Abstract

This paper examines how accurate property experts have been in forecasting one and two year office supply. The study covers 12 years of new supply and refurbishment forecasts for Australian state capitals. A range of statistical tests shows that the property expert's forecasts for new supply and refurbished space provided a poor indicator of future office supply. The margin of error suggests that property experts' assumptions on the timing of future supply were imprecise with the trend to overestimate new and refurbished supply, apart for year two refurbishment forecasts, which underestimated future refurbished space. During the office supply cycle, the forecast accuracy varied, with relatively good forecasts for new supply during the oversupply period, compared with high forecast error during the low supply period. A more robust analysis of future supply could be achieved using probability analysis on the timing of new supply, and employing econometric modelling techniques for refurbishment forecasts to link property and space market conditions to office lease expiry profiles.

Introduction

Forecasts are crucial when making major commercial property decisions. This has led to considerable emphasis being placed on understanding property market structure and the relationship with space, capital and property supply market determinants. The changing macroeconomic environment has previously focused property research on space and capital market drivers, as property supply has traditionally been viewed in the short term as being inflexible and within known supply parameters. This needs to be examined further to establish the credentials of property supply forecasts.
Office is to The survey, price used to calculate total office stock, which Market Property Council divides build­ used to deflate in indices dynamic The IillIII, and accurac~ the behaviour of the prop­ 100NU5TRAlIAN by the issues of commercial confi­ Similarly, Key et al (1994) noted the basic theory underlying property performance is, in essence, very simple: rents are the price resulting from the interaction between total occupier requirement for space and the space available to satisfy demand. The interplay leads to the extent of new supply forming a key determinant when modelling property market performance.

In identifying the importance of property supply data in property market models, Ball and Tsolacos (2002) expressed concern as to the accuracy of the UK government construction data. The issue relates to the way construction data is compiled, with the impact of large projects, the cost indices used to deflate current price data, missing information and the addition of unrecorded output and estimates. Such problems make the construction data relatively poor bases upon which to formulate property market forecasts.

The role of judgment in the forecasting process has long been a subject of analysis. Empirical evidence on judgmental forecasts is frequently illustrated using published evidence on specific events (see Makridakis et al, 1998, Delurgio 1998). Analysis of judgmental predic­tions follows the quantitative approach with reference to forecast accuracy tests. The failures of judgmental forecasts are well documented with Makridakis et al (1998) providing a table summarising the impacts and sources of judgmental bias.

The quality of the property supply forecasts needs to be established for accuracy and effectiveness. A measure of accuracy is the forecast "goodness of fit" to actual supply with a comparison to a naive forecast providing a gauge of effectiveness. Combining the information can establish the capability of property experts to provide property supply forecasts. This will assist property decision-makers, especially during different stages of the property cycle.

The remainder of the paper is divided into five sections. Firstly a literature review details the research behind the topic. Secondly a section discusses the forecast supply property data and thirdly the methodology for measuring forecast errors is examined. The results and a conclusion follow.

Literature Review

A large body of property research has examined the way in which the wider economy affects property (for example: London Economics 1998, Ball et al, 1998, DiPasquale and Wheaton 1996). Frequently illustrated is the 'cobweb theory', where the dynamic behaviour of the property market is demonstrated with short-term demand changes interacting with long-term supply characteristics.

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The use of construction data in Australian property market models is shown by the Higgins (2000) survey of 15 Australian organisations that provide property forecasts. The survey, limited by the issues of commercial confidentiality, did however show construction activity was a leading forecast determinant in Sydney CBD prime office rent models, and that retrospective analysis of the forecasts and property model inputs was deficient. The absence of a standard approach to accurately measure forecast error restricts the usefulness of the property forecasts.

