Forecasting Business Investment Using the Capital Expenditure Survey

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Business investment is a key driver of economic growth and is currently around record highs in Australia as a share of GDP. In compiling forecasts for business investment, the Reserve Bank uses a variety of different indicators, including information from liaison as well as survey measures of firms' investment intentions. The most comprehensive survey is the Australian Bureau of Statistics' (ABS) quarterly survey of Private New Capital Expenditure and Expected Expenditure (Capex survey). While firms' expectations of capital expenditure from the Capex survey are a useful guide for forecasting business investment, the relatively large forecast errors suggest that the Capex expectations data should be used in conjunction with other sources of information.

Introduction

Business investment accounted for around 17 per cent of Australia's GDP in the first half of 2012 and is forecast to increase further over the next year, driven by investment in large-scale mining projects. As outlined in Connolly and Glenn (2009), the Bank uses a variety of models, data sources and indicators to forecast business investment. Both the Bank's extensive liaison program, covering a range of businesses across different industries and regions, and private sector business surveys provide information on whether firms intend to increase or decrease their capital expenditure in the future.[1] Information from liaison as well as private providers of data on key projects also helps to construct forecasts of investment, while data on capital imports and non-residential building approvals are used by the Bank as another guide to near-term investment trends.

But the most comprehensive source of information on planned business investment is the ABS survey of Private New Capital Expenditure and Expected Expenditure (Capex survey).[2] This differs from other surveys in that it reports firms' actual capital expenditure in the reference quarter, as well as their estimates of future expenditure over a period of up to one and a half years ahead.

Outline of the Capex Survey

The quarterly Capex survey contains estimates of actual and expected new capital expenditure for private businesses across a broad range of industries. It is released eight weeks after the end of each quarter and around one week prior to the release of the national accounts. The survey provides information on both spending in the most recent quarter (in both nominal and real terms) as well as firms' intended investment spending in the future (in nominal terms only). Expectations for a particular financial year are surveyed from around six months prior to the start of that year, resulting in six progressive estimates of capital spending (and one final reading of actual spending). As an example, the December quarter 2010 Capex survey provided

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1 Park (2011) demonstrated that there was a short-term positive correlation between trend quarterly growth in business investment and business survey measures of capital spending.

2 See ABS Cat No 5625.0 'Private New Capital Expenditure and Expected Expenditure, Australia'.

the first reading of firms' expectations for capital spending in 2011/12 (Graph 1).[3]

Graph 1
Capital Expenditure Survey
Timing of estimates for 2011/12
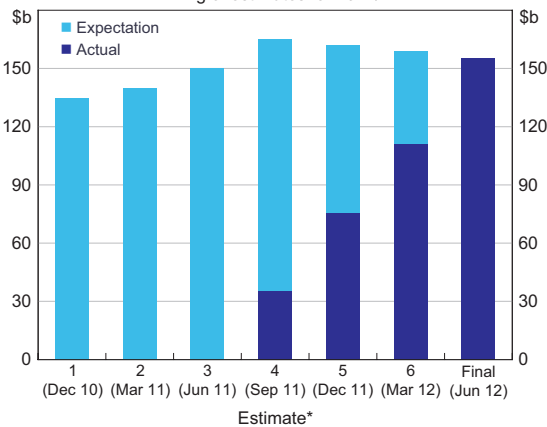
*   Quarter in which the estimate was published in brackets
Source: ABS

The Capex survey data are key inputs into the national accounts measure of business investment. However, there are some important differences between the coverage of, and concepts used in, the two releases. First, the Capex survey excludes firms from a number of key industries – namely agriculture, health care, education and public administration – which accounted for 17 per cent of economic output and 7 per cent of private investment in 2010/11. Second, the Capex survey provides disaggregated capital expenditure for some industries on a quarterly basis, whereas investment volumes by industry is only available in the annual national accounts (and includes public corporations). Finally, the Capex survey provides estimates of expenditure on machinery & equipment and buildings & structures, whereas the national accounts measure of business

