An empirical study of demand factors affecting the segmented Sydney housing market

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The median price of housing continued to rise across the board in Sydney since 1993. Many factors have influenced the price, including sustained economic growth, low inflation rate and relatively low interest and unemployment rates.

The purpose of this paper is to determine whether the same common factors influence price across segmented markets in Sydney. The segmented markets will be classified as "lower" and "higher" priced areas of Sydney. The method adopted is to apply the use of multiple regression analysis on secondary data of selected local government areas in Sydney.

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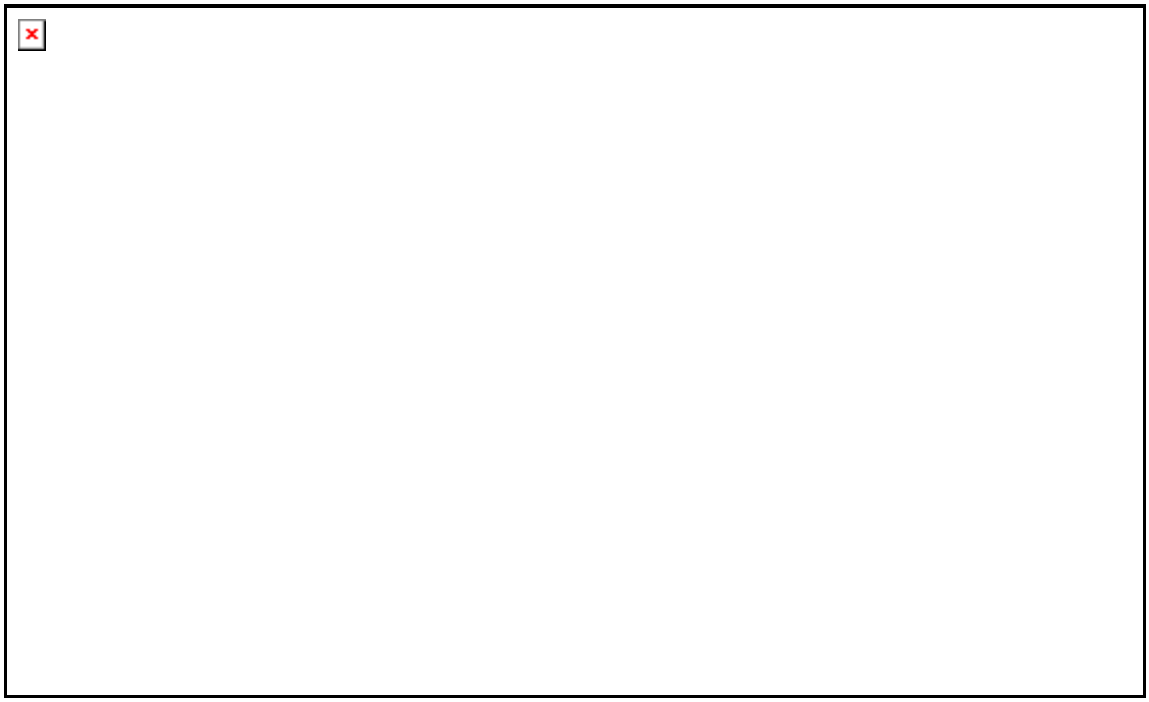
Introduction

In the past decade, Australia has witnessed sustained economic growth and an era of low inflation and interest rates relative to the previous decade. During this time, the Sydney housing market has also had a sustained price rise. Figure 1 shows the "median price" of dwellings for the Sydney metropolitan area, commencing at $175000 in March 1993 and doubling to $350000 in December 2001.

Figure 1
Sydney Housing Prices
Median Price



Source: Real Estate of N S W, Property Market View [Various]

Research on housing markets around the world has consistently identified macro factors as the cause for property price movements. Mitchell [1993] established a strong relationship between housing prices in New Zealand and some six economic indicators. In a study of UK house prices, Muellbauer et al (1997) identified real interest rates and income expectations as the major variables. In an Australian study, Oluwoye and Small [2001] showed there was a significant correlation between interest rates and property values, but this was not in the expected direction and one conclusion reached by the authors was that additional factors were required.

