into Australia over recent years. Since 2007, a large proportion of the FDI in the resources sector has been supplied through the reinvested earnings of the foreign owners of resources companies. In some cases, these capital flows are notional flows only as the funds have not left Australia, and are matched by notional income payments to foreign residents, which increases the net income deficit on the current account (RBA 2011).

Graph 11
Resources Sector Capital Flows*
Gross flows, share of GDP



* Mining data available from September quarter 2006 in ABS Balance of Payments by industry database
Sources: ABS; RBA

13 Although the share of funding from loans has increased recently as some of the large LNG projects under construction are being financed in part with syndicated loans.

14 This estimate is calculated by attributing 100 per cent foreign ownership to the foreign listings of shares in BHP and Rio Tinto and then applying the share of foreign ownership of Australian listed non-financial corporations, as measured by the ABS, to the remainder of Australian listed resources shares.

15 Sectoral balance of payments data is available only since September 2006 and does not cover the earlier part of the resources boom, which limits the time scope of this type of analysis.

Conclusion

Investment in the Australian resources sector has risen over recent years to record levels. This investment has been funded predominantly from the profits generated by Australian and foreign listed resources companies with projects in Australia. This has come about because the high commodity prices received by resources producers have made them highly profitable. In contrast, the contribution to funding from external sources – debt and equity – has been small. The high share of funding of resources sector investment attributable to foreign residents has contributed to the marked shift in the composition of Australia's capital (financial) account over recent years. Net capital inflows into the resources sector have partially offset the decline in net capital inflows into the banking sector and have contributed to the increase in net FDI inflows into Australia.

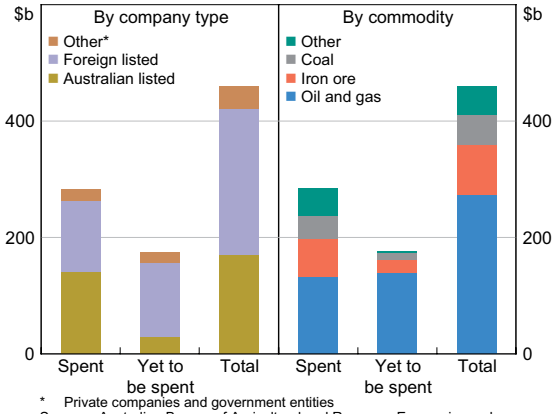
Appendix A

A list of resources projects was compiled as an intermediate step to building a database of the entities involved in the resources boom. The list includes projects that have been completed, or commenced but not finished by end 2012, since the start of 2003. The list was sourced primarily from the 'Resources and Energy Major Projects' database compiled by the Bureau of Resources and Energy Economics (BREE) since October 2011, and earlier by the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES). Additional information was drawn from the Deloitte Access Economics Investment Monitor

For each project, data were compiled on the entity (or entities) involved, including its type (listed, private or government), its domicile, and its share of ownership in the case of joint venture projects. Ownership of each entity was attributed to its ultimate parent where possible.

Estimates for the investment expenditure already made on projects under construction but not yet completed were compiled from publicly available data, principally from listed companies' investor presentations and other reports. These estimates were added to the reported expenditure on completed projects to arrive at the physical investment during the resources boom so far (2003 to 2012), split by completion status, entity type and entity domicile (Graph A1).

Graph A1
Australian Resources Investment
Projects completed or commenced since 2003



* Private companies and government entities
Sources: Australian Bureau of Agricultural and Resource Economics and Sciences; ABS; Bureau of Resources and Energy Economics; Deloitte Access Economics; RBA; company reports

In total, the bottom-up analysis identified $266 billion of project expenditure in the resources sector since 2003, which is around 95 per cent of the ABS's buildings and structures resources sector investment measure (the most comparable ABS measure). The discrepancy between the two is due to small projects not being captured in the bottom-up analysis and due to uncertainty over spending completed so far for projects underway.[16] The bottom-up estimates have been scaled up proportionally so that the aggregate reconciles to the ABS measure.

16 The BREE (and earlier ABARES) project list only includes projects greater than $50 million. Until October 2012, the BREE project list also included gold projects valued over $15 million.

The investment expenditure termed 'yet to be spent' on projects underway was derived as a residual between estimates of total project costs (as reported in the underlying databases) and estimates, from publicly available sources, of the spending that has been already made. It should not be interpreted as a forecast of future resources sector investment because it excludes projects that are under consideration for future development. There is a pipeline of such projects in the Australian resources sector and they are beyond the scope of this article.

Appendix B

This appendix sets out the use of company cash flow statements to calculate the funding of physical investment.[17] The analysis is summarised in Table B1. It takes into account net interest and dividend payments (which are reported as uses of funds) in net debt and net external equity figures (which are reported as sources of funds). Net bank loans are calculated as the residual between the change in net debt, reported in the company's cash flow statement, and the company's net bond issuance.

As the analysis is concerned with the funding of net physical investment, adjustments are made to account for the funding of non-physical investment. This is achieved primarily by determining the internal, debt and external equity funding split of large mergers and acquisitions (M&A) transactions, as these transactions tend to be funded very differently from other investments. These funding splits are determined from public disclosures by the relevant companies. The weighted average funding split for these large acquisitions is then applied to the remaining 'net acquisitions' data, resulting in an estimate of total M&A funding. Finally, 'other investment' (which is generally small), is assumed to be funded in the same proportions as all non-M&A investment. The end result is the funding profile of physical investment by listed companies involved in the Australian resources boom (Equation (1)).

$$\textit{Physical investment funding}_j = \textit{Total funding}_j - \textit{Funding M\&A}_j - \textit{Funding other investment}_j \quad (1)$$

where j = internal funding, debt funding, or external equity funding

Table B1: Sources and Uses of Funds

Sources of funds	Internal	=	Operating cash flows + decrease in cash balances
	Net debt	=	New bank borrowing + new bond issuance – repayments of debt – net interest payments
	Net external equity	=	New equity issuance – net dividend payments – buybacks
Uses of funds	*Net physical investment (i.e. capex)*	=	Purchases – proceeds from sales of property, plant and equipment (PPE)
	Net acquisitions	=	Purchases – proceeds from sales of other companies, subsidiaries or large assets (i.e. asset transfers between companies)
	Other investment	=	Net purchases of other entities debt securities and some hedging costs

Source: RBA

17 The starting point for this analysis is based on the source and uses of funds analysis in Black, Kirkwood and Shah Idil (2009).

A final adjustment is made to account for funding outflows, as this reduces funds available for physical investment. This typically occurs for external equity funding as dividend payments are often larger than equity issuance. In these instances, it is assumed that the funding outflow is financed proportionally by the sources that have positive inflows in a given reporting period.

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Developments in Banks' Funding Costs and Lending Rates

Benn Robertson and Anthony Rush*

This article updates previous Reserve Bank research on changes in the composition and cost of banks' funding and the impact of these changes on lending rates (Deans and Stewart 2012). The main findings are that the absolute levels of funding costs and lending rates have fallen over the past year, while spreads between these rates and the cash rate have widened. This latter development primarily reflects a continuation of strong competition for deposits. Over recent times, this competition has shifted from term deposits towards at-call savings deposits, and customers have responded to the shift in the relative returns on these products. Although the recent narrowing of spreads on long-term wholesale debt will eventually put downward pressure on funding costs, developments in deposit competition will have a larger impact on movements in funding costs. Lending rates have tended to move in line with funding costs over the past 12 months.