investment also includes estimates of mineral & petroleum exploration and investment in research & development, software, and livestock & orchards.
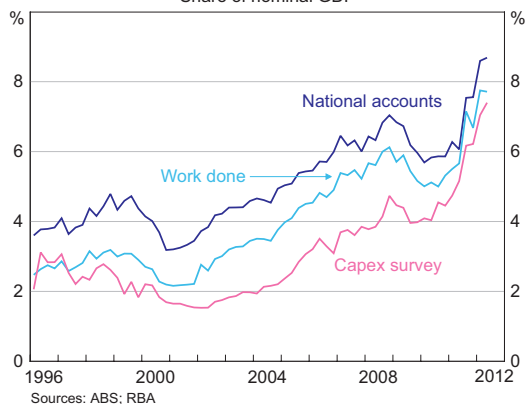
The ABS uses the Capex survey as the key indicator for the quarterly national accounts measure of machinery & equipment investment, but the national accounts measure also includes industries not sampled in the Capex survey. As a result, the Capex measure of spending only captures around two-thirds of total machinery & equipment investment (Graph 2). There can be large differences between growth in the Capex and national accounts series at times, particularly around turning points in the cycle; the mean absolute difference between quarterly growth in the two series over the past 20 years or so is 1.8 percentage points, although this has narrowed in recent years (Table 1). Nevertheless, there is a reasonably close correlation between the two measures.

Graph 2
Machinery & Equipment Investment
Share of nominal GDP

Sources: ABS; RBA
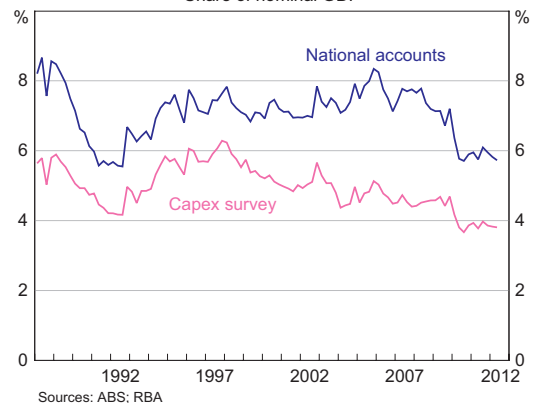
In contrast to machinery & equipment investment, the primary indicators for quarterly buildings & structures investment are the two 'work done' surveys – the Building Activity Survey and the Engineering Construction Survey (Graph 3). These surveys are released around the same time as the Capex survey. However, there are important conceptual differences between how investment is recorded in the work done surveys and how it is

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3   Firms provide three figures for each survey: actual expenditure in the reference quarter, a short-term expectation and a longer-term expectation. For a given financial year, say 2011/12, the first estimate was available in the December quarter 2010 survey as a longer-term expectation. The third estimate was available from the June quarter 2011 survey as the sum of both shorter-term expectations and longer-term expectations. In the next three quarters (the fourth, fifth and sixth estimates, respectively), the estimates are derived from actual expenditure (for the completed part of 2011/12) and expected expenditure (for the rest of the year). The final reading in the June quarter 2012 survey provided actual expenditure in 2011/12.

Graph 3
Buildings & Structures Investment
Share of nominal GDP

Sources: ABS; RBA

the timing of when investment is reported by these surveys. In the work done surveys, estimates of construction are based on the value of work physically done on a building or engineering site in the quarter, as reported by builders, whereas the Capex survey measures the purchases of buildings and engineering in the quarter, as reported by businesses (that is, the builders' clients).

The ramp-up in large-scale mining engineering projects – where the timing of work and transfer of ownership can differ substantially – has made the distinction between the work done surveys and the Capex survey increasingly important. For example, a structure that has been constructed offshore and then imported, such as part of a modular liquefied natural gas (LNG) processing plant, is recorded in the Engineering Construction Survey only once it

captured in both the Capex survey and the national accounts. These differences have implications for

Table 1: Quarterly Indicators of Business Investment Growth
Mean absolute difference, percentage points

	National accounts investment		
	Machinery & equipment	Non-residential building and engineering[a]	Engineering
Capex survey			
Machinery & equipment			
– Full sample	1.8		
– Past 3 years	1.1		
Buildings & structures			
– Full sample		7.1	
– Past 3 years		4.2	
Buildings & structures (Mining)			
– Full sample			9.1
– Past 3 years			7.1
Surveys of work done[b]			
Building & engineering			
– Full sample		1.9	
– Past 3 years		3.1	
Engineering			
– Full sample			3.3
– Past 3 years			4.4

(a) Buildings & structures
(b) Building Activity Survey and Engineering Construction Survey
Sources: ABS; RBA

has been imported and installed on-site in Australia. In contrast, both the Capex survey and the national accounts record such investment by the mining company as ownership progressively changes (typically approximated by progress payments made during its construction).[4] The rising importance of these types of high-value mining-related structures means that there has been a closer relationship between the Capex survey and national accounts measures of buildings & structures investment in recent years (Table 1).

