INNOVATIVE ASSET MANAGEMENT

Full Paper

FORECASTING PROPERTY PERFORMANCE

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ABSTRACT

The office construction industry is driven by space supply and demand which are, in turn, driven by the vitality of the commercial property market and the economy. International research has defined the key determinants for propelling new office space supply as: rent levels; vacancy rates; existing stock; office based employment growth; and the level of economic activity. Office markets, internationally, have at times through history experienced the spectre of space oversupply causing financial adversity for construction industries, commercial property markets and economies.

Initially, this paper examines the success, or otherwise, of property market modelling in the international context to determine its potential for mitigating the advent of office space supply shocks. More specifically, the market history and forecasts for the Australian city of Brisbane are examined to explore the financial performance impacts on four individual office towers built in four different decades. Building specific modelling is used to derive evidence of market impacts on property values. The physical attributes of the individual buildings are considered in terms of their past and future contributions or impediments to the overall investment performance of the properties.

The findings illustrate the importance of modelling the functional performance of CBD office buildings with the inclusion of professional capital expenditure projections and plausible property market and economic forecasts. The potential benefits to be derived by property owners and developers include the optimisation of returns and the provision of a decision support tool for astute selection of buy, sell, hold and refurbish options.

Keywords:
Office Buildings, Forecasting, Econometric Modelling, Discounted Cash Flows

1. INTRODUCTION

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Property valuers, analysts and fund managers rely on discounted cash flow analysis techniques as a main method of assessing values and investment returns for established commercial buildings and assessing viability measures for proposed commercial developments. Surveys of major property fund managers based in Sydney and Melbourne (Parker, 2003) and of prominent valuation firms in the Brisbane Central Business District (Cowley, 2004) have confirmed the reliance property professionals place on this method. Discounted cash flow analysis requires the forecasting or projection of the net cash flow stream from a building or development and the discounting of this cash flow back to a present value using a market derived discount rate. In the case of a proposed development, the discount rate is the developer's required rate of return and the analysis determines whether the proposal is viable within their required parameters. The analysis also establishes what price a developer can afford to pay for a site while maintaining the viability of the project.

In order to provide some guidance on this assessment process, an extract from a sample cash flow study is inserted below with descriptive annotations.

Total Capital Discounted Cash Flow Analysis — 111 George Street

Annual cash flow forecast for the 10 year period 1 Jul 2003 to 30 Jun 2012

Key Assumptions	
Holding Period	10 years
Assessment Intervals	Monthly
Discount Rate	10.50%
Effective Monthly Discount Rate	0.836%
Terminal Cap Rate	8.25%

Results		
ESTIMATED PRESENT VALUE	10.5% discount rate	104,646,348
Less Purchase Costs		-
ESTIMATED CURRENT MARKET VALUE		104,646,348
MARKET VALUE Purchase Price Say		**$ 104,650,000**

Annual Term Commencing	01-Jul-03	01-Jul-04	01-Jul-05	01-Jul-06	01-Jul-07	01-Jul-08	01-Jul-09	01-Jul-10	01-Jul-11	01-Jul-12	01-Jul-13
Period	0	1	2	3	4	5	6	7	8	9	10
GROSS INCOME											
Retail Rental Income	62,330	62,479	63,697	69,446	78,993	84,996	85,961	85,961	85,961	85,961	85,961
Commercial Rental Income	9,597,595	9,597,595	9,665,901	9,665,901	12,359,571	12,359,571	13,109,498	13,109,498	13,109,498	13,109,498	13,109,498
Car Park Rental Income	440,700	440,700	452,727	452,727	589,188	589,188	637,156	637,156	637,156	637,156	637,156
Naming Right Income	-	-	-	-	-	-	-	-	-	-	-
Communication Income	22,080	22,454	23,123	24,087	24,999	25,666	26,178	26,792	26,270	26,908	26,367
Storage Income	81,317	81,317	93,623	93,623	119,714	119,714	126,978	126,978	126,978	126,978	126,978
Total Gross Income	**10,204,022**	**10,204,545**	**10,299,071**	**10,305,784**	**13,172,465**	**13,179,135**	**13,985,771**	**13,986,385**	**13,985,863**	**13,986,501**	**13,985,960**
EXPENSES											
OPEX Inclusive of Land Tax	2,173,504 -	2,223,599 -	2,304,428 -	2,401,734 -	2,480,959 -	2,536,313 -	2,587,792 -	2,653,261 -	2,597,707 -	2,665,592 -	2,608,017
Bad Debt and Vacancy Allowance	-	-	-	-	-	-	-	-	-	-	-
Incentives and Agents Commission	-	-	-	-	-	-	-	-	-	-	-
					-	-	-	-	-	-	-
Net Income	**8,030,519**	**7,980,946**	**7,994,642**	**7,904,050**	**10,691,505**	**10,642,823**	**11,397,979**	**11,333,124**	**11,388,156**	**11,320,910**	**11,377,944**
CAPITAL EXPENDITURE											
Total	393,457	383,917	736,707	504,984	987,217	957,470	979,492	775,801	979,492	775,801	979,492
NET TERMINAL VALUE											
Sale Price	-	-	-	-	-	-	-	-	-	134,485,695	-
Less Sale Costs	-	-	-	-	-	-	-	-	-	2,689,714	-
NET CASH FLOW	**$ 7,637,062**	**$ 7,597,029**	**$ 7,257,936**	**$ 7,399,066**	**$ 9,704,288**	**$ 9,685,353**	**$ 10,418,487**	**$ 10,557,323**	**$ 10,408,664**	**$ 142,341,089**	**$ 10,398,452**
Running Yield on Purchase Price	7.7%	7.6%	7.6%	7.6%	10.2%	10.2%	10.9%	10.8%	10.9%	10.8%	10.9%

Figure 1 – Sample Discounted Cash Flow Analysis for Office Building – Source – CRC for Construction Innovation (2004)

1	Some key assumptions including the selected discount rate and terminal yield
2	Annual gross rent income figures for the different space categories
3	Line entries for monthly operating expenses, vacancy allowances and incentives
4	Capital expenditure projections
5	Calculated terminal sale price and selling expenses
6	Building's projected net cash flow including net sale proceeds less selling costs
7	Running yield on purchase price giving annual net return on initial investment
8	Cash flow analysis output displaying the property's rounded present value

Without specifying full technical details, brief explanations of some of the terms used in this model include:

- Terminal yield – market derived multiplier used to estimate the value of the property at the end of the study period;
- Vacancy allowance – provision for the loss of future building income due to space becoming vacant and the anticipated time taken to re-let the space;
- Incentives – inducements offered to encourage new or existing tenants to sign new leases; and
- Capital expenditure – projected costs of replacing or upgrading major building services, structural components and finishes.

As can be seen in the structure of this model, the net cash flow stream is determined by deducting projected building operating expenses, capital expenses and various allowances from the building's predicted rental income and sale price over the study period.

The purpose of this introduction to discounted cash flow studies is to emphasise the role forecasts play in determining the value and investment performance of commercial properties as well as the viability of commercial development proposals. The studies are influential in guiding development and, therefore, propelling construction activity in city and urban areas. Additionally, measures of the viability for rural ventures can rely on such studies (McCarthy, 2004).

This leads to the question as to how commercial building rent forecasts are formulated for cash flow studies.

