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“LOCATION LOCATION LOCATION”

WISE MAXIM OR CLEVER HOAX?

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Abstract: Median prices for individual suburbs in Australian capital cities are frequently quoted in the popular press as a measure of price change between geographic areas. This raises several interesting questions. Are these observed price changes truly representative of factors influencing prices autonomous within the specific suburb? Alternatively, are these changes the result of common factors that may be observed across several suburban areas during contemporaneous measurement periods? Are these reported price changes of any statistical significance? This paper empirically tests some of these questions. A rich data set of transactions for ten individual suburbs in the city of Perth, Australia for the period 1988 – 1999 is used. Quarterly hedonic price indexes are created for each individual suburb and tested for accuracy. Standard parametric and non-parametric statistical methods are used to test for significant differences between the ten suburb groupings. The results confirm a low number of statistically significant differences and the existence of a 'pricing size effect' as a determinant of house price change.

1.0 Introduction

Perhaps the most frequently quoted maxim with reference to real estate investment is "location, location, location". In Australia, the mainstream press frequently quotes research analysing the rates of price change for different suburbs in Australian capital cities. These reports often inspire keen public interest but are exposed to little serious statistical analysis or technical scrutiny. The information revealed by these reports raises some important issues. Do price changes occur on a consistent temporal scale for different location segments in housing markets?

The main source of mainstream press reports is from the various real estate institutes. The Real Estate Institute of Australia and its various state agencies regularly publish reports for the changes in median house prices for individual suburbs. It is well established in the house price index construction literature that the measurement of house price changes for small regions with the use of median price index methods is prone to some common problems. The median is a simple measure of central tendency and although more suited than the arithmetic mean for the analysis of real estate prices, it is still subject to problems of sample selection bias.

The use of a median price measure can often indicate more volatility than is actually occurring for a constant-quality housing unit in the region. This is often due to changing housing characteristics for the suburb sample. An example is the case where a number of new home developments are exposed to the market during a sample period in a particular suburb. New homes are generally larger and by definition modern. Is the resultant increase in the median price for that suburb the result of homebuyer location preferences or preference for the changing housing characteristics? Moreover, because a median sale price is constructed by a process of ranking there are no parameters of the distribution for prices in a region and as a result statistical tests using parametric methods for differences in house price changes between suburbs are not possible.

This study suggests a more robust methodology to test for price changes between suburbs. The constant-quality index construction methods used are an improvement over median price index methods. Firstly, the hedonic procedure controls for variations in housing characteristics that may influence price changes during the sample period. Secondly the calculated index coefficients are given with a standard error from the Ordinary Least Squares (OLS) regression procedure. These standard errors can be used to ascertain index accuracy ratios for both index levels and differences (Case & Shiller: 1989) These indexes are then used to construct variables that can be used in both parametric and non-parametric statistical tests for price changes between suburbs.

2.0 Theory – Related Literature

This study examines several areas of real estate theory. First, it examines the broad issue of location theory. Second, it draws upon the large volume of recent literature pertaining to hedonic analysis of real estate markets and the associated index construction literature. Third, the issue of information diffusion processes in housing markets is examined.

The popular view of location as being the key determinant of real estate value has been frequently challenged in the academic literature. Graaskamp (1981) argues:

> "Location is often identified as the critical factor….it is seldom understood that location value is related to the functional needs of the activity and not the site….The family chooses a home site that balances convenience against the cost of inconvenience….Therefore locational value is in the mind of the space user rather than inherent in the land and demand pressures on land shift as his perceptions of convenience shift" (Graaskamp: 1981 in Squirrell (Ed) 1997: 228).

In recent years the increasing availability of high quality transaction data has enabled rigorous empirical testing of housing markets using hedonic models. Significantly, these models can also be used for estimation of transaction based index models for housing markets, (Costello: 1997). The hedonic pricing model as applied to housing market analysis is consistent with the view that the value of an individual housing unit in either rental or capital value terms is a composite of values for individual attributes. As expressed by Linneman (1985):

$$V_i = f(Z_i;\alpha) + U_i \qquad (2.0.1)$$

where V_i is the market price of the *i*th the housing unit, expressed as a function of a vector of relevant structural and neighbourhood traits Z_i, a parameter vector representing the shadow prices of these traits α, and a random error term, U_i.