## How Useful is the Capex Survey for Forecasting?

The capital expenditure data for the latest quarter are useful for estimating growth in the corresponding business investment component of GDP for the same quarter, as the Capex survey is released one week earlier than the national accounts. Rather than simply using the published quarterly change in the Capex data as the estimate, the accuracy of the estimates of the national accounts measures can be enhanced by estimating simple regressions to find the best relationship between quarterly movements in the Capex and national accounts series. This approach adjusts for any systematic differences between the two series; other indicators can also be included in the regression to improve the relationship.

The Capex survey information on firms' expected capital spending, available for a period of up to one and a half years ahead, are used by the Bank to guide near-term forecasts of business investment. However, translating the Capex expectations data into an investment forecast is not straightforward. First, the expectations data need to be adjusted for certain biases in firms' expectations. The adjusted nominal capital expenditure estimates then need to be converted into a profile for the national accounts measure of nominal investment, taking into account the historical differences between the two measures (which reflect differences in concepts and coverage);

this nominal profile must then be combined with forecasts of investment prices to generate a forecast for real investment.

Firms' expectations of future capital expenditure can differ from their realised capital expenditure because circumstances change (for example, economic growth may turn out stronger than expected) and because they systematically misjudge future expenditure (owing to difficulty planning well in advance and certain tendencies firms have when responding to the survey). In order to be meaningful, the expectations data must be adjusted for any such systematic bias. The degree to which expected capital expenditure over- or underestimates the actual outcome can be illustrated with a 'realisation ratio', calculated as the ratio of the actual and expected outcome for a given period. Realisation ratios tend to vary depending on how far ahead the estimates are made, the type of investment, the industry undertaking the investment and the size of the firm. Accordingly, these different tendencies need to be taken into account when adjusting the expectations data.

Later estimates of capital expenditure for the full financial year tend to be more accurate (with a realisation ratio closer to 1) than earlier estimates (Graph 4). This improvement in accuracy is consistent with the inclusion of actual capital expenditure data as the financial year progresses, as well as more certainty
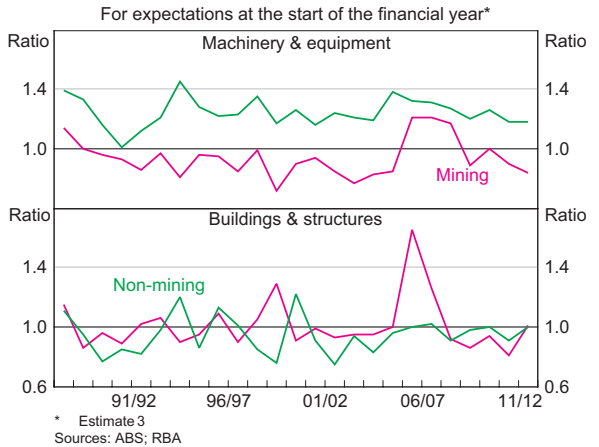

Graph 4
Average Realisation Ratios
Full financial years, 1988/89 to 2011/12

Sources: ABS; RBA

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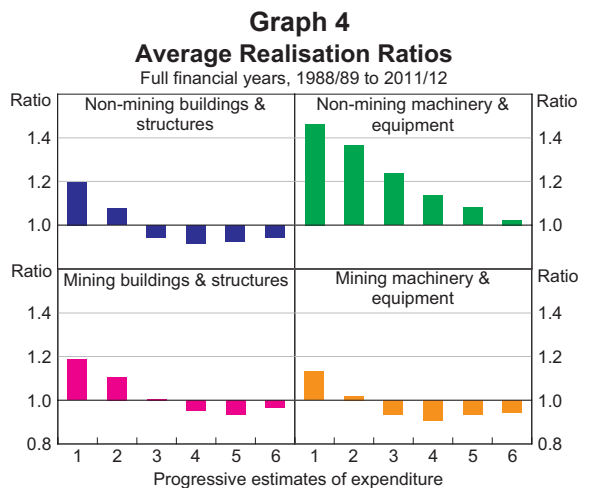
4 For more detail on how mining investment is recorded in ABS publications, see ABS (2012).