2. LITERATURE REVIEW

2.1 RENT FORECASTING

Research on office rent forecasting has had an intrinsic association with property market modelling involving the development of equations that simulate the markets' responses to changes in various determinants. Correlation analysis using historical data has generally been used to identify the property market and economic variables that influence changes in the levels of office rents. Once the explanatory variables have been established, experimentation and testing is undertaken to estimate an equation with best historical fit. This equation is then

used to "cast" forward rental values based on changes (or forecast changes) in the rent determinants, sometimes referred to as leading indicators (Chaplin, 2000).

Rosen (1984) signalled a problem in forecasting methods stating "*trend-line accounting techniques*" used at the time were inadequate in replicating the supply and demand relationships in the property market. He then proceeded to develop a multiple equation model to represent the relationships in an American office market. The main determinant chosen for the rent equation was the variation between the "optimal" office vacancy rate and the actual prevailing vacancy rate. This concept resurfaced in much of the subsequent American research (such as Wheaton, 1987; Wheaton & Torto, 1988; and Shilling, Sirman & Corgel, 1987). However, the "optimal" vacancy rate received several different names, including "desired", "structural", "natural" and "equilibrium" vacancy rate. Generally, the concept considered the office market vacancy rate to be mean reverting and the difference between the prevailing vacancy rate and the long-term average vacancy rate significantly influenced the future direction of rental levels.

During the same era research occurring across the Atlantic (Gardiner and Hennerberry, 1988:36) raised similar concerns about the methods used for forecasting office rents. It was stated that foregoing studies were, "*theoretically weak, methodologically under-developed or of limited practical application*" and the authors set out with an objective of "*constructing a theoretically sound, empirically based, rent prediction model*". Notably this study commenced a long-term inconsistency between American and British research with the adoption of a demand-side variable (Gross Domestic Product) as the key office rent determinant rather than the US supported vacancy rate variable. In addition, Gardiner and Henneberry argued rent forecast models should formulated on a "spatially disaggregated" basis rather than on a national basis due different market influences existing in different localities.

Subsequent research (Clark & Dannis, 1992) suggested rent forecasts should be linked to construction costs and investors' required rates of return.

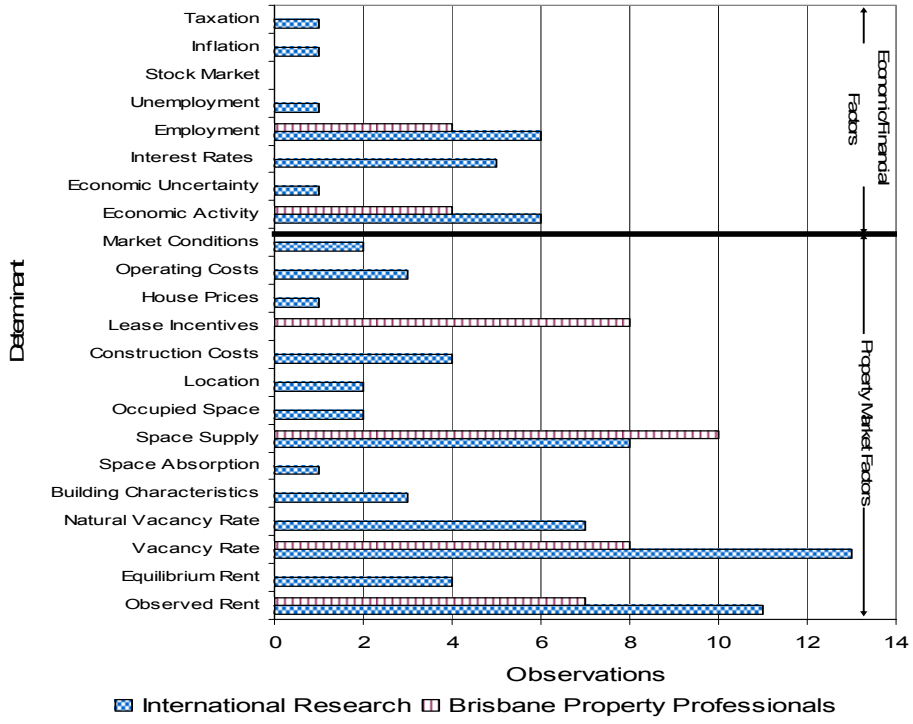
Further English studies (Giussani, Hsia & Tsolacos,1993 and Giussani & Tsolacos, 1993) examined rent determinants in ten European cities including London. The focus continued on Gross Domestic Product and office based employment as the key drivers of rent levels. Some difficulties were encountered in modelling European city markets aside from London.

Several models have been developed with the aim of forecasting rents at an individual building level based on the physical characteristics of the buildings and their locations within cities (Glascock, Kim & Sirmans, 1993; Dunse & Jones, 1998; and Dunse & Jones, 2002). A notable omission in research to date is the lack of a link between the individual building rent models and the "citywide" rent forecast models.

More recent rent models (DiPasquale & Wheaton, 1996 and Hendershott, Lizieri & Matysiak, 1999) have included an "equilibrium" rent determinant suggesting the level of office rent is mean reverting. However, in terms of previous assumptions that "equilibrium" vacancy rates are constant through time, a recent study has proposed that they are at least partly "time-varying" and models should make allowances for these variations (Tse & Fischer, 2003).

Published Australian research on rent modelling has been very limited. Commercially used models are rarely published for intellectual property reasons and this has been the experience overseas (Mitchell & McNamara, 1997). An attempt was undertaken to adapt the Royal Institute of Chartered Surveyors' London rent model to the Sydney market with little success due to market and data incompatibilities (MacFarlane, Murray, Parker & Peng, 2002). This trial did, however, find a strong linkage between Sydney's vacancy rate and the level of office rents prevailing in the city. Murray (2000) had also adopted the vacancy rate with new space supply as the main drivers for her earlier published model for Sydney. Conversely, Higgins (2000) adopted Gross Domestic Product, inflation and interest rates as explanatory variables for Sydney CBD rents, but found the reliability of macroeconomic forecasts needed for the single equation to be a serious handicap to the accuracy of office rent forecasts.

In summary it is interesting to observe a comparison of the relative level of use of different explanatory variables in 22 rent models developed internationally and detailed over time in literature on the subject. The following chart illustrates this analysis as well as superimposing the views of Brisbane property professionals on the city's office rent drivers established from an interview survey (Cowley, 2004).



This representation clearly shows a research and industry reliance on observed rents, vacancy rates and space supply as the property market drivers in modelling and forecasting office rent. Local property professionals also see lease incentives as a significant influence. A consensus exists on adopting economic activity and office based employment as the key economic explanatory variables.

2.2 SPACE SUPPLY FORECASTING

The literature has nominated office space supply as a significant determinant of office rent levels. There has also been significant research indicating oversupply in office markets has, over time, amplified the cyclical nature of commercial property markets. Office building development lags have been credited with at least partially generating "*powerful, pervasive and self-replicating*" cyclical forces within the commercial property market (Barras, 1994). The periodic historical misallocation of resources to office construction has also been said to have been cause of financial distress in the industry and, on a wider scale, a significant factor in precipitating the last Australian recession (Kummerow, 1997). In referring to the United States office space oversupply event in the late 1980s, Gallagher and Wood (1999) said the market was prone to overbuilding and this was known to cause the poor performance of office property. Mueller (1999) coined the term "hypersupply" of office space and indicated the cause as being the lag between demand growth and supply response.