A common approach in past property research was to accept forecasts based on the property model historical relationship with the actual data series. More recent articles, such as Chaplin (2000), Thompson and Tsolacos (1999) and Wilson et al (2000) have provided short-term, out-of-sample (ex-ante) forecast accuracy tests which highlighted that a good fit with historical data may have limited predictive powers. Analysis of ex-ante forecast error translates into measuring the quality of the forecast method and so provides a valuable tool in the property decision-making process.

For over 20 years, the Property Council of Australia (and its predecessor, the Building Owners and Managers Association) has compiled a comprehensive inventory of usable office space and projected supply in major Australian office markets. The office stock database includes details of building names and completion dates, quality grades, net lettable areas, ownership and building vacancy on a direct and sub-lease basis. This in­ventory is used to calculate total office stock, vacancy, supply, withdrawals and absorption.

As part of the office inventory, the office stock is graded. The Property Council divides build­ings into five quality categories according to size, location, building finishes and technical services. The Property Council of Australia office grades generally correspond with North American (NCREIF) and European (IPD) property index, although the category classifications vary. Market definitions can be supplied by the index providers.

Australian Prime office space relates to Premium and A grade buildings, whereas secondary office space accounts for the remaining B, C and D grade buildings. Prime office space provides the benchmark rental in Australia. Building features include the outlook, largely column-free floorplates, a multi-zoned air conditioning system, security key card access and short waiting intervals for lifts.

This paper analyses the Australian capital city office market. Figure 1 shows the com­position and size of the Australian office market at December 2002. As at December 2002 there were 11.6 million square metres of office stock in Australia's
likely future condition of the Australian office market. Knowledge of future office supply is a significant tool in commercial property decision making.

**Methodology**

Forecasts can be examined for both accuracy and effectiveness. Visual analysis together with statistical tests can show any systematic forecast errors which include the number and magnitude of over and underestimates of forecast values; whether the forecasts are improving with time; and if changes in the forecast error are associated with particular phases of the office supply cycle.

**Forecast Effectiveness**

Evaluating forecast models can relate to their effectiveness compared with alternative forecast methods. Comparisons can be to a simple naive standard or a simple adjustment to the judgment model. The Theil’s (1966) U coefficient test indicates whether a forecaster’s errors are significantly smaller than those of a benchmark. A frequently used naive standard compares a forecaster’s error with those obtained from a no change (random walk) naive model. In this instance, it is the most recent observation available prior to the forecast period.

Theil’s U test

\[ U = \frac{\text{RMSE of the forecasting model}}{\text{RMSE of the naive model}} \]

Comparing the RMSE (standard error) of the forecast model values to naive model values Theil’s equation provides a U value, which can be summarised as follows:

(i) \( U = 1 \) the naive model is as good as the forecast model.

(ii) \( U < 1 \) the forecast model is better than the naive model.

(iii) \( U > 1 \) the naive model is better than the forecast model.

A naive model can serve as an appropriate minimum standard of comparison, however with large annual supply variations an additional Theil U test can relate to the timeliness of the office supply. This examines if the property experts can predict when the office supply will occur. In this case, the forecast error value for each period is applied equally to the previous and next forecast period.

**Forecast Accuracy**

Forecast accuracy can be measured by how close the forecast values are to actual values. The methods to measure forecast accuracy generally embody either the absolute values of the error or the square of the errors, to prevent positive and negative forecast errors cancelling each other out. To evaluate the accuracy of the property performance forecasts, both systems were applied with the Mean Absolute Percentage Error (MAPE) and Root Mean Square Error (RMSE) tests. The statistical equations are detailed in the appendix.

When analysing data, Makridakis et al. (1998) explains there are issues with both statistical equations as with the MAPE test you can get extremely high percentage errors with low actual values. Likewise, as the RMSE test squares the forecast errors, a large data spread could affect the results. Therefore the forecast error data was examined initially for outliers and observations selected within +/- two standard deviations (95%) of the mean.

![Figure 1: Australian State Capital Office Market](image-url)

Prime office space 42%

Secondary office space 58%

Source: Property Council of Australia 2003

state capital CBDs. More than 200 prime office buildings, totalling 4.9 million square metres, represent the prime office space and account for between 32 and 56 percent of each state’s capital office stock.