around firms' capital spending at shorter horizons. This pattern is particularly noticeable for machinery & equipment investment in the non-mining sector; early estimates tend to substantially underestimate actual capital expenditure, such that actual expenditure is on average nearly 50 per cent higher than the first estimate, but this error diminishes with time. For the mining sector, the first estimate of machinery & equipment investment also tends to be an underestimate, but subsequent estimates tend to overstate the amount of investment that will be undertaken, with little improvement in accuracy as the financial year progresses. A similar pattern is evident for buildings & structures investment (in both the mining and non-mining sectors). These differing tendencies are likely to reflect small firms accounting for a larger proportion of machinery & equipment investment in the non-mining sector; many small businesses do not report any expected capital expenditure, thereby contributing to the underestimation (Burnell 1994). Elsewhere, the tendency to overestimate investment may reflect unanticipated delays in the construction of large buildings & structures projects, and mining projects in general.
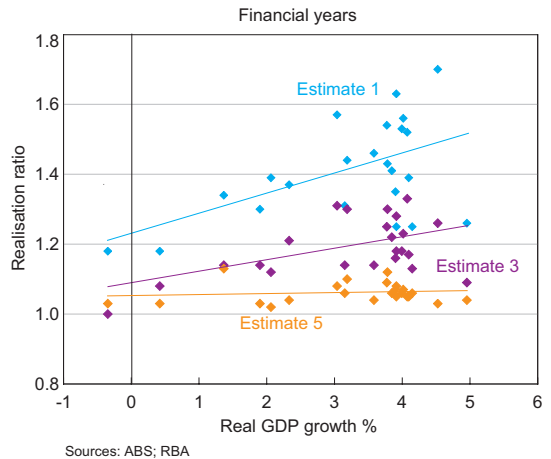
Realisation ratios also tend to fluctuate through time, broadly consistent with changes in business conditions (Graph 5). The future trading conditions a firm expects as it formulates its capital expenditure plans may be very different to the trading conditions prevailing at the time that the capital spending is due to be undertaken. As a result, conditions may be more positive or negative than expected, leading firms to revise their near-term capital expenditure plans. For example, in the mid 2000s, commodity prices increased much more quickly than mining firms expected, resulting in much stronger investment than they had planned initially (in contrast to the usual pattern of actual expenditure falling short of expectations). For more detail on how the Capex survey has tracked the progress of the mining investment boom, see 'Box A: A Case Study of Mining Investment'. The tendency for realisation

ratios to vary with business conditions is stronger at longer horizons, reflecting the greater uncertainty about conditions further out (Graph 6). It is also stronger for machinery & equipment than buildings & structures investment, and for non-mining firms rather than mining firms, possibly owing to the longer lead times for buildings & structures and mining projects. In general, the volatility of realisation ratios over time lessens for progressive Capex estimates, which again probably reflects the inclusion of actual capital expenditure data in full-year estimates as the financial year progresses, as well as more certainty for firms at shorter horizons.
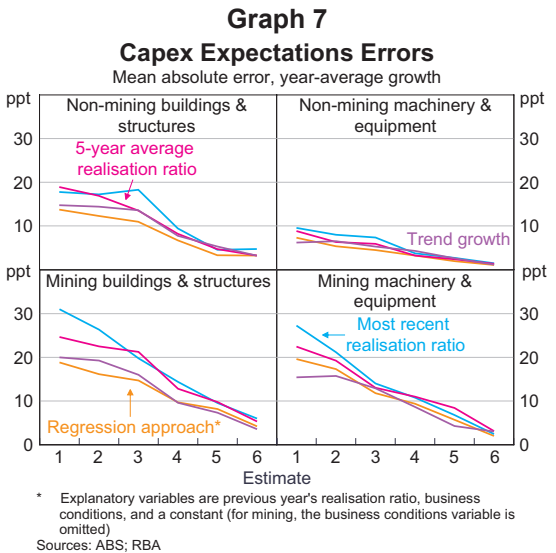
Graph 5
Realisation Ratios
For expectations at the start of the financial year*