Thirteen internationally office space supply models were identified through an analysis of literature on the subject. The space supply determinants adopted by the researchers are shown in *Table 1* and *Chart 2*, below, summarises the relative dominance of the adopted variables.

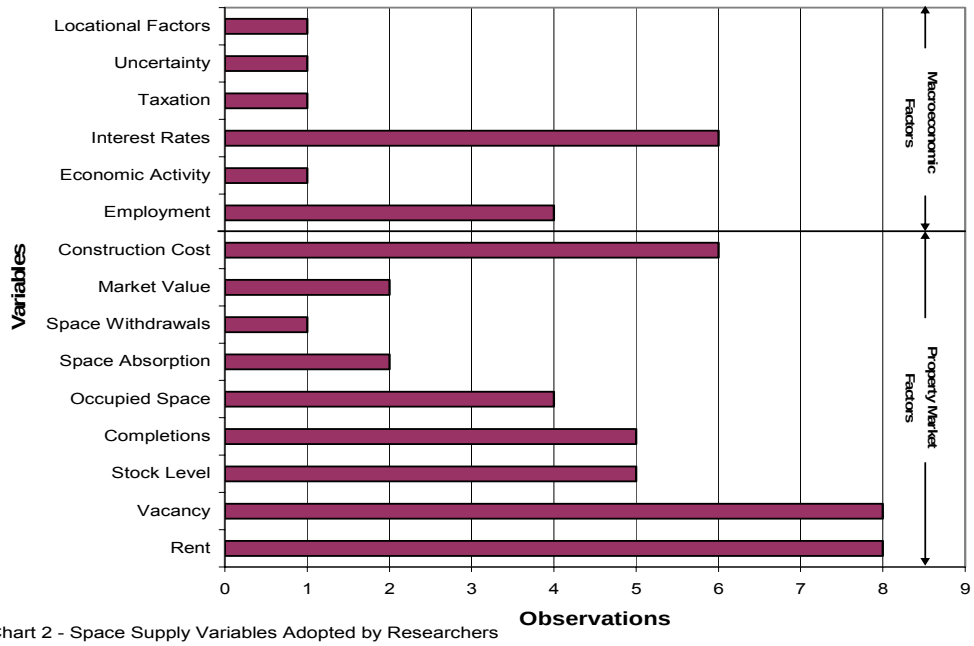


Chart 2 - Space Supply Variables Adopted by Researchers

Researcher(s) / Year	Rent	Vacancy	Stock Level	Completions	Occupied Space	Space Absorption	Space Withdrawal	Market Value	Construction Cost	Employment	Economic Activity	Interest Rates	Taxation	Uncertainty	Locational Factors
Rosen (1984)	■	■						■	■	■		■	■		
Hekman (1985)	■								■	■		■			
Wheaton (1987)	■	■	■	■	■				■	■		■			
Gardiner & Henneberry (1988)			■	■	■										
Hendershott, Lizieri & Matysiak (1996)	■	■													
DiPasquale & Wheaton (1996)		■	■	■	■	■									
Wheaton, Torto & Evans (1997)	■	■							■			■			
Viezer (1999)			■		■			■	■						
Tsolacos & McGough (1999)	■										■			■	
Sivitanidou & Sivitanides (2000)	■			■					■	■		■			■
MacFarlane & Moon (2000)		■	■												
MacFarlane, Murray, Parker & Peng (2002)	■	■					■								
Tse & Webb (2003)		■		■		■						■			
Observations	**8**	**8**	**5**	**5**	**4**	**2**	**1**	**2**	**6**	**4**	**1**	**6**	**1**	**1**	**1**

Table 1 – Office Space Supply Explanatory Variables Adopted by Researchers

From this summary it is possible to distinguish rent, vacancy rates, lagged completions and construction costs as the most represented property market variables while employment and interest rates appear as the dominant macroeconomic variables used to model and forecast office space supply.

Despite there being a significant amount of literature on the subject, little evidence of successful out-of-sample space supply forecasting has emerged. A study of office space supply forecasts in Australia (Higgins, 2003) found past short-term forecasts were lacking accuracy, even beyond a period of just 12 months. The difficulties of predicting the levels of refurbished space re-entering the office market was nominated as one cause of the shortcomings.

3. SAMPLE OFFICE MARKET – BRISBANE CBD

3.1 LAND USE PROFILE

Brisbane is the capital of the Australian State of Queensland and is the third largest Australian central business district in terms of office floor area with a total net lettable area of approximately 1.65M square metres.

An analysis undertaken using data collected from the Cityscope (2003) publication, indicates that the total developed lot area in the Central Business District is approximately 74 hectares, including 447 individual properties. After allocating primary land uses to each of these properties, the apportionment of developed land area to each use is represented in the following chart.

Brisbane CBD Land Uses by Area

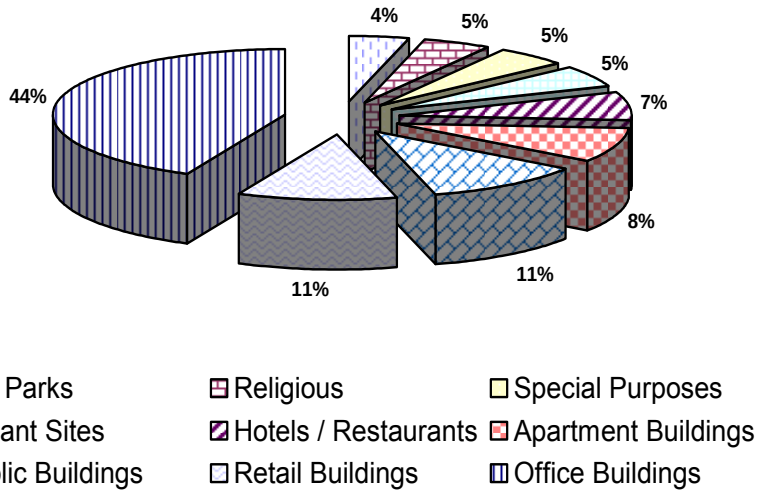


Chart 3 – Brisbane Central Business District Land Use Apportionment Based on Land Area

The dominant land use is office buildings occupying about 44 percent of the city's developed land or nearly 32 hectares. Retail uses occupy about eleven percent and a similar area is used for public buildings, such as, for example, law courts and city hall. Residential apartment buildings, either established or under construction, cover approximately 7.5 hectares or about eight percent of the total land area. At the time of writing this included approximately 4,972 apartments. Eight apartment towers under construction are incorporated in these figures. These new towers are to include 1,356 units and this provides an indication of the current dominance of residential construction activity as opposed to commercial development with only three office towers under construction. Vacant sites only amount to five percent of the CBD or about five hectares in total.

3.2 OFFICE BUILDING PROFILE

Looking more specifically at the office buildings within the confines of the CBD, further analysis of the data derived the following apportionment of building sizes, land area usage and floor areas.