Evidence in several segmented housing market studies suggests that similar factors determine price across the board. Costello and Elkins [2000] analysed the significance of location in a number of suburbs in Perth. They concluded that the "price segmentation of housing markets can yield useful information in several areas". Bounds et al [2000] in trying to ascertain whether the Sydney Olympics had an impact on the Olympic corridor as opposed to another area of Sydney, concluded that both areas were influenced by similar factors. In a USA study, using regional statistics, Painter and Redfearn [2002] found the same factors "across the board"

impact on housing prices, namely, interest rates in the short run only and that in the long run, rising incomes and demographics are most important

In the statistical analyses, many of the studies on housing use time series data, which have a tendency to produce autocorrelation in their results. In a Sydney residential study using time series data, Oluwoye [1992] derived first order positive autocorrelation. Also using time series data in an international empirical study, Englund and Ioannides [1996] found housing prices are predicted from their own past values, but their model also produced evidence of positive autocorrelation. This, they concluded was consistent with several studies, particularly with US based data.

The aim of this paper is determine whether the same factors influence prices across the board in the Sydney housing market. To do this, the paper has segmented the market into two areas namely, low priced and high priced areas in Sydney. Four local government areas (LGAs) which typify *working class* socio economic areas from the "lower priced" LGAs and four areas which typify relatively high socio economic areas were selected from the "higher priced" LGAs.

The study will firstly analyse the overall Sydney metropolitan housing market to determine a model and then will apply the same model to the eight selected LGAs. The four lower priced areas selected are, Blacktown, Liverpool, Marrickville and Rockdale, and the higher priced LGAs selected areas are Hunters Hill, Mosman, Strathfield and Woolahra.

Data

The paper uses quarterly time series data for the period March 1993 to December 2001. The price used is the "median price" of residential dwellings as derived by the Real Estate Institute of NSW (REI) for local government areas (LGAs) in the Sydney metropolitan area. The data used by REI is derived from the transfers registered with the NSW Land Titles Office and issued by the Valuer General of NSW.

Interest rates were derived from the Reserve Bank of Australia (RBA) and all other variables from the Australian Bureau of Statistics (ABS). The rate of interest used is the "bank's standard" housing rate, the average weekly earnings is the rate for NSW and the unemployment rate is the rate for the Sydney metropolitan area.

Methodology

The main hypothesis being tested is to determine whether the same factors determine prices in all LGAs in Sydney. The variables selected are based on previous studies relating to the price function for residential prices as referred to above.

The relationship between the dependent variable an the independent variable can be expressed as:

$$P = f(\%\Delta p, g, i, w, u) \qquad \text{Eq}$$

where:

P = Median Price
% Δp = Rate of change in median price
g = GDP
ι = rate of interest
w = average weekly earnings
u = unemployment rate

Preliminary analysis of the data revealed an unacceptably high level of correlation between average weekly earnings and employment, giving rise to multicollinearity. The pair-wise correlation matrix provided in Table 1 shows the very high level of correlation between AWE (average weekly earnings) and unemployment, and between GDP and AWE. As both AWE and unemployment are important, to overcome the problem of correlation, both were combined to form a single variable, w(1-u). This new parameter measures the average weekly total workforce earnings (*effective weekly earnings*) and can be regarded as Keynes' *effective* demand of the community. It is also evident from the correlation matrix that GDP and AWE are almost perfectly positively correlated and for this reason GDP was excluded from the estimating equation.

Table 1
Correlation Matrix

	GDP	*AWE*	*U/employ*
GDP	**1**		
AWE	**0.9834**	**1**	
U/employ	**-0.9278**	**-0.9021**	**1**

The revised model assumes that median price is explained by the rate of change in median prices, $\%\Delta p_t$, effective weekly earnings, $w(1-u)_t$, and interest rates, ι_t. The functional form of the estimating equation is linear and is represented by equation 2.

$$P_t = \alpha_0 + \beta_1 \%\Delta p_t + \beta_{2w(1-u)t} + \beta_3 i_t \qquad \text{Eq 2}$$

where:

P = Median Price
% Δp = Rate of change in median price
w(1-u) = Effective weekly earnings
ι Interest rate

Results

Sydney

Table 2 shows the correlation between the variables for the Sydney metropolitan area. As indicated, the correlation between the transformed variable effective weeklt

earnings [w(1-u)] and interest rate is -0.642. While this value is relatively large in absolute terms, it is unlikely to have an adverse effect on the model. This may be confirmed by reference to the VIF (variance inflation factor) which produces values of 1.61 for w(1-u) and 1.72 for interest rates. According to Flaherty et al [p397, 1999], these statistics are considered low and therefore suggests that multicollinearity is not a problem. Both these variables are considered to be of theoretical importance in explaining changes in prices.