* Estimate 3
Sources: ABS; RBA

Graph 6
**Machinery & Equipment Realisation Ratio
and Real GDP Growth**
Financial years

Sources: ABS; RBA

To generate more accurate forecasts from Capex expectations, the data need to be adjusted to account for these characteristics. First, sectors and asset types should be adjusted separately given different tendencies to over- or underestimate future capital expenditure. However, the choice of the appropriate realisation ratio to apply, for each estimate, asset type and sector, is difficult to determine. If the realisation ratio tended to vary randomly, a longer-run average would be likely to be most accurate. In contrast, if the realisation ratio tended to be more persistent, say because it reflected short-run economic dynamics, a shorter average might be more accurate. However, realisation ratios may also be influenced by longer-run business cycle fluctuations, which these approaches may not adequately capture. One alternative approach is to use a simple regression, whereby the current year realisation ratio is estimated as a function of the previous year's realisation ratio (as realisation ratios have demonstrated some persistence year-to-year) and a measure of business conditions (such as from the NAB business survey).

For expectations of capital expenditure growth in a financial year, the regression approach generally produces more accurate forecasts of the actual outcome than using the previous year's realisation ratio, a five-year average realisation ratio, or a naïve forecast of long-run average growth (Graph 7). Moreover, this result generally holds across estimates, asset types and sectors (except perhaps for mining machinery & equipment, in which case a forecast of longer-run average growth tends to perform best) and also against other regression approaches using GDP forecast errors or commodity prices as indicators of cyclical shocks. Nonetheless, the errors are still quite large. For example, for mining buildings & structures, if at the beginning of the financial year (estimate 3) the best estimate using the regression approach was for zero growth, the results suggest that the actual outcome would be between a rise of 15 per cent and a fall of 15 per cent only half of the time. In particular, early estimates of machinery & equipment investment

Graph 7

Capex Expectations Errors

Mean absolute error, year-average growth

*   Explanatory variables are previous year's realisation ratio, business conditions, and a constant (for mining, the business conditions variable is omitted)
Sources: ABS; RBA

are little better, if at all, than a naïve forecast based on long-run average growth, suggesting that these estimates are impressionistic at best. Errors for the realisation-ratio adjustment approaches generally decline with progressive estimates, as the full-year estimates include progressively more actual data, but the errors for estimate six remain surprisingly large, given that three quarters of actual data are available at this time. Forecasts of growth in non-mining machinery & equipment capital expenditure tend to be more accurate than forecasts in the other categories, in line with generally lower growth in this type of investment.

While the full-year expectations data tend to typically attract more attention, the Capex survey from the third estimate includes shorter-term expectations data (that is, the quarter-ahead or half-year expectations). This can also be used for forecasting purposes and provide an indication of how spending will be apportioned through the year. The results indicate that using the quarter-ahead forecasts available in the fourth and sixth estimate produces forecasts that perform as well, or better, than other forecasting approaches. However, the errors generally remain large, tentatively suggesting that a firm's expectations do not improve significantly with shorter horizons.

Box A
A Case Study of Mining Investment

The recent trends in mining investment provide a case study of the usefulness of the Capex survey in forecasting business investment. The latest Capex data suggest that mining capital expenditure fell by 7 per cent in 2009/10, reflecting deferrals of spending by mining firms following the global financial crisis and associated falls in commodity prices. In the two years to June 2012, mining investment increased by over 130 per cent and is expected to post a further sharp increase in 2012/13, underpinned by work on large-scale LNG projects.
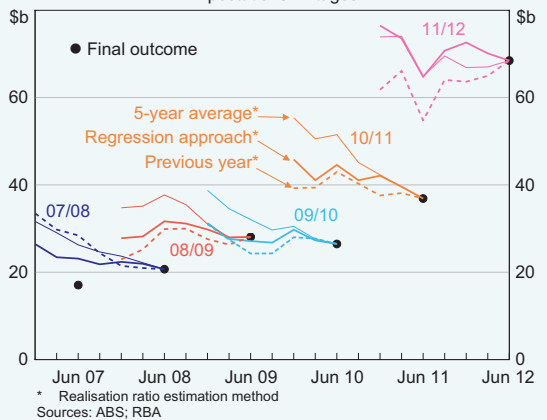
The Capex survey shows how mining companies pared back expectations for capital spending in 2008/09 and 2009/10 during the global financial crisis (Graph A1). Expectations for machinery & equipment spending were scaled back somewhat more aggressively than expectations for buildings & structures investment, which is consistent with spending on buildings & structures investment having a longer lead time.