Introduction

In setting lending rates, banks consider a number of factors. A key consideration is their cost of funding, which is a function of the composition and price of different liabilities (Fabbro and Hack 2011). Banks also take into account the required risk premia, including the credit risk associated with loans and the liquidity risk involved in funding long-term assets with short-term liabilities. Choices related to banks' growth strategies, competitive pressures and the desire to provide a return to equity holders also affect banks' lending rates.

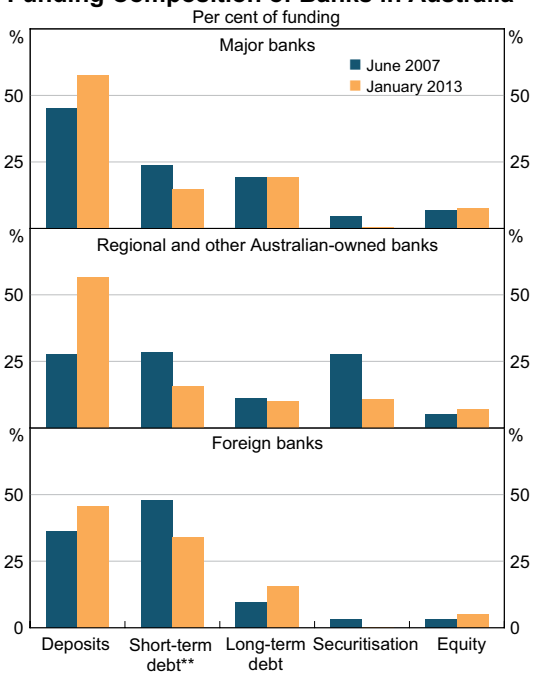
An important element in determining the overall cost of banks' funding is the level of the cash rate, which acts as an anchor for the broader interest rate structure of the domestic financial system. Nevertheless, changes in the level of compensation demanded by investors to hold bank debt, competitive pressures and non-price factors can exert significant influences on banks' funding costs. There is typically some delay before the full effect of changes in these factors flows through to funding costs and lending rates. In part, this reflects the time that it takes for balance sheet liabilities to be repriced, particularly those with longer terms to maturity. The Reserve Bank Board takes these developments into account when it determines the appropriate setting of the cash rate to ensure that the structure of interest rates faced by households and businesses is consistent with the desired stance of monetary policy.

* The authors are from Domestic Markets Department.

Composition of Banks' Funding

Banks operating in Australia have diverse funding bases. While the funding structure of individual banks can differ quite markedly from the aggregate, over the past five years there has been considerable change in the general composition of banks' funding. Most notably, there has been a broad-based shift away from the use of short-term wholesale debt, as well as the use of securitisation (Graph 1). In contrast, there has been a sustained increase in the use of deposits. These shifts are consistent with a reassessment of funding risks by banks globally, as well as market and regulatory pressures for banks

Graph 1
Funding Composition of Banks in Australia*



* Foreign liabilities are adjusted for movements in exchange rates
** Includes deposits and intragroup funding from non-residents
Sources: APRA; RBA

to secure more stable funding sources. Most of the shift in the composition of funding occurred between late 2008 and 2010. However, the share of deposit funding has continued to increase, rising by 4 percentage points over the past 12 months to its current level of about 55 per cent of total funding.

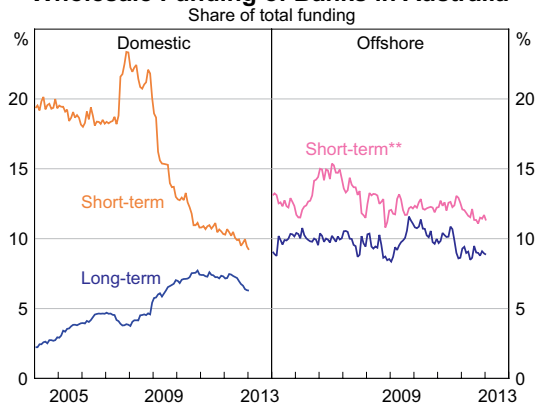
The increase in the share of funding sourced from deposits over recent years has occurred across all types of banks in Australia. This trend has been most pronounced for the regional and other smaller Australian-owned banks, with their share of funding sourced from deposit liabilities doubling since 2007. Prior to the global financial crisis, these institutions used securitisation more heavily as a form of funding. However, after the onset of the crisis, investor appetite for Australian residential mortgage-backed securities (RMBS) diminished and, while it has recovered somewhat, it remains below pre-crisis levels. As a result, the regional and other smaller Australian-owned banks have increased their use of deposits to fund their loan books.

Most of the growth in deposit liabilities had been driven by strong growth in term deposits, with the share of total funding sourced from term deposits increasing by 10 percentage points between June 2007 and early 2012. More recently, however, most of the growth in deposits has been in at-call savings deposits, reflecting developments in the pricing of these products. Transaction deposits, which typically offer near-zero interest rates, have diminished slightly as a share of funding.

The share of short-term wholesale debt funding has fallen from more than 30 per cent of total funding in the middle of 2007 to its current level of around 20 per cent, largely owing to lower issuance in the domestic market (Graph 2). The reduction in domestic issuance has been driven by a number of factors, including: domestic investors substituting away from certificates of deposit (CDs) towards more attractively priced term deposits; and banks reducing their cross-holdings of each other's paper.[1]

By contrast, the share of funding sourced from long-term wholesale debt markets has increased over the same period, although there has been a slight decline in the share of such funding sourced from the domestic market over the past 12 months.

Graph 2
Wholesale Funding of Banks in Australia*

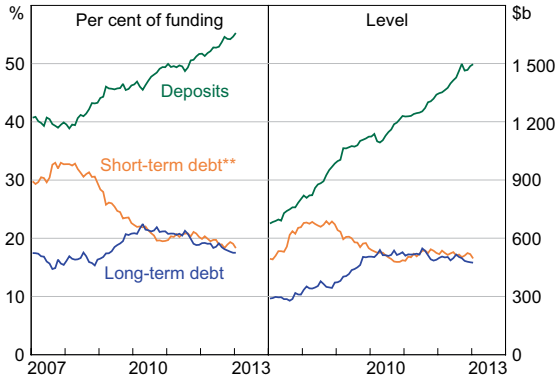


* Adjusted for movements in foreign exchange rates; wholesale debt is on a residual maturity basis
** Includes deposits and intragroup funding from non-residents
Sources: APRA; RBA

1 For more information on changes in the short-term funding composition of Australian banks, see RBA (2012a).

This recent decline largely reflects banks funding new lending with new deposits, while using wholesale markets to roll over maturing debt or to retire existing government-guaranteed debt (Graph 3).[2]