Table 2
Correlation Matrix

	Prices	% Δp	w(1-u)	int
Prices	**1.000**			
% Δp	**0.208**	**1.000**		
w(1-u)	**0.978**	**0.117**	**1.000**	
int	**-0.704**	**-0.273**	**-0.642**	**1.000**

Equation 3 presents the results for the Sydney area:

$$\text{Price}_{\text{Sydney}} = -148462 + 129745\%\Delta p + 617\, w(1-u) - 3601\iota \qquad \text{Eq 3}$$
$$\text{(t) stat} \qquad (-5.41) \qquad (2.32) \qquad (22.69) \qquad (-2.56)$$

Adj R^2 = 0.969; F Stat = 350.6; D - W (d)= 0.36

The model produced excellent results, with an adjusted R square of 0.969, which in normal circumstances would be an indicator of explaining nearly 97% results for Sydney. However, the Durbin Watson statistic shows that the model has positive autocorrelation, that is, the error term in one time period is positively correlated with the error term in the previous period and this tends leads to unreliable statistical results [Salvatore,1982]. Following the discussion on previous studies (see above), this was not a surprisingly result, as one problem in using time series is that it can result in autocorrelation.

When autocorrelation is present in the data, one can attempt to eliminate it by adding another independent variable or transforming the data. After adding GDP as an additional variable, the result was no better and in addition introduced severe multicolinearity to the model. Therefore, the model was re-estimated using a first-order autocorrelation algorithm. This was done by deriving the rho statistic and then re-running the model on the transformed data (see Flaherty et al, p402 for methodology).

After transforming the data, a new correlation matrix was produced and is shown in Table 3. As can be noted, the transformation also had the effect of reducing the correlation between effective weekly earnings and interest rates to r = 0.3.

Table 3
Correlation Matrix

	y	% Δp	w(1-u)	int
y	**1.000**			
% Δp	**0.531**	**1.000**		
w(1-u/e)	**0.804**	**0.071**	**1.000**	
int	**-0.402**	**-0.220**	**-0.300**	**1.000**

The transformed results produced are presented in equation 4 (critical values are shown at the bottom of Table 4):

$Price^*_{Sydney}$	**=**	**- 167333**	**+ 159622%Δp***	**+ 623w(1-u)***	**- 1992ι*** **Eq 4**
(t) stat		**(-6.68)**	**(7.02)**	**(11.14)**	**(-1.11)**

Adj R^2 = 0.865; F Stat = 71.2; D - W (d)= 1.90

The transformed model explains about 86.5% of the median price movement and has an F statistic which is considerably greater than its critical value, implying that the equation is significant. More importantly, the test for autocorrelation, using the Durbin Watson test now shows that there is no evidence of autocorrelation in the model. The t-ratios from this model may now be reliably used to carry out tests of significance.

Interpreting, the transformed results, the equation indicates that lagged rate of change in medium price and effective weekly earnings have positive influences on median price, whilst interest rates have negative influences. However, not all variables are statistical significance. Both rate of change in medium price and effective weekly earnings variables are statistically significant at 5% level, but interest rates indicated no significance.

Selected LGAs

The transformed model was then run on the eight selected LGA areas. The results of the selected LGAs are summarised in Table 4.

Table 4

Place	Constant	% Δp	w(1-u/e)	int	Adj R Sq	"F"	D - W
Sydney	-167333	159622	623	-1992	0.865	71.25	1.905
"t"	-6.7	7.0	11.1	-1.1			
Low Priced							
Blacktown	-143543	95137	447	-1631	0.803	45.96	1.101
"t"	-6.62	4.2	8.4	-0.9			
Liverpool	-197073	102326	562	-1713	0.866	72.04	1.646
"t"	-9.6	5.2	11.3	-1.0			
Marrickville	-275222	106628	888	-8775	0.844	60.41	1.166
"t"	-7.5	4.2	10.1	-2.8			
Rockdale	-272117	141028	895	-6097	0.871	75.35	1.890
"t"	-8.4	5.8	11.0	-1.9			
High Priced							
Hunters Hill	-799680	400667	2321	-22467	0.771	37.98	1.781
"t"	-5.4	7.9	5.3	-1.1			
Mosman	-875818	481794	2853	-28551	0.847	61.75	1.620
"t"	-6.1	9.5	7.3	-1.7			
Strathfield	-83431	200686	859	-10347	0.728	30.39	1.631
"t"	-1.2	6.7	4.5	-1.2			
Woolahra	-353131	365770	2063	-37652	0.771	38.13	1.499
"t"	-3.0	5.7	6.2	-2.6			