Building Size	Building Number	Land Area Usage	Total Floor Area (NLA)
< 2,000m²	38	19,701m²	42,941m²
>2,000m² <5,000m²	38	31,228m²	132,930m²
>5,000m² <10,000m²	37	43,297m²	258,716m²
>10,000m² <20,000m²	36	94,230m²	526,166m²
>20,000m² <30,000m²	19	74,896m²	476,945m²
>30,000m²	7	37,075m²	286,026m²

Table 2 – Brisbane Central Business District Building Sizes, Land Area Usage and Floor Areas

This analysis indicates that only 15 percent of the buildings in the CBD have a net lettable area over 20,000 square metres. Approximately 69 percent of the developed land area in the CBD accommodates office buildings with net lettable areas of over 10,000 square metres. Additionally, about 75 percent of the total office floor space in concentrated in the larger buildings over 10,000 square metres. The following chart illustrates these ratios.

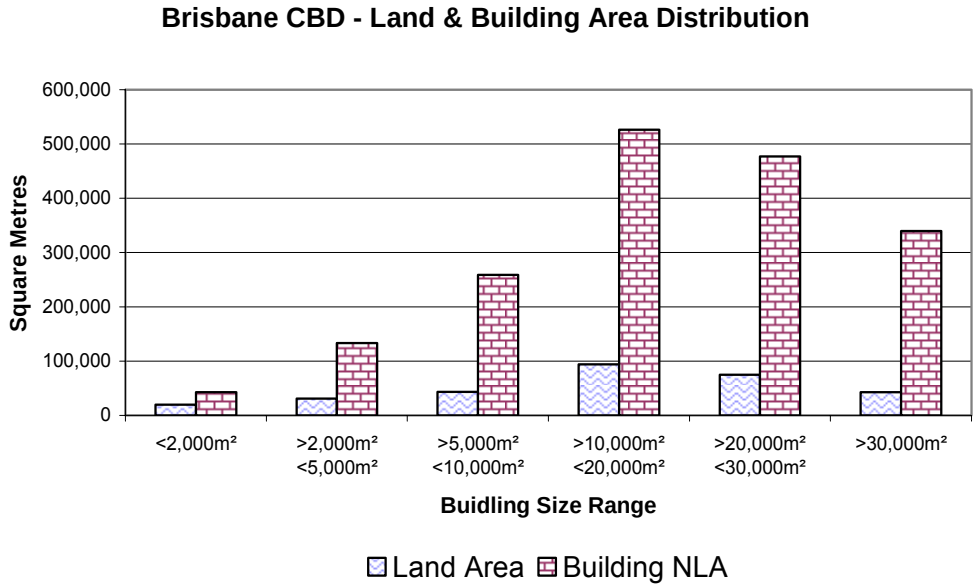


Chart 4 – Brisbane Central Business District Office Building Floor Area and Land Usage Distribution

Further analysis of the Cityscope data was undertaken to establish an age profile of the existing office buildings in the Brisbane CBD. It was not possible to attribute an age to 38 (or 20 percent) of the buildings, but for the balance, the total floor area and building counts falling within seven age ranges are represented in the following chart:

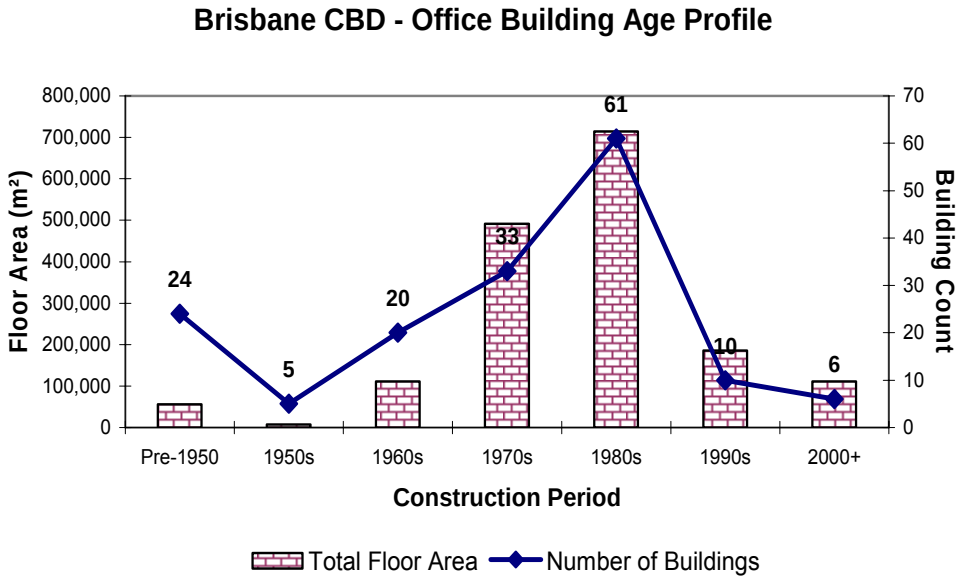


Chart 5 – Brisbane Central Business District Office Building Age Profile

This profile clearly identifies a building activity boom during the 1980s with approximately 41 percent of the city's total floor area being constructed during that decade.

3.3 HISTORICAL OFFICE SPACE SUPPLY AND DEMAND

The Brisbane CBD has experienced similar cyclical space supply and demand volatility as evidenced in published studies for other cities (some of which mentioned under *Section 2.*2). *Chart 6* displays the relationship between space supply, demand and the vacancy rate for Brisbane over the last 23 years and *Table 3*, below, summarises the key space market statistics for the city over the past 32 years.

Variable	Period	Mean	Std Dev	Minimum	Maximum
Vacancy (%)	1972-2003	9.3%	2.7%	3.5%	14.2%
Occupied Space (Δm²)	1972-2003	38,300m²	39,300m²	-33,600m²	132,000m²
Net Absorption (Δm²)	1972-2003	36,900m²	39,500m²	-33,600m²	132,000m²
Withdrawals (m²)	1972-2003	11,300m²	13,400m²	0m²	48,300m²
Completions (m²)	1972-2003	53,400m²	40,000m²	0m²	142,300m²

Table 3 – Brisbane Central Business District Space Market Statistics

These figures confirm the relative volatility of the market and *Chart 6* exhibits the strong space supply surge during the late 1980s, coinciding with a fall in net absorption, resulting in a spike in the vacancy rate. Of interest is a comparison with the level of non-residential building across Australia over a period since 1955. *Chart 7* displays this historical data in constant dollars and clearly shows the unprecedented space supply shock during the late 1980s.

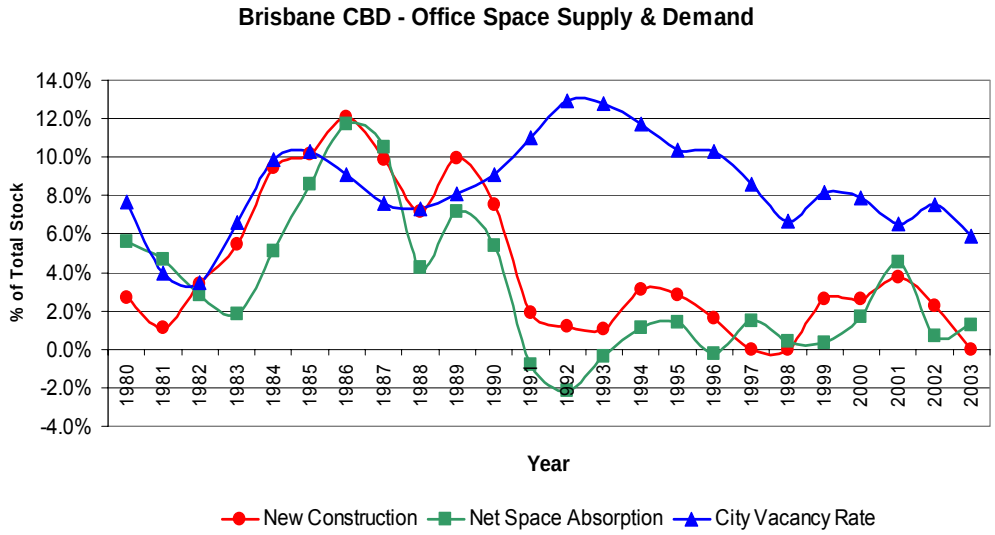


Chart 6 – Brisbane Central Business District – Historical Relationship Among Office Space Supply, Demand and Vacancy Rate