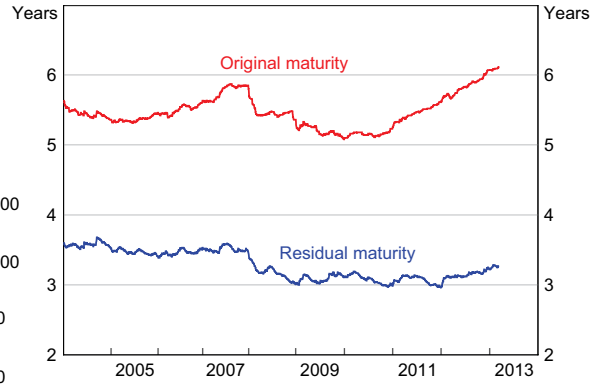
Graph 3
Funding Composition of Banks in Australia*



* Adjusted for movements in foreign exchange rates
** Includes deposits and intragroup funding from non-residents
Sources: APRA; RBA

Throughout 2012, banks continued to increase the maturity of new bond issuance, partly through the issuance of covered bonds, which were introduced in October 2011 (Graph 4).[3] In total, there has been around $50 billion of covered bonds issued by Australian banks, with issuance occurring at maturities of up to 19 years. The longer maturity of covered bond issuance reflects their higher credit ratings, given their dedicated collateral backing, and the expanded investor base to which these securities appeal. Overall, these securities have been issued with an average maturity that is about one year longer than unsecured issuance. The maturity of unsecured long-term wholesale bond issuance has also increased to be around its pre-crisis level.[4] There has also been a slight increase in the issuance of RMBS over the past year, although it remains at around one-quarter of its value prior to the crisis. More recently, there has been a further pick-up in the issuance of RMBS as banks have taken advantage of a narrowing in spreads.

Graph 4
Maturity of Banks' Long-term Debt
Outstanding wholesale debt, weighted average



Source: RBA

Cost of Funding[5]

Reflecting the general decline in interest rates, the absolute level of banks' funding costs fell during 2012, although the decline was less than the reduction in the cash rate. This largely reflected a sustained increase in the cost of deposits relative to the cash rate. Much of that increase occurred in the early part of 2012. Over the latter part of 2012, deposit rates moved broadly in line with the cash rate and relevant money market rates. The spread between the cost of outstanding wholesale debt and the cash rate continued to rise over 2012, although more recently there has been a significant narrowing in the spreads paid on newly issued debt.

Deposits

Competition for deposits remained strong throughout 2012, with the average interest rate offered by the major banks on their at-call savings and term deposit products rising relative to benchmark rates (Graph 5). While the average

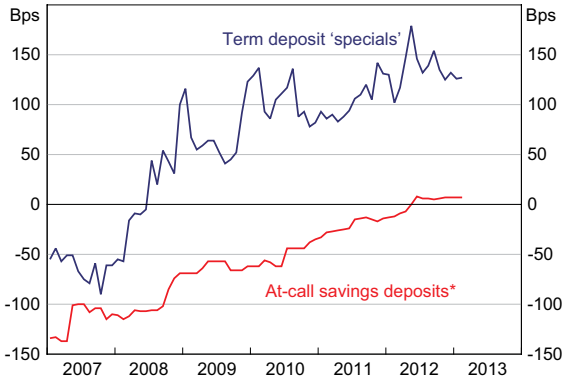
2 For further details on the buyback of government-guaranteed securities, see RBA (2013).

3 For further details on covered bonds, see RBA (2012b).

4 The onset of the global financial crisis saw a trend for bond issuance to occur at shorter terms. This reflected both supply and demand factors, with investors less willing to fund banks for an extended period and issuers preferring to borrow at shorter terms to avoid locking in high spreads for an extended period. For further details, see Black, Brassil and Hack (2010).

5 The Reserve Bank uses a wide range of information to make the estimates presented in this article. It supplements the analysis with detailed discussions with financial institutions.

Graph 5
Major Banks' Deposit Rates
Spreads over money market rates of equivalent maturity



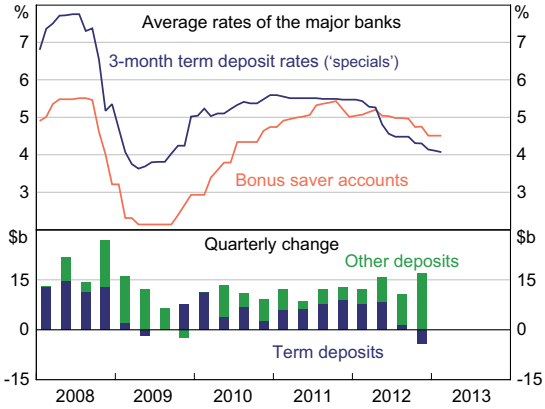
* Spread to cash rate; existing customers only; excludes temporary bonus rates
Sources: Bloomberg; RBA

cost of total deposit funding for the major banks is estimated to have declined by 90 basis points, this was less than the 125 basis point reduction in the cash rate over the year.

Until recently, competition for deposits had been most intense for term deposits. The spread of advertised term deposit 'specials' to wholesale benchmark rates of equivalent maturity paid by the major banks has increased by around 200 basis points since the onset of the global financial crisis. In addition, the major banks also offer an additional premium to some customers above their advertised term deposit rates. The size of these premiums varies depending on the nature of the customer relationship, the size of the deposit and the rates offered by other financial institutions. As these premiums paid to customers are negotiated on an individual basis, they are difficult to track over time.[6] Liaison with the major banks suggests that the average size of these premiums has not changed substantially over the past six months, with some customers offered premiums of up to 30 basis points.

Over the past year, there was a marked shift in competition towards at-call deposits. This has largely manifested itself as an increase in the rates offered on bonus saver accounts relative to term deposits around the middle of the year (Graph 6).[7] As a result of these more attractive rates, the volume of at-call deposit flows increased substantially, while some of the growth occurred at the expense of term deposits in the second half of the year.

Graph 6
Household Deposits



Source: RBA

While the average rate on the major banks' transaction and at-call savings deposits fell by 80 basis points over 2012, spreads to the cash rate widened by 45 basis points. This is slightly more than the widening of spreads for term deposits relative to their benchmark rates. For transaction accounts and some cash management accounts, interest rates offered are generally very low and are typically not repriced following adjustments to the cash rate. Hence the difference between these rates and the cash rate have become less negative as the cash rate has decreased.

By contrast, traditional online savings accounts typically offer an interest rate close to the cash rate and these products are generally repriced in line with movements in the cash rate. Since these accounts were introduced in the late 1990s, most financial institutions have been offering such products. Increased competition for online deposits recently has resulted in a greater number of institutions

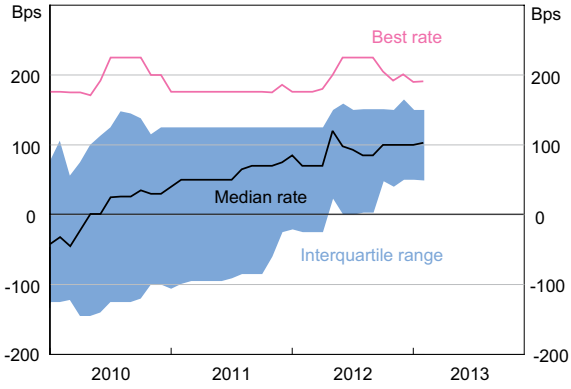
6 The monthly retail deposit and investment rates published by the RBA (Statistical Table F4) are based on banks' advertised deposit rates, which do not include these premiums.