Location variables can be included in the hedonic analysis. However, an important issue in using transaction data is the structure of the data and the characteristics of the variables available for analysis. Typically, structural variables such as building area or age may be measured discretely. Other categories of variables including location cannot be measured discretely. Location expressed as a suburb name can be transformed to a 'dummy' variable for hedonic analysis. It is likely that suburb selection may best represent the 'state of mind' of the purchaser as previously argued by Graaskamp (1981). Is location as determined by a suburb name a statistically significant determinant of price change? This is the central empirical question examined in this study.

The question of location influence is also an important question relating to the informational efficiency of housing markets. Several authors have examined patterns of information diffusion processes between geographic regions (Clapp, Dolde & Tirtiroglu (1995), Dolde & Tirtiroglu (1997)). If inconsistencies for price change between different location segments can be observed and predicted, investors might develop trading strategies to exploit the information contained within past price changes. If price changes for different location segments do not occur on a consistent temporal scale it is possible that price changes in one location segment may serve as useful signals for later price changes in other location segments.

3.0 Data

This study uses housing transaction data for the capital city of Perth, Western Australia. Perth is a city of approximately 1.3 million people. In Western Australia, important local services (education, health, police etc) are financed at the state government level thereby minimising the influence of 'Tiebout factors'[1] associated with local government financing. The transaction details were taken from the Western Australian Valuer General's Office for the period 1988 (third quarter) – 1999 (first quarter). The period of analysis includes the housing price 'bubble' that occurred in late 1988 and early 1989 and the subsequent decline in house prices associated with the implementation of monetary policies during that period.

The sample selected is 'strata title' sales[2]. This is a segment of the housing market covering a variety of housing styles and densities, with accurate hedonic variables for building age and area. Chart 1 shows the time series for indexes for all suburbs and two selected suburbs. These indexes are estimated using the constant quality hedonic method as shown in equation (4.0.1) below. The suburb of Cottesloe represents the suburb with the largest measured index change whereas Armadale represents the lowest measured index change. It is evident that there are notable differences for index changes between these different suburbs.

[1] The 'Tiebout hypothesis' refers to the observation by Charles Tiebout in 1956 that homeowners base their location preferences according to the standards of *local* government services. This is discussed here because the indexes in this study are created for the full city using *structural* characteristics only. The structural characteristics used are consistent for all price segments. Greater index accuracy can be achieved with the use of spatial variables but this would constitute the construction of varying index models for price segments and therefore violate the results for the influence of price segments.

[2] This is analogous to 'condominium' title systems in other parts of the world.

The sample size was limited to 10 residential suburbs. This sample selection procedure was designed in an attempt to cover a number of geographical regions of the Perth metropolitan area. The suburbs selected represent different regions as determined by compass direction from the Perth central business district. All arms-length transactions for the sample period were included for each suburb. A summary of descriptive statistics for the aggregate data and relevant suburb sub-samples is shown as Exhibit 1.

It is evident from Exhibit 1 that there is some significant variation in mean selling prices for the individual suburbs for the sample period 1988-1996. The highest mean selling price is observed for the suburb of Cottesloe with the lowest applying to Maylands. Cottesloe is a prestige coastal suburb whereas Maylands is an inland suburb associated with lower housing quality. The standard deviations for mean prices reported in Exhibit 1 indicate some large differences between individual suburbs. When expressed as a coefficient of variation (Std dev/mean) it can be seen that there is a very large range in the variance between suburbs. Maylands has the largest variance, (coefficient of variation 1.20) whereas Armadale has the smallest (.20). The distributions of selling prices for all suburb regions are distinctly non-normal. The skewness and kurtosis statistics for these distributions (not reported) confirm both positive skewness and kurtosis in the distributions of selling prices for all suburbs in the sample. When multiple comparison tests[3] (results not reported) are applied to selling prices it is evident that the cheaper suburbs (Armadale, Hamilton Hill, Maylands, Midland) form one homogenous group and another homogenous group is formed by several more expensive suburbs (East Fremantle, Subiaco). Interestingly the most expensive suburb of Cottesloe is independent from any homogenous group, as are the suburbs of Scarborough, Victoria Park and South Perth.