The composition of state capital office markets limits new supply, as prime office buildings are rarely demolished and redeveloped, while there is a choice for secondary grade office buildings to be either redeveloped, refurbished or to undergo a change of use to residential apartments. This would indicate that while new developments will continue to occur in these office markets, refurbishment will form an important part of the future office supply and is a key component in the office supply cycle.

At the same time as the office inventory survey, the Property Council of Australia collects office supply data. A broad range of information is collated from a survey of owners, developers, agents and architects. Information on new supply and refurbishments includes the development timeline, completion date, lettable areas (office, retail, showroom, etc.), typical floor areas and space precommitments. Once this information has been compiled in a detailed schedule, it is vetted by a committee of industry specialists who collectively review details of each new construction, full refurbishment and partial refurbishment project, and assess the project’s expected or mooted viability. Each new and refurbishment project requires a certificate for occupation to verify completion.

The comprehensive office market information in the Property Council of Australia’s Australian Office Market Report is used extensively and provides a benchmark for the current and upcoming period.
Results

For the 12 years to December 2002, office supply in Australian state capitals expanded by 1.0 percent on average per annum. The low office supply was due to a major downturn in the early 1990s which signalled a more cautious approach for new development with substantial tenant precommitments required. During this period the availability of existing office space placed pressure on property owners to upgrade their buildings to compete and attract tenants. The movements between new and refurbished supply can be compared with vacancy levels. See Figure 2.

Figure 2 shows the structural change in Australian office supply. The oversupply in the early 1990s created an unsustainable 5.2 percent annual increase in the total office stock. The office market down cycle was rapid and by the mid 1990s new office supply was nearly zero. More recently, the fluctuating low office supply growth pattern appears to provide evidence of an efficient marketplace.

Table 2 details the Property Council of Australia's one and two year forecasts for new office supply in the Australian state capitals. Table 2 shows that year one and two forecasts generally overestimated the supply of new office space. For the 12 years, the year one forecasts overestimated for eight years with a mean forecast error of -7.5 percent compared with the year two forecast of seven years with a mean forecast error of -13.8 percent. The forecast error varies between years and there was no evidence of forecast accuracy improving with time, or by combining year one and two forecasts.

However, new supply forecast errors varied during the office supply cycle. Large office supply in the 1991–1993 period yielded a minimal year one mean error of -0.8 percent compared with the high -36.3 percent mean error associated with the low new supply of the 1995–1998 period. This suggests that expert forecasts were biased towards a positive office development outlook during the low new office supply period.

The two year forecasts offered a contrast with a wide range of forecast errors including two forecasts of virtually no error (1994 and 2000).

The changes in the office supply cycle illustrate the emergence of refurbished space as a source of supply.

The supply of office space relative to property market demand can lead to distinct office supply phases. These occur over periods of years and can be grouped together as in Table 1. The changes in the Australian office market are evident as shown by the emergence of refurbished space in the mid 1990s which provided an attractive alternative to new office supply. The swing between new and refurbished space can affect office supply forecasts. Importantly, refurbishment appears to be less affected by movements in the office cycle as a single floor to the complete building can be refurbished.

The forthcoming office supply should be assessable with a long construction timelines and substantial development costs. In addition there is data on space precommitments and lease expiry profiles of major space occupiers. Information is extensive and should provide the property experts with the tools to extrapolate with some certainty about future office supply.
The forecast error appears arbitrary, although since 1995, forecasts have exhibited a two- or three-year pattern alternating between positive and negative error. The systematic error can be linked (with some success) to economic conditions at the time of the forecasts. The property experts overestimated the rate of supply during strong economic growth and underestimated it during a slowdown in the economy, even though development timeframes would suggest that new developments should be well into the building construction phase.