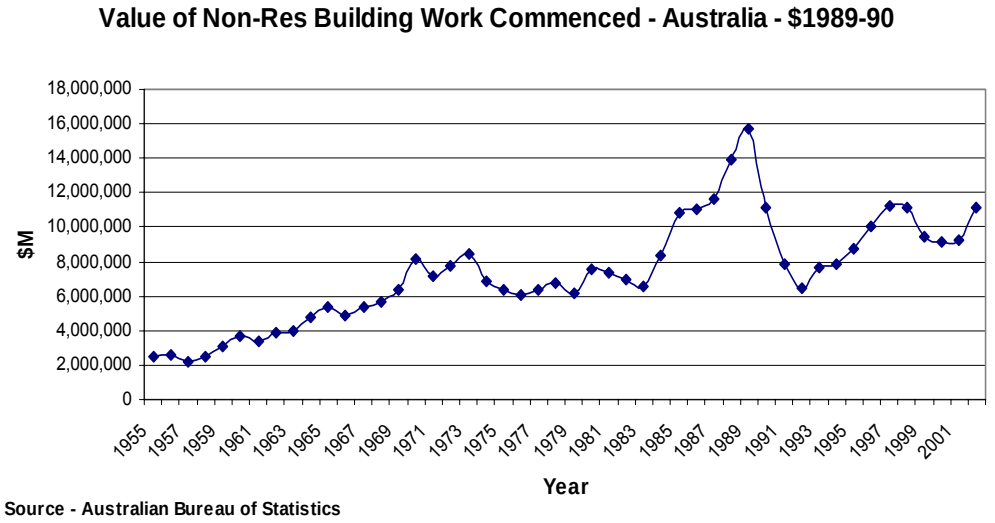


Chart 7 – Value of Australian Non-Residential Building Work Commenced in Constant Dollars

As discussed in *Section 2.1*, the importance of examining historical space supply relates to its influence on city vacancy levels and, therefore, changes in rent levels.

3.4 HISTORICAL OFFICE RENT TRENDS

Brisbane CBD rent levels have similarly shown considerable volatility. This volatility in office rents is also reflected in property values as the values of

investment properties is inherently linked to their income generating ability. This was demonstrated in the introduction (*Section 1*) dealing with the cash flow method of assessment. *Chart 8*, below, displays the historical change in Brisbane CBD prime office rents since 1980 and a comparison with the corresponding changes in a property value index.

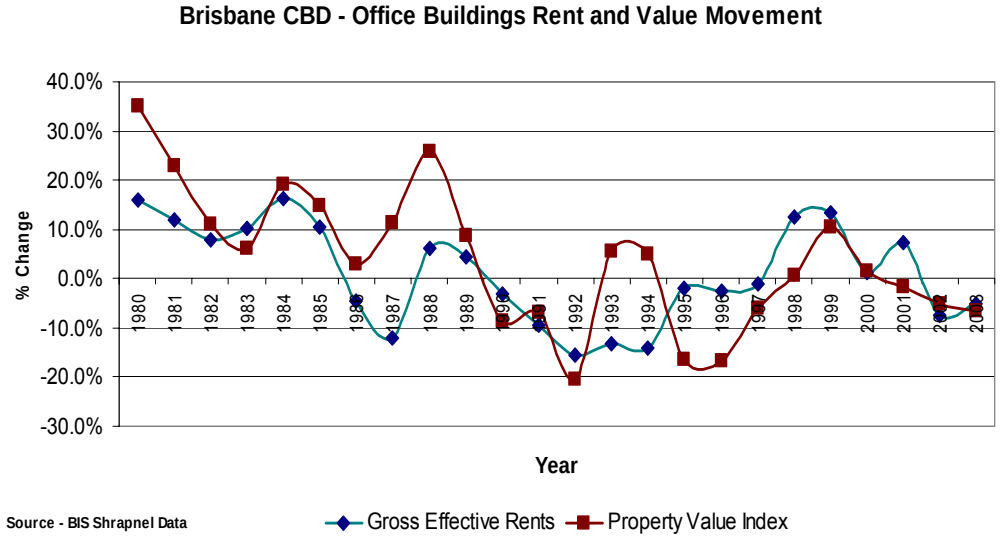


Chart 8 – Brisbane CBD Historical Changes in Prime Rents and Property Values

Prime office rents peaked in 1990 and, during the 14 years since, still have not regained the same levels. The average historical change has been 5.5% and the standard deviation has been $88 per square metre.

4. FORECASTING

4.1 SPACE SUPPLY FORECASTING

Having regard to the earlier research identifying the most likely drivers for new office construction, analyses were undertaken using historical Brisbane data to identify the space supply determinants for Brisbane. Correlation tests found lagged changes in rents, vacancy rates and property yields to be probable influences. One of the few earlier developed econometric models incorporating an equation for supply and containing the rent and vacancy variables was the Wheaton, Torto and Evans (1997) model developed for the London market. McDonald (2002) and Hendershott, MacGregor and Tse (2002) perceived the Torto Wheaton Research models of this type as being “state of the art”. For these reasons it was decided to assess the fit of an adaptation of this equation to the Brisbane CBD office market for forecasting purposes. The reconfiguration was adopted in this form:

$$C_t = \beta_0 + \beta_1 \Delta R_{t-2} + \beta_2 V_{t-4} + \beta_3 Y_{t-2} + \varepsilon_t$$

Where:

C_t	Office completions in m² as a % of stock
ΔR_t	% change prime effective office rent rate
V_t	Vacancy rate as a % of total stock
Y_t	Office properties net yields

Using annual data extending from 1978 to 2003, the following results were derived from the regression:

Descriptor	Coefficient	t-statistic
β_0	0.0496	1.804
β_1	0.1334	1.756
β_2	-0.4787	-2.246
β_3	0.6558	1.941
Adjusted R^2 = 0.51		Durbin-Watson = 0.73

The variables are all significant in explaining the change in completions at a 90 percent confidence level. The vacancy rate is the only variable significant at a 95 percent confidence level. The coefficient of determination indicates the explanatory power of the equation is not particularly strong and the Durbin-Watson statistic signifies positive autocorrelation in the residuals.

Using the equation to generate a four year out-of-sample forecast resulted in a considerable over-prediction of space supply for the years 1999 to 2003, as illustrated in the following chart.