The Capex survey also predicted the sharp rises in mining investment over the past two years well in advance. The large increase in 2010/11 was predicted by the first Capex estimate for that year, made in the December quarter 2009. At that time, an adjustment of the raw Capex data using the range of approaches outlined in the article would have suggested that mining buildings & structures expenditure in 2010/11 could have increased by between 50 and 110 per cent (Graph A2). Over the course of the next 18 months, however, mining companies responding to the Capex survey gradually revised down their expectations of capital expenditure in 2010/11, resulting in realised spending on buildings & structures investment around 40 per cent higher than in 2009/10, somewhat lower than initially envisaged. Similarly, the Capex survey pointed to a large rise in mining buildings & structures investment in 2011/12, starting with the first estimate for that year made in the December quarter 2010. Again, using a

Graph A1
Machinery & Equipment – Mining
Expectations vintages

* Realisation ratio estimation method
Sources: ABS; RBA
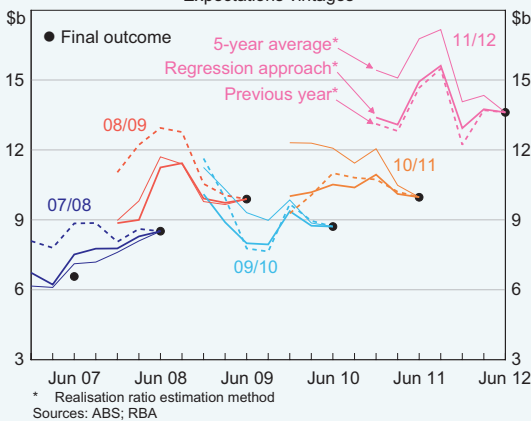
Graph A2
Buildings & Structures – Mining
Expectations vintages

* Realisation ratio estimation method
Sources: ABS; RBA

range of adjustments to the raw Capex data at that time would have suggested an increase in mining buildings & structures capital expenditure in 2011/12 of between 70 and 105 per cent. Expectations of spending were also revised a little lower over time, with the latest Capex survey suggesting that mining buildings & structures investment in 2011/12 increased by 85 per cent.

If used on their own, the Capex expectations data have tended to overpredict the upswing in mining investment over the past two years, with the realisation ratios for both 2010/11 and 2011/12 at the low end of historical experience. This may be because the mining projects under way are large and complex in nature – particularly the projects in the LNG sector – and there have been unanticipated delays in work on these projects. Indeed, the latest expectations data for 2012/13, contained in the June quarter 2012 Capex survey, suggest that mining capital expenditure could increase by anywhere between 30 and 50 per cent. Forecasters must translate these expectations into forecasts for the corresponding national accounts measures, and to gauge the effect on GDP growth they would also need to forecast investment prices over the next year. The experience of the past few years shows that the forecast errors are non-trivial for mining investment, and highlights the fact that the Capex forecasts need to be interpreted with caution and augmented by other quantitative and qualitative data.
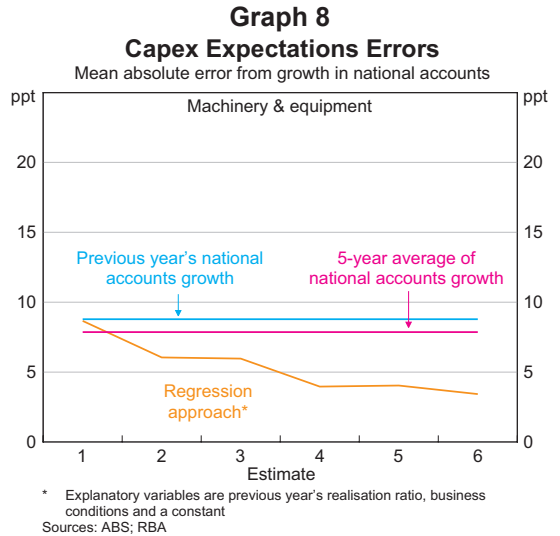
Comparison with the National Accounts