Exhibit 1 also provides summary statistics for the important structural variables for each suburb. These are discretely measured variables for building area, age of building at date of transaction, numbers of bedrooms and car bays. It is evident that there is not a significant variation in the mean building areas for these suburbs other than for the suburb of Maylands which appears to have a significantly smaller average building area than the other suburbs. The standard deviations for building area also appear to be fairly consistent for all suburbs. When multiple comparison tests are applied to the building area variable Maylands does not form a homogenous group with any other suburb. The suburbs of Cottesloe, South Perth and East Fremantle form a distinct homogenous group of suburbs with larger building sizes.

There is more variation in the average building age at date of sale for these suburbs. Cottesloe, East Fremantle and Maylands represent older buildings, whereas Midland, Victoria Park and Armadale are characterised by younger buildings. There appears to be no significant differences for the mean number of bedrooms other than Maylands (mean = 1.9 bedrooms) which appears to be a predominantly two bedroom dwelling suburb but with a higher proportion of one bedroom dwellings. The results for the mean number of bedrooms are interesting given the corresponding results for the total building area and age of buildings. It appears that the more modern buildings (Armadale, Midland, Victoria Park), may have a higher proportion of three bedroom dwellings and may also have larger non-bedroom areas.

[3] The multiple comparison test applied was Tukey's 'honestly significance difference test'. This was applied with a one way ANOVA test. The Tukey test uses the studentised range statistic to make all pairwise combinations between groups and sets the experimentwise error rate to the rate for the collection of all pairwise comparisons.

4.0 Empirical Method – Index Construction

The index methodology used in this study is derived from the explicit-time variable (ETV) hedonic procedure as discussed by Clapp and Giacotto (1991), Gatzlaff and Ling (1994) and Costello (1997). The empirical study following utilises a number of different ETV indexes. Briefly these indexes are estimated for the full (aggregate) data set, being all suburb groups, together with *regional* indexes for smaller individual suburb sub-samples.

The ETV method groups all data for adjacent time periods and includes discrete time periods as independent (dummy) variables. The following is the functional form of equation used for estimation of indexes.

$$\ln P_{it} = \sum_{j=1}^{k} \beta_j \ln X_{jit} + \sum_{t=1}^{T} c_t D_{it} + e_{it}, \qquad (4.0.1)$$

where P_{it} is the transaction price of property i at time t, i = 1,...,n, and t = 1,...,T; β_j, j = 1,...,k, are a vector of coefficients on the structural and housing style attributes, X_{jit}; c_t the time coefficients of D_{it}, quarterly time dummies with values of 1 if the ith house is sold in quarter t and 0 otherwise; and e_{it} is the random error with mean, 0, and variance σ_e^2. The sequence of coefficients $c_1, ..., c_T$ represents the logarithm of the cumulative price index over the time period T.

4.1 Index Accuracy

An important issue in house price index construction methods is that of index accuracy. The index accuracy ratios reported in Exhibit 2 are those used in the study by Case & Shiller (1989). These index accuracy ratios are calculated from the quarterly index levels, annual (fourth) differences and standard errors derived from the respective regression procedures used to construct the individual indexes. The figures given are ratios of the standard deviation of a variable to the average standard error for that variable. Higher ratios indicate more accurately measured index characteristics. Case & Shiller (1989) describe ratios in excess of 4.0 for the log index in levels as "accurate", and ratios in the vicinity of 2.0 – 4.0 for annual differences as "fairly accurate". Ratios in the vicinity of 1.0 – 2.0 for quarterly differences were discussed: "we thus cannot accurately describe the quarterly changes in the log prices, though the index will give a rough indication." (Case & Shiller (1989: 127)).

Using Case & Shiller's (1989) criterion it is evident that for this data the quarterly levels are quite well measured for most suburb samples, the exceptions being Armadale, Hamilton Hill and Midland. The annual difference ratios are not so well measured. According to Case & Shiller's criteria these measured differences will provide only a "rough indication" of the true annual differences occurring in these suburbs.