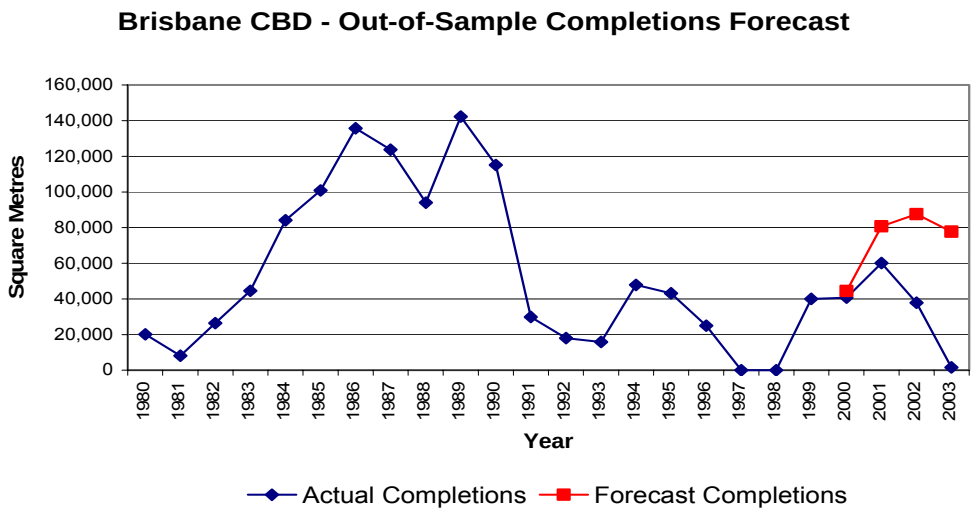


Chart 9 – Brisbane CBD Out-of-Sample Office Space Supply Forecast Using Adaptation of Wheaton, Torto & Evans (1997) London Model

This over-prediction of new building completions may have been partially driven by the prevailing historical low vacancy rate not propelling the levels of new space supply that has been evident in the past. Additionally, two office buildings (46,000 square metres) under construction and scheduled for completion in 2003

will not be completed until 2004. However, despite these factors, the equation in its current form has limited application for the Brisbane market.

4.2 RENT FORECASTING

Having regard to the results from previous research and undertaking an analysis to identify potential office rent determinants for the Brisbane CBD, measures for vacancy rate, new space supply, net space absorption and interest rates were isolated as probable explanatory variables. A new equation was estimated, taking the following form:

$$R_t = \beta_0 + \beta_1 R_{t-1} + \beta_2 V_{t-2} + \beta_3 SU_{t-2} + \beta_4 AB_t + \beta_5 I_t + \varepsilon$$

Where:

R	Prime gross effective office rent rate
V	Vacancy rate as a percentage of total stock
SU	New office supply as percentage of total stock
AB	Net office space absorption in square metres
I	Commonwealth ten year bond rate as an annual average

Using annual data covering the period from 1976 to 2003, the equation generated the following results:

Descriptor	Coefficient	t-statistic
β_0	127.778	4.592
β_1	0.533	6.088
β_2	-710.200	-4.792
β_3	30.792	0.298
β_4	0.0002	2.413
β_5	354.087	3.044
Adjusted R^2 = 0.93		Durbin-Watson = 1.97

The results indicate the lagged measures for the rent rate, vacancy and the expected bond rate are significant at a 99 percent confidence level while the anticipated net absorption, as a indicator of demand, is significant at a 95 percent confidence level. The vacancy coefficient is signed as expected, recognising the counter-cyclicality between rent and vacancy rates. Surprisingly, the lagged new supply of office space is not significant. A test of an alternative equation incorporating space absorption as a percentage of new supply, being a measure of the balance between supply and demand, also failed to enhance its explanatory power.

The overall explanatory power of the equation, as signified by the coefficient of determination (0.93), registers as quite strong. The Durbin-Watson statistic (1.97) signals little autocorrelation remaining in the residuals.

However, running an out-of-sample test, as done for the supply equation, found the equation over-predicts rent for the four test years (2000 +6.7%; 2001 +5.3%; 2002 +11.3% and 2003 +24.4%). While correctly forecasting a turning point in 2001, the equation incorrectly forecast an upswing in rents in 2003. This is illustrated in *Chart 10*.

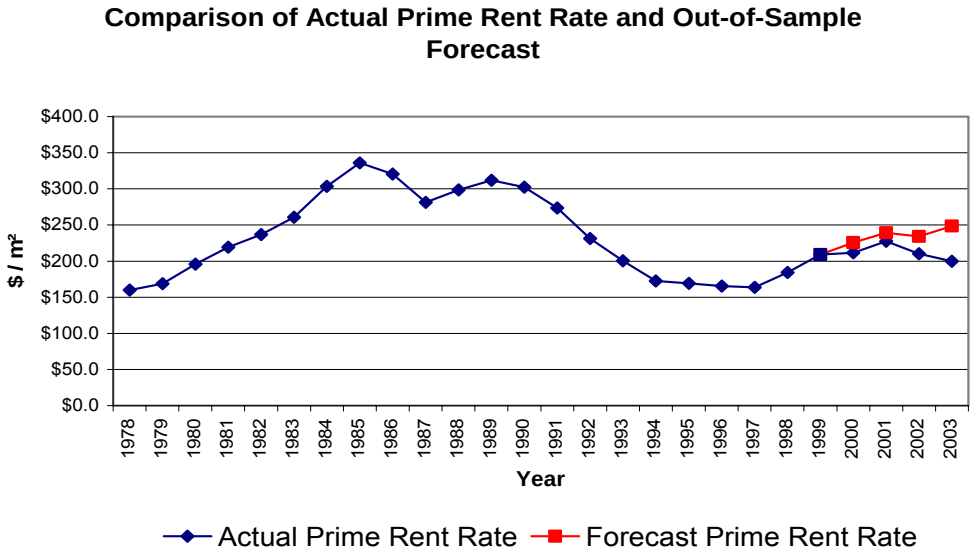


Chart 10 - Brisbane CBD Out-of-Sample Office Rent Forecast Using Estimated Model

These results confirm a necessity to exercise caution in the application of pure mathematical models to property markets. Further research is required to refine modelling techniques and to include qualitative inputs.

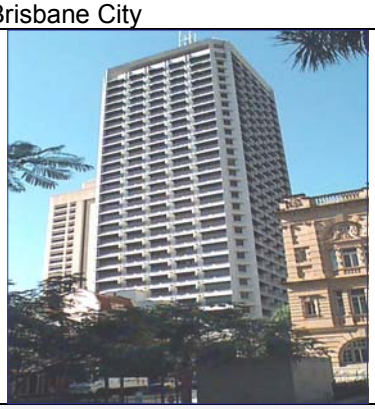
5. IMPLICATIONS

5.1 SAMPLE OFFICE BUILDING PORTFOLIO

The commercial building cash flow model developed through the Cooperative Research Centre for Construction Innovation (briefly introduced in *Section 1.)* is used to test the sensitivity of valuation assessments to variations in the adopted rent forecasts. Four existing Brisbane CBD buildings, built in four different decades, are used for the case studies. While the four buildings are government owned, detailed rent, operating expense and professionally projected capital expense data was collected to underpin the assessments. In addition, the owner of the buildings (Department of Public Works - Queensland) made available the recent independent market valuations for the buildings for comparative purposes.