7 Bonus saver accounts are those at-call savings accounts where the bank offers a bonus rate of interest to customers who meet certain conditions on deposits and/or withdrawals over a given period.

offering attractive introductory rates for new customers. Nevertheless, the cost of these deposits, relative to the cash rate, has been little changed over the past year.

This is not the case for rates offered on bonus saver accounts, which have increased substantially over recent years (Graph 7). The median interest rate offered on bonus saver accounts by all institutions is now around 100 basis points above the cash rate; three years ago, bonus saver deposit rates were around 50 basis points below the cash rate. More recently, increased competition for these types of deposits has resulted in an increase in the number of financial institutions offering bonus saver accounts and a narrowing in the dispersion of bonus rates on offer.

Graph 7
Distribution of Bonus Saver Accounts*
Spread to cash rate



* Maximum bonus saver rates available for new customers with deposit balances of $10 000
Sources: CANSTAR; RBA

Increased competition for bonus saver deposits by financial institutions is broadly consistent with the aim of securing stable deposit funding. In particular, the pricing characteristics of these accounts appeal to customers who want to earn a higher rate of interest while maintaining ready access to their deposits (although a withdrawal may involve foregoing the bonus rate of interest). The bonus nature of the interest payment discourages customers from reducing their deposit balances, which limits withdrawals from these accounts. By comparison, traditional online savings accounts do not typically penalise customers if they withdraw funds.

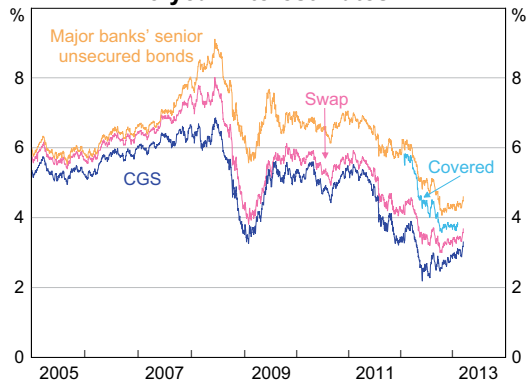
Despite the intensification in competition for deposits, the best rate offered on bonus saver accounts in the market has remained around 200 basis points above the cash rate in recent years.

Wholesale debt

The absolute cost of issuing both secured and unsecured long-term wholesale debt has fallen over the past year, largely reflecting the decline in benchmark rates (Graph 8). Spreads on the major banks' unsecured bond issuance widened sharply at the end of 2011, reflecting a broad-based increase in the level of compensation demanded by investors globally for credit risk (Graph 9). However, these spreads have since narrowed with the improvement in financial market sentiment. In early 2013, spreads on the major banks' unsecured bonds fell to their lowest level since late 2009. While many banks have taken advantage of the decline in spreads to retire more expensive government-guaranteed debt, new issuance has generally been priced above the spreads at which maturing debt was issued, reflecting the fact that there remains some debt outstanding that was issued prior to the global financial crisis.

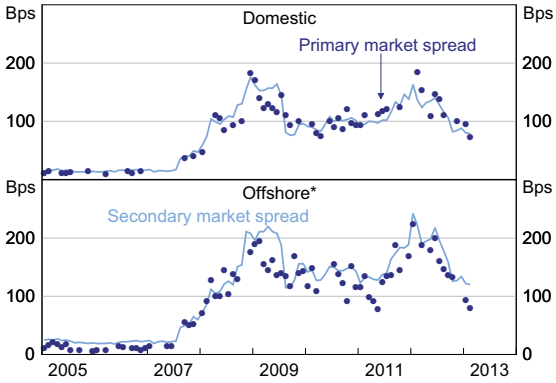
The significant decline in spreads over the second half of 2012 pushed the (marginal) cost of the major banks' *new* long-term wholesale debt below

Graph 8
5-year Interest Rates



Sources: Bloomberg; RBA; UBS AG, Australia Branch

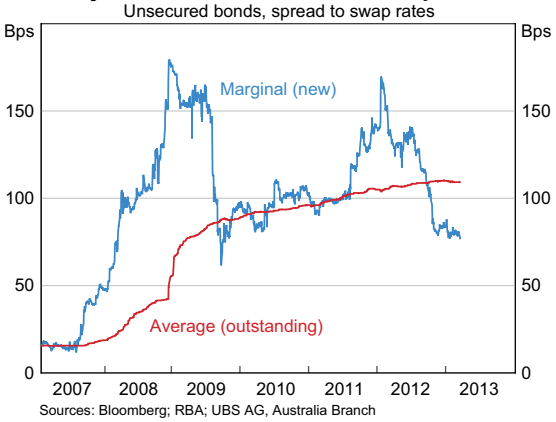
Graph 9
Major Banks' Bond Funding Costs
Unsecured 3-5 year bonds, spread to BBSW/Swap



* Secondary market spreads are assumed to equal domestic spreads plus an estimate of foreign exchange hedging costs
Sources: APRA; Bloomberg; RBA; UBS AG, Australia Branch

the weighted average cost of their *outstanding* bonds (Graph 10). However, the average cost of the outstanding stock of bonds, as measured by spreads to benchmark swap rates, continued to rise throughout 2012. This reflects both the timing of issuance and the historical spreads at which *maturing* debt was initially priced. In particular, around one-quarter of the major banks' 2012 maturing wholesale debt was issued prior to 2008 when spreads were considerably lower. Consequently, the spreads paid on maturing debt was noticeably lower than spreads paid on new debt issued in 2012. So as maturing debt was rolled over, the average spread of outstanding bonds increased. The timing of both

Graph 10
Major Banks' Domestic Bond Spreads
Unsecured bonds, spread to swap rates



Sources: Bloomberg; RBA; UBS AG, Australia Branch

issuance and any change in spreads will continue to have an influence on average long-term wholesale debt costs, with a portion of the major banks' debt maturing in 2013 having been issued below current market spreads. However, if current bond spreads are maintained, this will, in time, see the average cost begin to decline, as newly issued bonds are issued at lower spreads than those maturing.

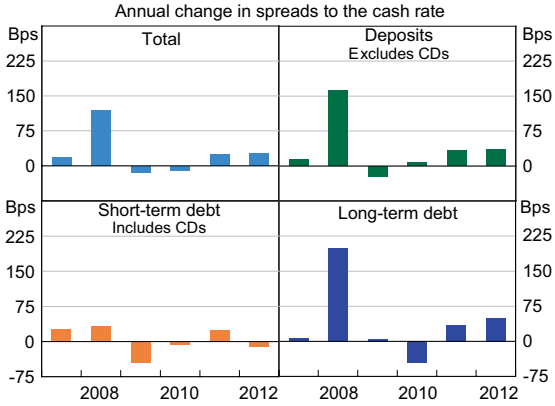
Although the relative importance of short-term wholesale debt has diminished over recent years, it continues to account for around 20 per cent of banks' funding liabilities. A large proportion of this debt is issued as 1-month or 3-month bank bills or CDs, the spreads on which narrowed relative to the cash rate over 2012. This narrowing of spreads on short-term debt alleviated some of the upward pressure on total funding costs.