Table 3 shows that office refurbishment forecasts have contrasting patterns of forecast error. The year one forecasts overestimated actual supply for seven years with a low, mean error of 0.3 percent. This compared with an underestimation by year two forecasts of 10 years with a high mean error of 63.9 percent. The contrast in the refurbishment forecasts initially suggests that those preparing the forecasts have a good knowledge of current office refurbishment. Beyond the one year period, refurbishment forecasts may need to use an alternative forecasting approach.

Table 3: Australian State Capitals Refurbishment Forecasts 1991–2002

<table>
<thead>
<tr>
<th>Year</th>
<th>Actual</th>
<th>Year One</th>
<th>Year Two</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Refurbishment</td>
<td>Forecast</td>
<td>Error</td>
</tr>
<tr>
<td>1991</td>
<td>48,000</td>
<td>50,206</td>
<td>-2,206</td>
</tr>
<tr>
<td>1992</td>
<td>139,800</td>
<td>74,800</td>
<td>65,000</td>
</tr>
<tr>
<td>1993</td>
<td>61,000</td>
<td>45,200</td>
<td>15,800</td>
</tr>
<tr>
<td>1994</td>
<td>142,900</td>
<td>129,000</td>
<td>13,900</td>
</tr>
<tr>
<td>1995</td>
<td>85,400</td>
<td>89,300</td>
<td>-3,900</td>
</tr>
<tr>
<td>1996</td>
<td>138,200</td>
<td>195,200</td>
<td>-57,000</td>
</tr>
<tr>
<td>1997</td>
<td>122,100</td>
<td>129,900</td>
<td>-7,800</td>
</tr>
<tr>
<td>1998</td>
<td>241,233</td>
<td>211,000</td>
<td>30,233</td>
</tr>
<tr>
<td>1999</td>
<td>156,124</td>
<td>120,800</td>
<td>35,524</td>
</tr>
<tr>
<td>2000</td>
<td>229,170</td>
<td>244,200</td>
<td>-15,030</td>
</tr>
<tr>
<td>2001</td>
<td>69,467</td>
<td>95,157</td>
<td>-25,690</td>
</tr>
<tr>
<td>2002</td>
<td>83,887</td>
<td>128,597</td>
<td>-44,710</td>
</tr>
</tbody>
</table>

The maximum positive and negative forecast errors appear to be unrelated, as the dates for the major forecast errors in year one did not appear a year later in year two. This would suggest each forecast appeared to be made separately and is unrelated to previous forecasts, with little evidence of back testing.

Table 4 examines the historical accuracy of the new supply and refurbishment forecasts. Preliminary data analysis shows the new supply forecast contained outliers (+/- two standard deviations) in the new supply forecasts (year one: 1994 and year two: 1998). These were excluded from the forecast accuracy and effectiveness test data. Both the MAPE and RMSE test revealed high error readings, which deteriorated from year one to year two forecasts. The contrast between year one refurbishment and new supply results was due, in part, to refurbishment forecast error being in a narrower range but which contained individual values with high forecast error. The extent of the error in new supply and refurbishment forecasts would be of concern to property decision-makers.

Table 4: Descriptive Statistics of the Forecast Error

<table>
<thead>
<tr>
<th></th>
<th>New Supply Forecasts</th>
<th>Refurbishment Forecasts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year One</td>
<td>Year Two</td>
</tr>
<tr>
<td>Mean</td>
<td>-14,024</td>
<td>-25,687</td>
</tr>
<tr>
<td>Standard error</td>
<td>8,005</td>
<td>20,725</td>
</tr>
<tr>
<td>Median</td>
<td>-15,500</td>
<td>-9,500</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>27,729</td>
<td>71,794</td>
</tr>
<tr>
<td>Skewness</td>
<td>-0.63</td>
<td>-0.90</td>
</tr>
<tr>
<td>Range</td>
<td>103,551</td>
<td>253,169</td>
</tr>
<tr>
<td>Minimum</td>
<td>-73,800</td>
<td>-182,825</td>
</tr>
<tr>
<td>Maximum</td>
<td>29,751</td>
<td>70,344</td>
</tr>
</tbody>
</table>
Appendix