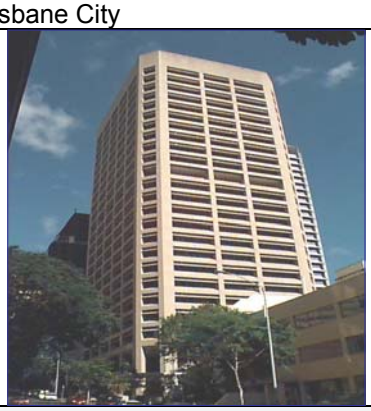
The rent forecasts adopted for the case studies include the median of the valuers' forecasts established through the professional survey (Cowley, 2004) and rent predictions cast forward using the model discussed in *Section 4.2*. The rent model forecasts a boom / bust cycle in rents in second half of the decade.

The physical and financial details of the four buildings selected for the analyses are summarised in the following tables.

Building: 111 GEORGE STREET **Address:** 111 George Street, Brisbane City	
Property Description	
A modern, A-Grade, 30 level office building completed in 1994, comprising two levels of basement car parking, a lower plaza level (conference facilities), ground level and 26 upper levels of office accommodation.	

Physical Details		**Financial Details**	
Site Area	2,541m²	**Value** (31/12/02)	$103,000,000
Total Net Let. Area	27,402m²	**Value Rate $/m² NLA**	$3,759
Retail Component	0.0017%	**Office Rent $/m²**	$350
Car Spaces	117	**Park. Rent / bay pcm**	$325
Parking Ratio	1 space per 234m²	**Est. Net Ann. Income**	$8,020,485
Typical Floor Plate	998-1068m²	**Capitalisation Rate**	7.75%
Build Date	1994	**Est. Outgoings $/m²**	$78

Table 4 – Sample Building – Physical and Financial Details – 111 George Street, Brisbane

Building: EDUCATION HOUSE **Address:** 30 Mary Street, Brisbane City	
Property Description	
A semi-modern, B-Grade, 27 level commercial office building completed in 1986 and including three basement levels of parking, a lower ground plaza level incorporating parking and retail tenancies, ground level foyer and auditorium and 22 upper levels of office accommodation.	

Physical Details		**Financial Details**	
Site Area	3,664m²	**Value** (31/12/02)	$66,000,000
Total Net Let. Area	22,347m²	**Value Rate $/m² NLA**	$2,953
Retail Component	0.0075%	**Office Rent $/m²**	$290
Car Spaces	218	**Park. Rent / bay pcm**	$325
Parking Ratio	1 space per 103m²	**Est. Net Ann. Income**	$5,710,842
Typical Floor Plate	966-1053m²	**Capitalisation Rate**	8.50%
Build Date	1986	**Est. Outgoings $/m²**	$77

Table 5 – Sample Building – Physical and Financial Details – 30 Mary Street, Brisbane

Building: MINERAL HOUSE **Address:** 41George Street, Brisbane City	
Property Description A semi-modern, B-Grade, 30 level commercial office building completed in 1979 and including three basement levels of parking, ground level retail tenancies, office accommodation and foyer, three upper podium levels and a further 23 tower levels of office accommodation.	

Physical Details		**Financial Details**	
Site Area	2,811m²	**Value** (31/12/02)	$77,000,000
Total Net Let. Area	29,468m²	**Value Rate $/m² NLA**	$2,613
Retail Component	0.0031%	**Office Rent $/m²**	$285
Car Spaces	124	**Park. Rent / bay pcm**	$325
Parking Ratio	1 space per 238m²	**Est. Net Ann. Income**	$6,867,588
Typical Floor Plate	1,065-1,107m²	**Capitalisation Rate**	8.75%
Build Date	1979	**Est. Outgoings $/m²**	$70

Table 6 – Sample Building – Physical and Financial Details – 41 George Street, Brisbane

Building: PRIMARY INDUSTRIES BUILDING **Address:** 62 Ann Street, Brisbane City	
Property Description A semi-modern, B-Grade, 10 level commercial office building completed in 1968 and including a basement level, ground level, three upper podium levels and five upper levels of commercial office accommodation. A major refurbishment occurred in 1989 and the air conditioning plant and lifts have been upgraded in recent years.	

Physical Details		**Financial Details**	
Site Area	2,746m²	**Value** (31/12/02)	$29,000,000
Total Net Let. Area	14,602m²	**Value Rate $/m² NLA**	$1,986
Retail Component	0.0%	**Office Rent $/m²**	$265
Car Spaces	11	**Park. Rent / bay pcm**	$325
Parking Ratio	1 space / 1,327m²	**Est. Net Ann. Income**	$2,751,809
Typical Floor Plate	1,351-1,819m²	**Capitalisation Rate**	9.25%
Build Date	1968	**Est. Outgoings $/m²**	$74

Table 8 – Sample Building – Physical and Financial Details – 62 Ann Street, Brisbane

5.2 RENT FORECAST SENSITIVITY

Running the cash flow model for each of the four buildings with all market and economic assumptions remaining constant except for the rent forecasts derived the results listed in *Table 9* below:

Building	CB Richard Ellis Valuation	Valuation Using Model Generated Forecast	% Variation	Valuation Using Mean Valuers' Forecast	% Variation
111 George Street	$103,000,000	$98,500,000	-4.4%	$106,500,000	+3.4%
Education House	$66,000,000	$60,000,000	-9.1%	$65,500,000	-0.8%
Mineral House	$77,000,000	$74,500,000	-3.2%	$81,250,000	+5.5%
Primary Industries	$29,000,000	$25,000,000	-13.8%	$27,500,000	-5.2%

Table 9 – Building Valuations using Model Generated and Valuers Survey Mean Rent Forecasts

The results indicate the forecasts from the rent model derive valuations 3.2% to 13.8% below the independently assessed values, while the mean of the valuers survey rent forecasts over and under value the buildings with a range from -5.2% to 5.5%. Materially significant variations exist between the valuations derived using the rent forecasts from the two sources with differences ranging from 8.1% to 10.0%. In dollar terms, these differences range up to $8M and this confirms that the formulation, sourcing and application of rent forecasts are of consequence when adopting the discounted cash flow method of valuation.

6.0 CONCLUSIONS

Surveys of Australian property professionals have found an increasing reliance on discounted cash flow modelling as a means of assessing the value and viability of office buildings and projects. This method of assessment requires the explicit inclusion of office rent forecasts over study periods often ranging up to ten years into the future.

Historically, formal techniques used for the formulation of rent forecasts have relied upon office market modelling involving the identification and application economic and property market leading indicators or explanatory variables through the use of regression equations. Analysis of the literature on the subject found the dominant drivers of new office construction to be: rent levels; vacancy rates; previous building completions; construction costs; white collar employment growth; and interest rates. In association with this, researchers and property professionals have nominated the key determinants in office rent level changes to be: subsisting rent levels; vacancy rates; space supply; economic activity; and white collar employment growth.

After examining the historical relationships among these and other property market drivers in the sample city of Brisbane, space supply and rent equations were estimated. Out-of-sample forecasts generated by these equations were compared to actual changes in supply and rent levels. Both models tended to initially over-predict growth in the market despite their reasonable historical fit.

These results add weight to the need for further research on property market forecasting to identify supplementary techniques to improve upon purely mathematical formulation methods.

Further support for this proposal is derived from test results showing alternate office rent forecasts materially impact upon property valuations. These results were generated by a professionally developed discounted cash flow model used to assess valuations for four existing office buildings. The model was operated using real income and expense data, including detailed capital expenditure projections for each of the buildings.