4.2 Parametric Statistical Tests – Method and Results

From the individual regional indexes the variable z can be constructed. Let z be the annual difference for the respective quarterly period hedonic index.

$$z_{it} = \hat{c}_{it} - \hat{c}_{it-4} \qquad (4.2.1)$$

Where $\hat{c}_{it}$ is the estimated logarithmic coefficient for suburb i, taken from time dummy variables as used in the hedonic index procedure shown in equation (4.0.1). The mean z for each respective hedonic index can then be calculated. The mean z statistics are shown in Exhibit 2. It can be seen that there are some significant differences between the mean z results for the various regions.

The mean z for the index including all suburbs is about 2.9% per annum. This figure represents the annual average rate of price appreciation for the sample for the period 1988-99 unadjusted for inflation. It can be seen that the rate of change for Cottesloe is significantly higher, approximately 7.6% per annum. The lowest reported annual increase is for the suburb of Armadale approximately one third of one percent per annum. Chart 2 provides detail on the relationship between the mean sale price for a suburb and average annual price change (mean z) for the individual suburb samples. Chart 2 supports the existence of a pricing size effect. It can be seen that the higher rates of price change appear to apply to the more expensive suburbs and the lower rates of price change to the cheaper suburbs.

Standard parametric statistical methods can be used to test for statistically significant rates of annual price change for the individual suburb samples. Firstly, the mean z results are subjected to a one-sample t test. The null hypothesis for this test is that the mean z for the respective suburb is no different than the mean z for the index constructed from all suburbs. Second, the mean z results are subjected to a one way analysis of variance (ANOVA) procedure. The null hypothesis for the ANOVA procedure is that all mean z results are drawn from the same sample.

The one-sample t test results are shown in Exhibit 2. Three of the individual suburb samples have mean z statistics significantly different from the mean z for all suburbs at a significance level of 5%. The significance level is taken from a one tail t distribution as it is assumed the direction of the difference from the mean z for all suburbs is known. The suburb of Armadale has a mean average rate of annual price change below the rate for all suburbs, whereas Cottesloe and Subiaco have average annual rates of price change above the rate for all suburbs.

The one way analysis of variance procedure (ANOVA) results (not reported) were inconclusive. The null hypothesis that the mean z is the same for all suburb samples could not be rejected at the 5% level of statistical significance.

4.3 Non-Parametric Statistical Tests - Method and Results

A significant problem associated with the parametric tests reported above concerns the issue of index accuracy. The index accuracy ratios shown in Exhibit 2 confirm that for several suburb indexes the index level is measured quite accurately, however the annual index difference is measured with marginal index accuracy. This provides some questions as to the validity of the parametric test results. An alternative approach is possible with a transformation to the data and the application of a non-parametric statistical testing procedure. Let ΔPA_{it} be the abnormal price change[4] for suburb i at time t

$$\Delta PA_{it} = z_{it} - \overline{Z}_t \qquad (4.3.1)$$

Where z_{it} is the annual index difference for suburb i calculated in equation (4.2.1) and $\overline{Z}_t = \frac{1}{n}\sum_{j=1}^{n} z_{jt}$, z_{jt} is the annual index for all suburbs in the sample. This is in effect a transformation to differentials. The right hand term of equation (4.3.1) represents the difference between the annual index change for suburb i and the average unweighted annual change for all suburbs in the sample. The sum of all abnormal price changes for the sample will be zero, $\sum_{i=1}^{n} \Delta PA_{it} = 0$

The transformation procedure used for abnormal price changes will result in individual suburbs having either positive or negative abnormal price changes for any sample period. This is determined by the direction of the difference from the average price change for all suburbs for a particular period. The calculated mean annual abnormal price changes for individual suburbs are shown in Exhibit 2 and Chart 3. These results are consistent with previous results in that the

[4] The term *abnormal price change* as used here is consistent with the methodology used in several US studies. Clapp Dolde & Tirtiroglu (1995) and Dolde & Tirtiroglu (1997) constructed this variable in studies of information diffusion processes for house prices both within and between different regional housing markets.

suburbs with the lowest mean *z* results display negative average abnormal price changes and vice versa.