Overall cost of funding

As noted previously, there are a number of factors that influence banks' total debt funding costs, including changes in risk sentiment and competition for funding sources. These factors affect both the price of banks' funding liabilities and the composition of their balance sheets. Taking the cost of the individual funding sources noted above and weighting them by their share of total bank funding provides an estimate of the overall change in banks' funding costs. This approach considers the effect of changes in both the price and composition of banks' funding liabilities and suggests that the major banks' cost of funding has increased by about 150 basis points relative to the cash rate since the onset of the global financial crisis (Graph 11).

Most of the increase in funding costs for the major banks occurred during late 2008 and early 2009, when the global financial crisis was at its most severe. From that period until mid 2011, the major banks' funding costs are estimated to have moved broadly in line with changes in the cash rate. Since then, however, increases in the cost of deposit funding and the level of compensation demanded by investors to hold bank debt, particularly in the

Graph 11
Major Banks' Funding Costs*
Annual change in spreads to the cash rate



* RBA estimates
Sources: Bloomberg; RBA; UBS AG, Australia Branch

first half of 2012, has seen estimated funding costs rise by a further 40–50 basis points relative to the cash rate. More recently, overall funding costs have been broadly unchanged; deposit rate spreads have been broadly constant, and the recent decline in long-term wholesale debt spreads have, to date, had little effect on outstanding funding costs.

For the regional banks, the evidence suggests that the overall increase in funding costs since the onset of the global financial crisis has been larger than the increase in funding costs experienced by the major banks. A large portion of this increase has been driven by the substantial shift in the composition of regional banks' funding liabilities away from securitisation and towards relatively more expensive deposit funding, as well as an increase in the cost of their deposits and wholesale debt funding.

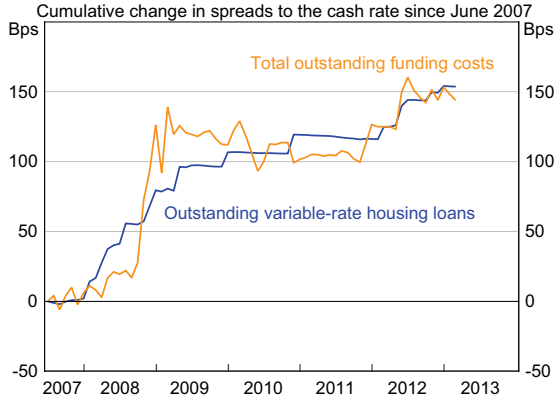
Banks' Lending Rates

In setting lending rates, banks take account of the cost of funding liabilities and equity, as well as a risk margin designed to cover the expected losses from making a loan. In the 10 years leading up to the global financial crisis, banks' overall cost of funds followed the cash rate closely; risk premia were low and stable, and the relative importance of equity capital in funding banks' loan portfolios was fairly constant. Since the onset of the global financial crisis, the spread between lending rates and the cash rate has increased for all loan types. This has predominantly reflected an increase in debt funding costs. The variation in lending rates across different loan types reflects a reassessment of the relative riskiness of those loans.

During 2012, the average interest rate on outstanding variable-rate housing loans rose by about 40 basis points relative to the cash rate. This increase is consistent with the overall increase in banks' funding costs, suggesting that risk margins were largely unchanged (Graph 12). By contrast, the average interest rate on new variable-rate housing loans increased by around 35 basis points relative to the cash rate, reflecting a small increase in the average size of discounts offered by banks to new customers, as competition for mortgage lending remained strong throughout the year.

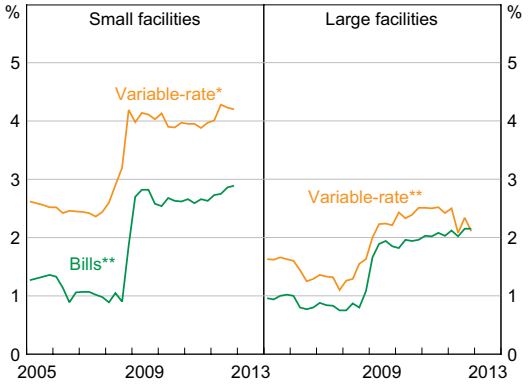
The interest rates on around two-thirds of business loans are typically set at a margin over the bank bill swap rate rather than the cash rate. Since 2009, spreads on both small and large business bill facilities have fluctuated within a tight range (Graph 13). However, after peaking in September 2011, the spread on outstanding variable-rate large business facilities has decreased, whereas spreads on other outstanding business lending have been gradually trending higher. By contrast, spreads on small business variable-rate lending increased in

Graph 12
Funding Costs and Housing Interest Rates
Cumulative change in spreads to the cash rate since June 2007



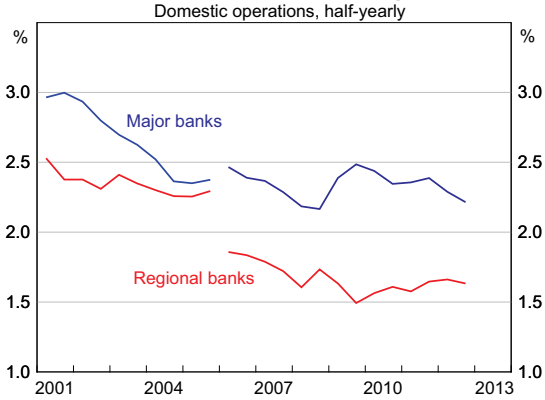
Sources: ABS; APRA; Perpetual; RBA; UBS AG, Australia Branch

Graph 13
Spreads on Outstanding Business Loans



* Spread to the end-quarter cash rate
** Spread to the 3-month trailing average of the 90-day bank bill rate
Sources: APRA; RBA

Graph 14
Banks' Net Interest Margin*
Domestic operations, half-yearly



* From 2006 data are on an IFRS basis; prior years are on an AGAAP basis
Sources: RBA; banks' financial reports

the first half of 2012. These loans are predominantly secured by residential mortgages and are therefore repriced in a similar manner to housing loans.

Net Interest Margins

Lending rates and funding costs are key drivers of changes in banks' net interest margins. During 2012, both lending rates and funding costs fell by similar amounts in absolute terms. Abstracting from changes in other factors, this suggests that the major banks' net interest margins should not have changed much. However, the net interest margins reported by the major banks contracted during 2012, although some banks have subsequently reported a widening of their margin in recent trading updates. In part, this reflects timing differences between balance sheet reporting dates and changes in both funding costs and lending rates, particularly those that have occurred since mid 2012. Changes in the composition of banks' assets, including holdings of liquid assets, the use of derivatives to hedge net interest income, and the amount of banks' equity funding will also influence banks' reported net interest margins. The average margin for the major banks continues to fluctuate within a fairly narrow range of between about 2¼ and 2½ per cent (Graph 14).

Net interest margins for the regional banks declined by less than the margins for major banks over the past year. In part, this reflects the relative increase in lending rates by the regional banks over 2012. Nonetheless, regional banks' margins continue to be lower than those of the major banks, reflecting their increased use of more expensive deposit funding, the higher cost of their wholesale debt funding compared with the major banks, and their larger share of lower-margin housing lending.