Improvements in the consistency and reliability of forecasts hold potential to enhance decision making processes for investors and possibly ameliorate some of the pain producing volatility in commercial property markets.

REFERENCES

Australian Bureau of Statistics (2003), *Building Activity, Australia*, Cat. No. 8752.0 at www.abs.gov.au

Australian Bureau of Statistics (2004), *Consumer Price Index, Australia TABLE 1A. CPI: All Groups Index Numbers (Financial Year)* at www.abs.gov.au

Barras R (1994), "Property and the Economic Cycle: Building Cycles Revisited", *Journal of Property Research* Vol 11 pp 183-197.

Brisbane Cityscope, Cityscope Publications Pty Ltd 2003, Sydney.

Chaplin R (2000), "Predicting Real Estate Rents: Walking Backwards into the Future", *Journal of Property Investment and Finance* Vol 18 No 3 pp 352-370.

Clark DL & Dannis CG (1992), "Forecasting Office Rental Rates: Neoclassical Support for Change", *The Appraisal Journal* January pp 113-128.

Cooperative Research Centre for Construction Innovation (2004) *Evaluation of Functional Performance in Commercial Buildings*, Report No. 2001-011-C, Brisbane.

Cowley M (2003), "*Property Market Cycles*", Masters Dissertation, Queensland University of Technology.

Cowley M (2004), "*Property Market Forecasts and their Valuation Implications*", Masters Thesis to be submitted, Queensland University of Technology.

DiPasquale D & Wheaton WC (1996), Urban Economics and Real Estate Markets, Prentice Hall, New Jersey.

Dunse N & Jones C (1998), "A Hedonic Price Model of Office Rents", *Journal of Property Valuation and Investment* Vol 16 No 3 pp 297-312.

Dunse N & Jones C (2002), "The Existence of Office Submarkets in Cities", *Journal of Property Research* Vol 19 No 2 pp 159-182.

Gallagher M & Wood AP (1999), "Fear of Overbuilding in the Office Sector: How Real is the Risk and Can We Predict It?", *Journal of Real Estate Research* Vol 17 No 1/2 pp 3-32.

Gardiner C & Henneberry J (1989), "The Development of a Simple Regional Office Rent Prediction Model", *Journal of Property Valuation and Investment* Vol 7 No 1 pp 36-52.

Giussani B, Hsia M & Tsolocas S (1993), "A Comparative Analysis of the Major Determinants of Office Rental Values in Europe", *Journal of Property Valuation and Investment* Vol 11 No 2 pp 157-173.

Glascock JL, Kim M & Sirmans CF (1993), "An Analysis of Office Market Rents: Parameter Constancy and Unobservable Variables", *Journal of Real Estate Research* Vol 8 No 4 pp 625-637.

Hekman JS (1985), "Rental Price Adjustment and Investment in the Office Market", *AREUEA Journal* Vol 13 No 1 Spring pp 32-47

Hendershott P (1996), "Rental Adjustment and Valuation in Overbuilt Markets: Evidence from the Sydney Office Market", *Journal of Urban Economics* Vol 39 No 1 pp 51-67.

Hendershott P & Lizieri C & Matysiak GA (1996), "Modelling the London Office Market", *The Cutting Edge 1996, RICS Research*, London.

Hendershott P, Lizieri C & Matysiak G (1999), "The Workings of the London Office Market", *Real Estate Economics* Vol 27 pp 365-387.

Hendershott PH, Macgregor BD & Tse RYC (2002), "Estimation of the Rental Adjustment Process", *Real Estate Economics* Vol 30 No 2 pp 165-183.

Higgins D (2000), "*The Determinants of Commercial Property Market Performance*", PhD Thesis, University of Western Sydney.

Higgins D (2003), "Predictability of Australian Office Supply", *Australian Property Journal* Vol 37 No 8 pp 561-566.

Kummerow M (1997), "Commercial Property Valuations with Cyclical Forecasts", *The Valuer & Land Economist* Vol 34 No 5 February pp 424-428

MacFarlane J, Murray J, Parker D & Peng V (2002), "Forecasting Property Market Cycles: An Application of the RICS Model to the Sydney CBD Office Market", Paper Presented to the *8th PRRES Conference*, Christchurch.

MacFarlane J & Moon S (2000), "Characteristics of Australian Commercial Property Markets: Towards an Improved Forecasting Model", Paper Presented to the *6th PRRES Conference*, Sydney.

McCarthy I (2004), "Financial Viability of a Forestry / Pastoral Rotation", *Australian Property Journal* Vol 38 No 2 pp 99-104.

McDonald JF (2002), "A Survey of Econometric Models for Office Markets", *Journal of Real Estate Literature* Cleveland Vol 10 Issue 2 pp 223-242.

McGough T & Tsolacos S (1995), "Forecasting Commercial Rental Values Using ARIMA Models", *Journal of Property Valuation and Investment* Vol 13 No 5 pp 6-22.

Mitchell PM & McNamara PF (1997) "Issues in the Development and Application of Property Market Forecasting: The Investor's Perspective", *Journal of Property Finance* Vol 8 No 4 pp 363-376.

Mueller GR (1999), "Real Estate Rental Growth Rates at Different Points in the Physical Market Cycle", *Journal of Real Estate Research* Vol 18 No1 pp131-150.

Murray (2000), "Forecasting Office Rents in Sydney" in Economic Forecasting (edited by Abelson P and Joyeux R), Allen and Unwin, Sydney.

Parker D (2003), "*An Assessment of Generic Software Packages Used by Property Fund Managers in Australia*", A report prepared for the Cooperative Research Centre for Construction Innovation, Brisbane.

Rosen K (1984), "Toward a Model of the Office Building Sector", *AREUEA Journal* Vol 12 No 3 Fall pp 261-269

Shilling J, Sirmans C & Corgel J (1987), "Price Adjustment Process for Rental Office Space", *Journal of Urban Economics* Vol 22 pp 90-100

Sivitanidou R & Sivitanides P (2000), "Does the Theory of Irreversible Investments Help Explain Movements in Office-Commercial Construction", *Real Estate Economics* Vol 28 pp 623-661

Tse RYC & Fischer D (2003), "Estimating Natural Vacancy Rates in Office Markets Using a Time-Varying Model", *Journal of Real Estate Literature* Vol 11 Issue 1 pp 37-45.

Tse RYC & Webb JR (2003), "Models of Office Markets Dynamics", Urban Studies Vol 40 No 1 pp 71-89.

Tsolacos S & McGough T (1999), "Rational Expectations, Uncertainty and Cyclical Activity in the British Office Market", *Urban Studies* Vol 36 No 7 pp 1137-1149

Viezer TW (1999), "Econometric Integration of Real Estate's Space and Capital Markets", *Journal of Real Estate Research* Vol 18 Issue 3 pp 503-519.

Wheaton WC (1987), "The Cyclic Behaviour of the National Office Market", *AREUEA Journal* Vol 15 No 4 Winter pp 281-299.

Wheaton WC & Torto RG (1988), "Vacancy Rates and the Future of Office Rents", *AREUEA Journal* Vol 16 No 4 pp 430-436

Wheaton WC, Torto RG & Evans P (1997), "The Cyclic Behaviour of the London Office Market", *Journal of Real Estate Finance and Economics* Vol 15 No 1 pp 77-92.