An important advantage of this abnormal price change variable over the mean *z* variable is that the results are not so dependent upon the accuracy of measurement for the index difference. To use the abnormal price change in a non-parametric testing procedure such as the runs test, the main assumption required is that the direction of the change as measured from zero has been measured correctly. The magnitude of the change is not relevant in a runs test.

The runs test (Siegel & Castellan: 1988) analyses the sign of abnormal price changes during the sample period to test for independence of the changes for individual periods. The term *runs* refers to consecutive periods of price changes of the same sign. If it is assumed that abnormal price changes in individual periods are independent (the null hypothesis) then the expected number and length of runs can be calculated. By comparing the actual number of runs with the expected numbers of runs, evidence of dependence in price changes between periods can be gathered.

By using this procedure those suburbs with measured levels of abnormal price change consistently positive or negative would be identified as locations that are either significantly above or below the average level of price change for all suburbs. The level of statistical significance for a runs test is measured with the use of a *Z* score. The results for the runs tests on individual suburbs are shown in Exhibit 2. It can be seen that the only suburb with a runs test result that rejects the null hypothesis of independence between abnormal price changes is Cottesloe (significant at a level of 10%). This result can be interpreted as indicating that for a constant-quality housing unit in Cottesloe, abnormal price changes are consistently positive and are therefore not independent. This provides evidence of a location influence in Cottesloe. For all other suburbs abnormal price changes appear independent, providing evidence against any location influences in these suburbs.

5.0 Caveats and Implications for Further Research

The results reported in this study confirm that location segmentation offers a number of opportunities for further testing of price formation and information diffusion processes in housing markets. There are several areas of concern and a number of potential areas for further research revealed by this study. The future areas of research involve the influence of location segmentation on the informational efficiency of housing markets. A number of studies have examined real estate market efficiency using serial correlation tests with lagged index differences (Gatzlaff & Tirtiroglu: 1995). The use of indexes as determined by location segments raises a number of new and challenging issues for house price index construction methods.

The hedonic index models used in this study may not be appropriate for analysis of location segments due to problems of index accuracy. The hedonic model used in this study utilises a minimum number of accurately measured structural attributes that are common for all properties. Despite this consistent index model, Exhibit 2 confirms that there are still significant variations in the accuracy of hedonic indexes according to location segment. Several frequently discussed issues concerning hedonic index methodology require examination. Meese and Wallace (1995) proposed the use of nonparametric index methods in testing informational efficiency in housing markets. They argue that nonparametric methods are desirable over parametric methods because: "(i) the functional form of the hedonic is generally unknown, and should be allowed to vary by municipality; (ii) nonparametric regression allows variation in the attribute prices every quarter so that a well-defined price index can be generated; and (iii) flexibility in estimation of the hedonic is likely to translate into a generated price index with more reliable short-run dynamics than a fixed parametric approach." (Meese and Wallace (1995: 248-249)). The influence of location segmentation in housing markets should be further tested with alternative index methods.

The most important issue raised by this study concerns the potential influence of price segmentation. The results reported here confirm the results of some recent studies examining the influence of price segmentation and pricing size effects in housing markets (Costello: 1999). These studies confirm that price segmentation is important in explaining house price dynamics and that pricing size effects exist according to the price hierarchy of housing units sold. Cheaper properties exhibit higher rates of real price change in the short term but the lowest rates in the longer term. This pattern is also evident in the restricted sample examined in this study. Chart 2 provides evidence of a similar pricing size effect. The higher priced suburbs exhibit the highest mean annual rates of price change and vice versa. This casts some doubt as to whether the results reported here are indicative of location or price segmentation influences.

The future use of demographic variables is an important consideration. It is very likely that the most influential levels of location segments have not been identified in this study. Segmentation by suburb name represents a simplistic approach to analysis of a housing market with many determinants of relevant sub-markets. This methodology could be improved with segmentation criteria identified on the basis of relevant housing market theory. One attractive option is specification of location segments according to demographic variables. Census data could be used to identify relevant demographic determinants of the housing stock. This data could then be matched with transaction data in specific spatial sub-markets with similar demographic profiles. Specific spatial markets could then be used in similar tests to these. The shift-share analysis technique (Costello: 1995) could be usefully employed in this type of analysis.