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Trends in Mobile Payments in Developing and Advanced Economies

Darren Flood, Tim West and Daniel Wheadon*

As mobile phones have become commonplace throughout the world there has been an increasing focus on their potential use for making payments. Adoption of mobile payments in developing economies has occurred well ahead of that in advanced economies, reflecting the particularly large benefits these systems can provide in some economies. Advanced economies, including Australia, are now seeing the emergence of mobile payments, but generally following very different models to those that have become popular in developing economies. This divergence highlights the fact that mobile payments encompass a range of quite different payment types, each of which appeals in different circumstances.

Introduction

The widespread adoption of mobile phones and other mobile communications devices throughout the world has had a significant social and economic impact and is likely to continue to do so for some years to come. One area of mobile activity that has become a focus in recent times is the use of mobile phones for making payments. The adoption of mobile payments globally has followed a path unlike almost any other technological development, with rapid take-up in some developing economies, while advanced economies have been slower to follow. This largely reflects the fact that specific types of mobile payments have offered dramatic benefits to developing economies in terms of financial inclusion and payments system efficiency, while in advanced economies, where there is ready access to financial services, the case for adoption of those payment types has been less clear. In the advanced economies, use of mobile payments is likely to be driven by different mobile payment models that rely on newer mobile phone and network technology that is only now becoming more widely available. This highlights the fact that mobile payments should not be thought of as a single payment type; the term encompasses a range of different classes and subclasses of payments, each offering a quite different set of benefits.

This article explains the various models of mobile payments, how adoption is evolving differently in diverse parts of the world and briefly touches on what might lie ahead for mobile payments in Australia.

What are Mobile Payments?

'Mobile payments' refers to a variety of financial transactions initiated with a mobile device. This might range from a remittance sent to a person some distance from the sender using only the services of the mobile network operator, to a 'credit card' transaction made at a retail outlet utilising a contactless chip in the phone.[1] The very different models for mobile payments can lead to confusion in the discussion of payment trends, which is made

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1 This article uses 'credit card', 'debit card' and 'prepaid card' to refer to transactions that are made via a card payment scheme (such as eftpos, MasterCard or Visa) even though, when made with a mobile phone, a physical card is not used.

worse by sometimes inconsistent and overlapping use of the terminology to describe some payment types.[2]

In order to properly understand the disparate payment types that fall under the banner of mobile payments, it is helpful to consider several aspects of those payments, including the economic purpose of the payment, the technological interface used, the funding source and the payment network type. These are described briefly below.

Economic purpose

Mobile payments facilitate two broad types of economic and financial activity:

- *purchases*: that is, payments in exchange for goods and services
- *transfers/remittances*: that is, payments that do not create an obligation for (or extinguish an obligation to) another party.

Purchases might be further broken down into point-of-sale purchases, where the payer and the payee are in the same location and typically interact via a payment terminal, and remote purchases, where the payer and payee are in different locations. Mobile *point-of-sale purchases* might include making a 'credit card' or 'debit card' payment using a contactless chip in a mobile phone or by sending a Short Message Service (SMS) instruction to make a purchase from a vending machine using the same account. The use by a small merchant of a device attached to a mobile phone to accept a card payment for goods and services might also be considered a mobile point-of-sale transaction, though the focus of this article is the use of mobile phones for the initiation of payments.

A *remote purchase* might involve a traditional payment type (such as a 'card' payment, BPAY or 'pay anyone' transaction) initiated via mobile internet or a payment initiated via SMS from a prepaid account held with a network operator of some type ('mobile money').

Mobile *transfers/remittances* are common in developing economies. This includes both domestic and cross-border worker remittances, often based on a mobile money model. In Australia, some banks and PayPal have also begun offering personal transfers via mobile applications on smartphones.

Technological interface

There are three main ways to initiate payments on a mobile device:

- *SMS* or *Unstructured Supplementary Service Data* (USSD), where a message is sent by the user via the mobile phone network to initiate a payment.[3] While SMS- and USSD-initiated payments can be used for purchases, including at the point of sale, these types of systems are more commonly used for remote money transfer payments (i.e. domestic and international remittances).
- *Mobile internet*, where the mobile device provides a means of accessing the internet. Payments via this transaction interface are similar to transactions made from a personal computer, but website services (including internet banking) can be tailored to make them more suitable for a mobile environment through the provision of a dedicated application ('app').
- *Contactless or Near Field Communication* (NFC), where a mobile device enabled with an NFC chip is placed in proximity to an NFC-enabled terminal and transmits payment information using radio frequencies. Communication between the devices can offer the same basic functionality as a contactless credit or debit card or a more complex interaction to allow additional services to be provided.

2 In this article, 'mobile money' is used to describe Short Message Service (SMS) and Unstructured Supplementary Service Data (USSD) based systems that access stored value funds, typically managed by a telecommunications provider. 'Mobile banking' refers to software applications ('apps') provided by financial institutions for internet-enabled smartphones or tablets, where some of the main features include the ability to make person-to-person funds transfers and access to other banking-related services. 'Mobile wallet' here refers to apps for smartphones that package together several mobile payment types. The same term is often used in developing countries to refer to 'mobile money'.

3 USSD is a mobile messaging service, which, unlike SMS, exchanges messages in a real-time 'open session'.

Funding source

The funds utilised in a mobile payment generally come from one of three sources – a credit account with a financial institution, a deposit account with a financial institution (including a 'prepaid card' account), or funds held in store with another entity (i.e. 'stored value funds', which in many cases are held by a mobile network operator).[4]

Payment network

Where mobile payments are between accounts held with financial institutions, they are able to utilise traditional interbank payment networks. For instance, they can be drawn from a deposit account via the Direct Entry system which underpins internet 'pay anyone' transactions in Australia. Payments from credit, debit or financial-institution-based prepaid accounts could also be processed via the card scheme networks used for traditional card transactions (for instance MasterCard or Visa).

Other systems utilise a 'closed' network, that is, where all those wishing to send and receive payments via that system must hold an account within it. This might be the case for a system where prepaid funds are held with a telecommunications provider. Such systems are simpler to establish because they do not require funds to be passed between different entities and therefore do not require cooperation with other parties.

The range of characteristics of mobile payment systems is illustrated in Table 1. Combining these characteristics in different ways leads to a wide range of possible mobile payment models. Which model is adopted will depend on the purpose of the transaction, the technology that is available in mobile handsets, networks and point-of-sale terminals, and, importantly, the level of access users have to traditional financial infrastructure. The latter may dictate whether the solution is largely delivered by traditional financial institutions and networks, or whether it is provided outside the traditional financial system. The importance of this is explored in the next section.

Global Differences in the Adoption of Mobile Payments

Developing economies

The first wave of mobile payment systems around the world were based predominantly on a 'mobile money' model – funds held with the mobile carrier, with transfers initiated via SMS or USSD. This was a relatively simple extension of existing prepaid mobile services, given that the carrier was already holding stored value on behalf of customers. This model has gained relatively little traction in economies with mature payment systems, but appears to have been more relevant in many developing economies,

Table 1: Characteristics of Mobile Payment Systems

Economic purpose	Technological interface	Funding source	Payment network
Purchase – point of sale – remote Transfer/remittance	SMS/USSD Mobile internet (apps) Contactless (NFC)	Financial institution – deposit account – credit account – prepaid card Other stored value (e.g. with mobile operator)	Interbank network (e.g. Direct Entry) Card scheme network (e.g. MasterCard, Visa) Closed loop (e.g. mobile operator)

Source: RBA

4 Credit from a mobile phone operator via a post-paid account is also possible, but is less common.

where there has been a proliferation of systems and rapid, though inconsistent, take-up by consumers.