Critical Values:

$F_{.01,3,30} = 4.51$; $t_{.05/30} = 2.042$; $d_{30/.025}$: $d_l - d_u = 1.12 - 1.54$ & $4\ d_l - 4d_u = 2.46 - 2.88$

Results for all eight LGAs show that the model explains their respective price movements reasonably well, with the adjusted R squared ranging from 0.728 (Strathfield) to 0.871 (Rockdale). All areas had a satisfactory F statistic, indicating the significance of the model at 99% level. Testing for autocorrelation showed that only Blacktown produced evidence of autocorrelation, with both Marrickville and Woolahra in the inconclusive zone.

On examination of the variables at 5% level, the variables rate of change in medium price and effective weekly earnings are significant in all eight selected area. The rate of interest was significant in only two of the LGAs, one from each group, namely Marrickville and Woolahra. However, it will be recalled from Table 4, that for these

two LGAs, the evidence of autocorrelation was inconclusive which causes the t ratio to be unreliable.

Conclusion

The evidence presented in this paper, suggest that percentage price change together with average weekly earnings and unemployment are consistently influencing residential prices in the Sydney metropolitan area and across the board in the selected lower and higher priced areas. Consistent with previous studies, the results also indicate that there is no evidence to suggest a different pattern of influences between the segmented markets, which in this study were the lower and higher priced areas of the Sydney residential market.

In addition, whilst the model produced the *traditional* negative correlation between price and interest rates, the results also suggest that interest rates are not necessarily important across the board with most areas showing no significance. Indeed, interest rates were significant in only two of the LGAs tested, but with a question mark on their respective statistical significance. Notwithstanding, these two LGAs are again not segmented, with one coming from each group.

Overall, the findings indicate that there is no identifiable consistency when segmenting the Sydney housing market into lower and higher priced areas. In the final analysis, this study indicates that similar variables affect the Sydney residential market, but to a varying degree.

References

(ABS) Australian Bureau of Statistics [2002] "National Accounts" Time Series Spreadsheets, http://www.abs.gov.au/Ausstats.

(ABS) Australian Bureau of Statistics [2002] "Average Weekly Earnings" Time Series Spreadsheets, http://www.abs.gov.au/Ausstats.

Bounds M, Dwyer W and Mallik, G [2000] "The Olympics And Regional Movements In The Price of Residential Property: A Comparative Analysis Of Two Rapid Growth Regions In Sydney" 6th Pacific Rim Real Estate Society Conference, Sydney.

Costello G & Elkins R [2000] "Location Location Location Wise Maxim or Clever Hoax?", Pacific Rim Property Research Journal, Vol 6, No 1, UTS.

England P and Ioannides Y [1996] "House Price Dynamics: An international Empirical Perspective", Journal of Housing Economics, Vol 6, p119-136.

Flaherty J, Lombardo R, Morgan P, de Silva B & Wilson D [1999] "A Spreadsheet Approach to Business Quantitative Methods", Logistics Group, RMIT.

Mitchell I [1993] "Economic Variables Affecting Residential Property Value Using Past Performance to Predict Future Trends", New Zealand Valuer's Journal, March, p42-46.

Muellbauer J and Murphy A [1997] "Booms and Busts in the UK Housing Market", Economic Journal Vol 197, p1701-1727.

Norman E, Sirmans G, and Benjamin J [1995] "The Historical Environment of Real estate returns, The Journal of Real Estate Portfolio Management, Vol1, No 1, p1-25.

Oluwoye, J.O. [1992] "Average Weekly Earnings Elasticity of Housing Demand in the Sydney Metropolitan Area". Australasian Real Estate Educators, University of South Australia.

Oluwoye J & Small G R [2001] "Asset Management: The Relationship Between Economic Variables and Property Values", European real Estate Society Conference, Alicante, Spain.

Painter G and Redfearn C [2002] "The Role of Interest Rates in Influencing Long-Run Homeownership", The Journal of Real Estate Finance and Economics, Vol 25, No 2/3, September/December.

(RBA) Reserve Bank of Australia: Time Series Spreadsheets, http://www.abs.gov.au/Ausstats.

(REI) Real Estate Institute of N S W [Various] "Property Market Facts", REI, NSW

Salvatore D [1982] "Statistics and Econometrics" Schaum's Outline Series, McGraw Hill Book Company, USA.