For the Capex survey to be used to forecast the national accounts measure of business investment, these Capex forecasts must be translated into profiles for the corresponding components of business investment, taking account of the differences in terms of the concepts and coverage of the series. To assess the usefulness of Capex expectations, the errors of Capex year-average growth expectations (based on the regression approach) relative to actual growth in the national accounts measure can be compared with two naïve forecasts: year-average growth in the national accounts in the previous financial year and the average growth in the previous five years.[5]

As noted earlier, quarterly movements in the Capex and national accounts measures of machinery & equipment are highly correlated (in both real and nominal terms). However, as the Capex measure has a narrower industry focus, and the national accounts measure also incorporates data from other sources, the two measures can diverge (see Graph 2). This introduces an additional source of error when using Capex expectations to forecast movements in the national accounts measure of machinery & equipment investment. Aside from forecasts based on the first Capex estimate, the Capex expectations outperform both of these naïve forecasts, although for the fourth to sixth estimates the outperformance will partly reflect the inclusion of actual data as the financial year progresses (Graph 8).

As with machinery & equipment investment, the Capex and national accounts measures of buildings & structures investment move in a broadly similar fashion, but owing to the various differences outlined earlier, quarterly and annual changes in the series often differ, sometimes by a substantial margin (see Graph 3). Once again, this introduces an additional

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5 This illustrative analysis using full-year Capex forecasts, for both machinery & equipment and buildings & structures investment, could be replicated using the various half-year and quarter-ahead Capex forecasts.

Graph 8
Capex Expectations Errors
Mean absolute error from growth in national accounts

* Explanatory variables are previous year's realisation ratio, business conditions and a constant
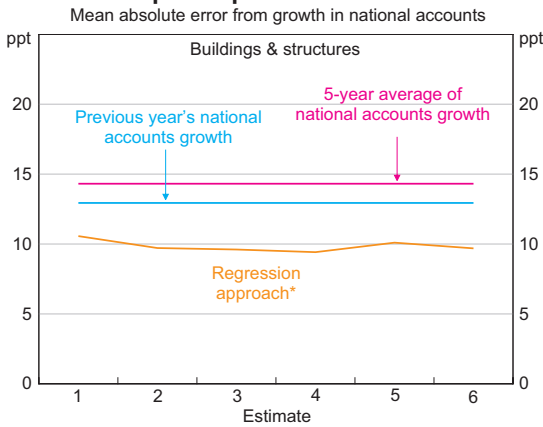Sources: ABS; RBA

source of error when using Capex forecasts to predict movements in the national accounts measure of buildings & structures investment.

The sizeable errors in predicting the actual Capex measure of buildings & structures investment using Capex expectations are compounded when the expectations are used to predict movements in the national accounts measure. As a result, Capex expectations (based on the regression approach) produce large mean absolute errors when used to forecast annual growth in the national accounts measure of buildings & structures investment, but nonetheless easily outperform naïve forecasts (Graph 9). It is notable that little improvement in forecast accuracy is observed with progressive estimates.

This analysis can be put into context by looking at the implications of the June quarter 2012 Capex survey, which provides the third estimate of capital expenditure in 2012/13. The adjusted expectations data (based on the regression approach) imply that the national accounts measure of buildings & structures investment will increase to around 9¾ per cent of GDP, though the results suggest that there is only a 50 per cent chance that the outcome will be between 9 and 10½ per cent of GDP. The same

Graph 9
Capex Expectations Errors
Mean absolute error from growth in national accounts

* Explanatory variables are previous year's realisation ratio, business conditions and a constant

Sources: ABS; RBA

provide a guide to general trends in investment, both across industries and over the near term. In order to generate meaningful forecasts of investment, however, the Capex expectations data need to be adjusted for their systematic bias and their tendency to fluctuate with the business cycle. A simple regression that does this tends to outperform naïve forecasts of growth in national accounts investment. However, the analysis in this article suggests that there are large forecast errors associated with using the Capex survey. Accordingly, forecasts derived from the Capex survey must be interpreted with a fair degree of caution by forecasters, and its use as a forecasting tool should be augmented with other qualitative and quantitative information.

analysis would imply machinery & equipment investment will increase slightly to around 6 per cent of GDP, with a 50 per cent chance that the outcome will be between 5¾ and 6¼ per cent of GDP.

Conclusion

Capex forecasts of nominal growth in capital expenditure that are based on expectations data are useful for forecasting growth in the national accounts measures of business investment. They

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