According to the GSM Association (GSMA) there are 163 mobile payments products operating in developing economies today, with around another 107 planned (GSMA 2013). Of those, around 90 are operating in Africa, with around 40 in the Asia-Pacific region and 17 systems in the Americas. A survey of 78 service providers in 49 developing economies reported 82 million customers as at June 2012 (30 million of them active), with six service providers reporting that they individually had more than one million active customers (Pénicaud 2013). However, adoption rates vary; in 2011 the majority of mobile transactions reported were conducted through the highly successful M-Pesa system in Kenya (Davidson and Pénicaud 2012), where 73 per cent of people use mobile money and 23 per cent do so at least once a day (Demombynes and Thegeya 2012). Other very successful developing country systems have been Smart Money in the Philippines (Smart 2012), which has over 10 million subscribers, and M-Pesa in Tanzania, which has a reported 4.4 million subscribers (Awad 2012). Table 2 describes a sample of the mobile payment systems that have been deployed in developing economies.

The rapid adoption of mobile money systems in developing economies reflects the benefits they can offer in countries where a large proportion of the population do not have an account at a financial institution or where underdeveloped financial infrastructure means that there is limited access to convenient and affordable financial services.[5] For instance, in some regions it is not possible for financial institutions to provide networks of branches and ATMs profitably (e.g. where relatively small populations are dispersed across remote areas). In these cases, mobile payments improve financial inclusion and provide a relatively efficient electronic payment system quickly and economically. This is possible because, while financial infrastructure may be underdeveloped, adoption of mobile phones has grown rapidly in recent years. For instance, while sub-Saharan Africa still has relatively low mobile adoption rates, there were an estimated 53 mobile phone subscriptions per 100 people in 2011, compared with 18 subscriptions per 100 people in 2006 (World Bank 2012). Mobile phone ownership is typically supported by an extensive network of agents for the mobile provider. This can facilitate the adoption of mobile payments, because funds can typically be paid in by cash via an agent and can be withdrawn by the recipient in the same way.

While many mobile payment systems in developing economies rely on customers holding stored value with the mobile phone operator, some systems use the same SMS/USSD interface to initiate payments between accounts held with financial institutions. This allows the banking system to achieve a wider reach where extensive branch networks are not possible.

Mobile money systems in developing economies are predominantly used for funds transfer, with over 80 per cent of the value of transactions processed in such systems related to person-to-person transactions (Pénicaud 2013). This highlights the growing role of mobile payments in facilitating domestic remittances (for instance, from urban to rural areas) and international remittances in a more accessible, efficient and affordable way than established methods. Nonetheless, a number of mobile systems have also been established in developing countries to facilitate point-of-sale purchases and remote consumer-to-business payments via mobile devices. A mobile device allows people in remote locations to make transactions without using cash, which can be difficult to obtain and risky to hold in large sums. Furthermore, mobile devices can be used to pay for necessities such as electricity remotely without the payer having to travel to make the payment or arrange payment through a third party.

5 There are strong disparities across countries in the use of financial services, with around 90 per cent of adults in high-income countries having a bank account, compared with around 40 per cent in low-income countries, though this share varies considerably across low-income countries (Demirguc-Kunt and Klapper 2012).

Table 2: Examples of Mobile Payment Systems in Developing Economies

Product/Operator	Model	Description
M-Pesa/Safaricom (Kenya)	Stored value funds and an extensive network of agents. Funds are pooled and stored in a trust fund at a bank.	M-Pesa enables consumers to make personal transfers, ATM withdrawals, pay bills, make point-of-sale purchases and top-up their mobile phone account. Partnered with Western Union to allow M-Pesa customers to receive international remittances.
Wizzit/A Division of the South African Bank of Athens Limited (South Africa)	Branchless banking service that customers access through their mobile phone via USSD. Operates through a network of agents, with no formal branch network.	Wizzit offers a broad range of services, including: personal transfers, mobile phone account top-up, and electricity vouchers. Customers also receive a Maestro-branded debit card and access to internet banking.
Smart Money/Smart (Philippines)	Stored value funds, stored under the customer's name in a bank.	Enables customers to make personal transfers, bill payments, top up a mobile phone account and receive international remittances. Customers also receive a linked MasterCard for ATM access to stored funds and for point-of-sale purchases.
Digicel Mobile Money/Digicel (Samoa, Fiji, Tonga)	Stored value funds system operating in a number of Pacific island nations. A network of agents is used (e.g. Post Fiji and bank branches) and funds are held in trust accounts.	Allows customers to make person-to-person payments, top up their mobile phone account, pay their mobile phone bill and receive international remittances. For the latter, the remittance sender in Australia or New Zealand loads funds via a credit card or bank transfer. Remittance receivers receive an SMS when the funds arrive.
MiCash/Nationwide Microbank (Papua New Guinea)	Bank account operated through mobile phone.	Customers can top up their mobile phone account, check balances and make personal transfer payments. Deposits and withdrawals occur through branches or a network of agents.

Sources: Digicel; GSMA; Mas and Kumar (2008); Nationwide Microbank; RBA; Safaricom; Smart; Wizzit

The potential significance of mobile money systems to developing economies extends beyond the financial sector to the broader economy. A more accessible, effective and efficient financial system helps to facilitate economic activity by lowering transaction costs. The potential advantages have led international organisations such as the Asian Development Bank, United Nations and the World Bank to take a significant role in facilitating the development of mobile payment systems, along with programs to ensure the development of suitable legal frameworks and regulatory arrangements to support these systems.[6]

Advanced economies

In the advanced economies consumers and businesses typically already have access to established electronic payment systems. This means that there is less need for the types of mobile payment systems that are popular in developing countries. For example, the Consumer Payments Use Study conducted by Roy Morgan Research on behalf of the Reserve Bank in 2010 indicated that at that time around 10 per cent of consumers had made what they considered to be a mobile payment, but that those were mainly to purchase ringtones, games or applications for their phone, rather than for a broader range of goods and services (Bagnall, Chong and Smith 2011).

The fact that 'mobile money' has not yet presented a compelling case in Australia and other advanced economies does not mean that mobile payments more generally are not relevant.[7] Adoption of other forms of mobile payments is occurring and the rate of adoption may pick up in the future, particularly mobile internet and contactless (NFC) transactions. Both are reliant on the availability of supporting technologies, such as smartphones and NFC-enabled handsets and point-of-sale terminals.

Mobile internet access has allowed the widespread adoption of mobile banking applications offered by financial institutions, with some banks now reporting more connections to their systems via a mobile device than other means. While these offer broader account management services, a key selling point is often their payment capabilities. At present, these tend to focus on traditional payment methods such as BPAY and 'pay anyone' transactions, but in some cases more streamlined person-to-person payment applications are available, including where customers of the same financial institution can receive funds in real time. While mobile internet access can readily support stored value systems where funds are held by a party that is not a financial institution, transactions typically occur directly via a financial institution. Nonetheless, some non-traditional players, such as PayPal, are making inroads via their own mobile payment applications.