(i) Mean absolute percentage error (MAPE)

\[ \text{MAPE} = \frac{1}{n} \sum_{t=1}^{n} \frac{|P_t - E_t|}{E_t} \]

(ii) Root mean square error (RMSE)

\[ \text{RMSE} = \sqrt{\frac{1}{n-1} \sum_{t=1}^{n} (P_t - E_t)^2} \]

Where: 
- \( P_t \) is the forecast error in time period \( t \),
- \( E_t \) is the measure of the error to actual ratio in time \( t \),
- \( n \) is the number of observations in the forecast period.

Source: Delurgio 1998

References


Table 5: Forecast Accuracy and Effectiveness Tests

<table>
<thead>
<tr>
<th></th>
<th>New Supply Forecasts</th>
<th>Refurbishment Forecasts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year One</td>
<td>Year Two</td>
</tr>
<tr>
<td>Forecast Accuracy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean absolute percentage error</td>
<td>29%</td>
<td>67%</td>
</tr>
<tr>
<td>Root mean square error</td>
<td>22,098</td>
<td>53,256</td>
</tr>
<tr>
<td>Forecast Effectiveness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>U Value - Naive forecast</td>
<td>0.21</td>
<td>0.20</td>
</tr>
<tr>
<td>U Value - Timing Error</td>
<td>0.82</td>
<td>1.58</td>
</tr>
</tbody>
</table>

Conclusion

This paper considers the quality of Australian office supply forecasts over the past 12 years. Panels of local property experts provide the regular one and two year new supply and refurbishment forecasts in the bi-annual Property Council of Australia's Australian Office Market Report. This research examines the Australian state capital cities which, during this period, exhibited distinct office supply cycle phases. The nature of property with long construction time frames and recorded office lease expiry profiles should deliver some certainty for office supply forecasts. In contrast, the forecasts exhibited over time a wide range of forecast errors, which restricts the applications for this data in property market models.

Overall, the forecast accuracy deteriorated between year one and year two forecasts. The trend was to overestimate new and refurbished supply, apart from year two refurbishment forecasts, which seriously underestimated the future refurbished space. During the office supply cycle, the forecast accuracy varied, with relatively good new supply office forecasts during the over-supply period (1991-1994), compared with high forecast error during the period of low office supply (1995-1998). The year one refurbishment forecasts appeared to rotate on a two- and three-year cycle from over to underestimating the forecast refurbished supply.

Forecast errors appear arbitrary for both new supply and refurbishment forecasts from year one to year two. There is little evidence that forecasts have improved over time, with deficiencies invariably existing in forecasting the timeliness of future office supply.

There is a strong case for improving the forecasting approach, this could be achieved by including probability analysis on the timing of new supply and the employment of econometric modelling techniques for refurbishment forecasts to link property and space market conditions to office lease expiry profiles. An increase in the forecast accuracy record would assist with the challenges in modelling the commercial property markets.

' there is a strong case for improving the forecasting approach '

It is less clear if property experts have the ability to correctly gauge the supply timetable. Adjustment to the property expert forecasts based on the surrounding forecast errors provided values similar to superior Theil U values. This suggests that property experts have difficulty forecasting projected completion dates. Probability analysis forming part of the judgmental forecast process should improve forecasting performance. This is when forecast supply for a specified time period is close to either the previous or next time period, they a proportion of the forecast supply should be allocated to the adjoining time period.

The forecast accuracy and effectiveness tests demonstrated the limitations of property experts providing office market supply forecasts. The discrepancies in new space and refurbishment forecasts appear unrelated. The lower forecast error in year one new supply forecasts suggests that those preparing the forecasts have a better knowledge of the expected new supply than of refurbishments.

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