Contactless payments, available through an NFC chip, allow for point-of-sale payments initiated via a mobile phone. In this case, the phone itself would be presented to the reader at the contactless terminal to make a payment, rather than a card. Contactless readers are now widely available in Australia, though the handset technology required for seamless deployment of mobile contactless payments has lagged somewhat. One bank has sought to facilitate contactless purchases through the use of a special phone case, while other pilot programs to incorporate NFC payment capabilities in handsets are also underway. An alternative model that does not rely on NFC uses a combination of mobile internet and geo-location services (that the customer can use to 'check-in' to nearby stores and identify themselves at the checkout) to effect a transaction.

6 For example, a number of multilateral organisations, including the United Nations, through the Pacific Financial Inclusion Programme (PFIP), supported the rollout of Digicel's Mobile Money product in Fiji, Samoa and Tonga. This program also supported the rollout of Vodafone's M-Paisa system in Fiji.

7 Japan is a significant exception to the low take-up of mobile money systems in advanced economies. NTT Docomo's Osaifu Keitai ('wallet mobile') has been widely adopted. According to NTT Docomo there are 36 million Osaifu-Keitai equipped mobile phones in Japan.

Mobile NFC is an interface which can facilitate a number of different types of transaction (see discussion of mobile wallets below), but it is likely that initial applications will once again feature traditional account-based products, processed through traditional card scheme networks. Table 3 outlines a number of types of mobile payment systems available in advanced economies.

Table 3: Examples of Mobile Payment Systems in Advanced Economies

Product	Description
Mobile banking apps (Australia)	Most Australian banks have mobile banking applications that allow typical online banking transactions, such as bill payments, internet transfers and balance checking, optimised for mobile phones. In addition, some banking apps allow person-to-person payments addressed using a mobile phone number, email or Facebook. One bank also allows mobile NFC payments to be made with a specialised phone case.
PayPal (Australia, United States)	Customers can link bank accounts, credit or debit cards or use funds in a PayPal account to make purchases in store or online. Instore payments can be made by using a mobile phone to 'check in' to a nearby store; the customer's name and photo will be displayed at the checkout for a PayPal payment to be automatically processed. Customers can make personal transfers, addressed to either the recipient's email or phone number.
Google Wallet (United States)	Allows both online and point-of-sale purchases via various 'debit' and 'credit cards', including via NFC technology. At selected merchants, the payment, redemption of vouchers and accrual of rewards points are combined in a single transaction called SingleTap.
Square Wallet (United States)	Customers link a debit or credit card to their Square account. The consumer can open a tab on their mobile device for a nearby participating retail store and their name and photo appears at the store's terminal. Customers can then pay 'with their name'. Square has also enabled instore payments at one retailer by scanning a quick response (QR) code, sent to the mobile device, at the register.
Osaifu-Keitai ('Wallet Mobile') (Japan)	Osaifu-Keitai is a mobile wallet with NFC capabilities used for a variety of functions, including prepaid funds transactions, event and transport ticketing, membership and rewards schemes. It also facilitates the iD credit payment service, which enables subscribers to defer payment to a later date (similar to a charge card).

Sources: Google; NTT Docomo; PayPal; RBA; Square; Australian banks' websites

What Lies Ahead?

In advanced economies, mobile internet and mobile NFC payments are likely to evolve so as to provide incremental benefits in convenience for customers, rather than filling the types of gaps in financial infrastructure that have been the focus of mobile money systems in developing economies. Similar incremental benefits have been capable of spurring rapid take-up of mobile services; for example, mobile banking has been adopted rapidly, even though similar services have been available via desktop PCs for some time. Over time, smartphone-based offerings may have a greater impact by integrating non-payment services with payments and by bringing existing payment services into new environments; for instance, facilitating point-of-sale payment via systems that have previously been suitable only for remote payments (e.g. PayPal).

One development that might help to facilitate the latter process is the likely proliferation of 'mobile wallets' in the near future. This is where one party packages a number of mobile payment systems into a single application. 'Wallet' is a reference to the ability of the user to select between a number of payment options in a similar way that a person carrying a physical wallet might choose to pay with cash, debit card or credit card. While mobile wallets can facilitate mobile internet transactions, a major focus is likely to be facilitating multiple types of payment transactions using the phone's NFC chip. For these transactions, the cardholder's credentials must be held securely in the phone itself, similar to a chip on a payment card. A single wallet could provide access to a number of 'debit' and 'credit cards', potentially from different schemes and issuers, along with alternative payment systems, stored value and person-to-person payments. Wallets are likely to be coupled with ways of managing loyalty programs, coupons, receipts and even tickets for entertainment or transport.

The wallet itself could be provided by any number of parties. Globally, such products, or their precursors, are already being provided by financial institutions, card schemes, telecommunications carriers and mobile handset/operating system providers. At least initially there is likely to be vigorous competition for the provision of wallets, as this will influence both how different payment methods are presented to the customer and merchant, and which parties have control over associated data flows.

One important development in Australia over the coming years is the anticipated establishment of a new interbank payment system that will provide new capabilities well suited to mobile payments. In February 2013, payments industry representatives announced a proposal to establish the new system in response to the findings of the Payments System Board's Strategic Review of Innovation in the Payments System, which concluded in June 2012 (Real-Time Payments Committee 2013). The new system is intended to provide for: payments to be made with close to real-time availability of funds to accounts held with financial institutions; the use of simple identifiers to address payments (e.g. phone numbers rather than BSB and account numbers); and additional information to be transmitted with payments.[8] While some existing mobile internet systems can provide similar services within a closed system or a single financial institution, the new system will allow the same convenience for transactions between customers of different financial institutions. It is expected to be delivered in 2016 and is likely to be associated with a fresh round of innovation in mobile payments.

Conclusion

What are loosely described as mobile payments should in reality be thought of as a group of often unrelated payment types. The differences between them are important for understanding why mobile payments have tended to develop in different ways around the world. They are also important for understanding likely future trends and the policy implications of mobile payments. In developing

8 A BSB number (originally 'bank, state, branch') is a six digit number used to identify where a financial institution account is held.

economies, the focus has been on encouraging financial inclusion through mobile payments and ensuring appropriate regulation of the new players offering deposit-like products that have emerged as a result. In advanced economies, where financial institutions and established payment networks are likely to continue to play a role, this is likely to be less of a focus. In Australia, the Bank and the payments industry are seeking to ensure that the interbank payments system will be able to support the future needs of mobile payments in whichever way they evolve. The Bank expects to see mobile payments become a tool to support competition, both between payment systems and between participants in those systems.

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Most of the publications listed below are available free of charge on the Bank's website (www.rba.gov.au). Printed copies of these publications, as well as a wide range of earlier publications, are also available on request; for details refer to the enquiries information at the front of the *Bulletin*.

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These statements, issued in February, May, August and November, assess current economic conditions and the prospects for inflation and output.

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These reviews, issued in March and September, assess the current condition of the financial system and potential risks to financial stability, and survey policy developments designed to improve financial stability.

Annual Reports

- *Reserve Bank of Australia Annual Report*
- *Payments System Board Annual Report*
- *Equity & Diversity Annual Report*

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This series of papers is intended to make the results of current economic research within the Bank available for discussion and comment. The views expressed in these papers are those of the authors and not necessarily those of the Bank.

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