6.0 Conclusions

Location is often discussed as a key influence in explaining house price dynamics. This study presents two methodologies based upon the construction of constant-quality house price indexes to test whether statistically significant price changes can be observed for a sample of Perth suburbs for the period 1988 – 1999. The results confirm a low level of influence for location variables. These results are consistent for both parametric and non-parametric statistical methods. The results also provide some evidence of a pricing size effect according to the price hierarchy of housing units sold. The further analysis of location and pricing size influences will have an important role in understanding the information diffusion processes that operate both within and between housing sub-markets.

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Exhibit 1

Descriptive Statistics											
Variables	All Suburbs Mean *Std dev*	Armadale Mean *Std dev*	Cottesloe Mean *Std dev*	East Fremantle Mean *Std dev*	Hamilton Hill Mean *Std dev*	Maylands Mean *Std dev*	Midland Mean *Std dev*	Scarborough Mean *Std dev*	South Perth Mean *Std dev*	Subiaco Mean *Std dev*	Victoria Park Mean *Std dev*
Sale Price ($'000)	110.61 *79.15*	64.18 *13.34*	205.54 *125.68*	126.21 *76.76*	74.59 *24.66*	65.64 *79.15*	82.66 *25.62*	99.56 *38.27*	167.91 *118.89*	134.67 *64.96*	110.37 *51.45*
Building Area (sqm)	80.8 *29.5*	83.5 *14.4*	89.9 *39.9*	93.6 *36.8*	77.6 *20.7*	69.0 *21.1*	84.3 *16.8*	79.0 *24.4*	89.3 *37.2*	77.5 *28.4*	83.5 *30.5*
Building Age (Years)	18.6 *11.3*	13.1 *9.0*	24.0 *13.0*	21.4 *13.1*	18.2 *10.1*	20.0 *9.5*	9.9 *15.8*	18.9 *9.3*	20.7 *9.2*	20.7 *15.3*	13.4 *12.8*
Bedrooms (N)	2.2 *0.7*	2.6 *0.6*	2.0 *0.8*	2.3 *0.6*	2.2 *0.5*	1.9 *0.6*	2.5 *0.5*	2.2 *0.6*	2.2 *0.6*	2.0 *0.8*	2.3 *0.8*
Car bays (N)	0.7 *0.6*	0.8 *0.4*	0.7 *0.8*	0.6 *0.7*	0.6 *0.6*	0.4 *05*	1.0 *0.4*	0.8 *0.5*	0.8 *0.7*	0.6 *0.6*	0.8 *0.6*
Number (N)	14,814	799	780	795	510	3,183	300	3,206	2,411	763	2,067

Exhibit 2

Index Accuracy and Statistical Test Results

	Variables	All Suburbs	Armadale	Cottesloe	East Fremantle	Hamilton Hill	Maylands	Midland	Scarborough	South Perth	Subiaco	Victoria Park
Index Accuracy Ratios *1.*	Quarterly Index Level	3.9	1.3	2.8	2.1	1.9	2.2	0.9	3.5	3.4	2.9	3.1
	Index Annual Difference	2.5	1.7	1.2	1.3	2.0	2.0	1.3	2.2	1.5	1.3	1.5
Parametric Tests	Mean *z* *2.*	0.029	0.003	0.076	0.040	0.025	0.014	0.015	0.031	0.044	0.057	0.041
	t test statistic *3*	*n.a.*	-1.79 †	2.50 †	0.69	-0.18	-1.37	-0.48	0.14	1.23	2.03 †	1.17
Non-Parametric Tests	Mean Abnormal Price Change ΔPA *4*	*n.a.*	-0.031	0.041	0.005	-0.009	-0.021	-0.019	-0.004	0.009	0.022	0.007
	Runs Test *Z* score *5*	*n.a.*	0.00	1.87 ‡	-0.65	0.00	0.55	1.10	-0.65	-0.22	-0.43	-0.46

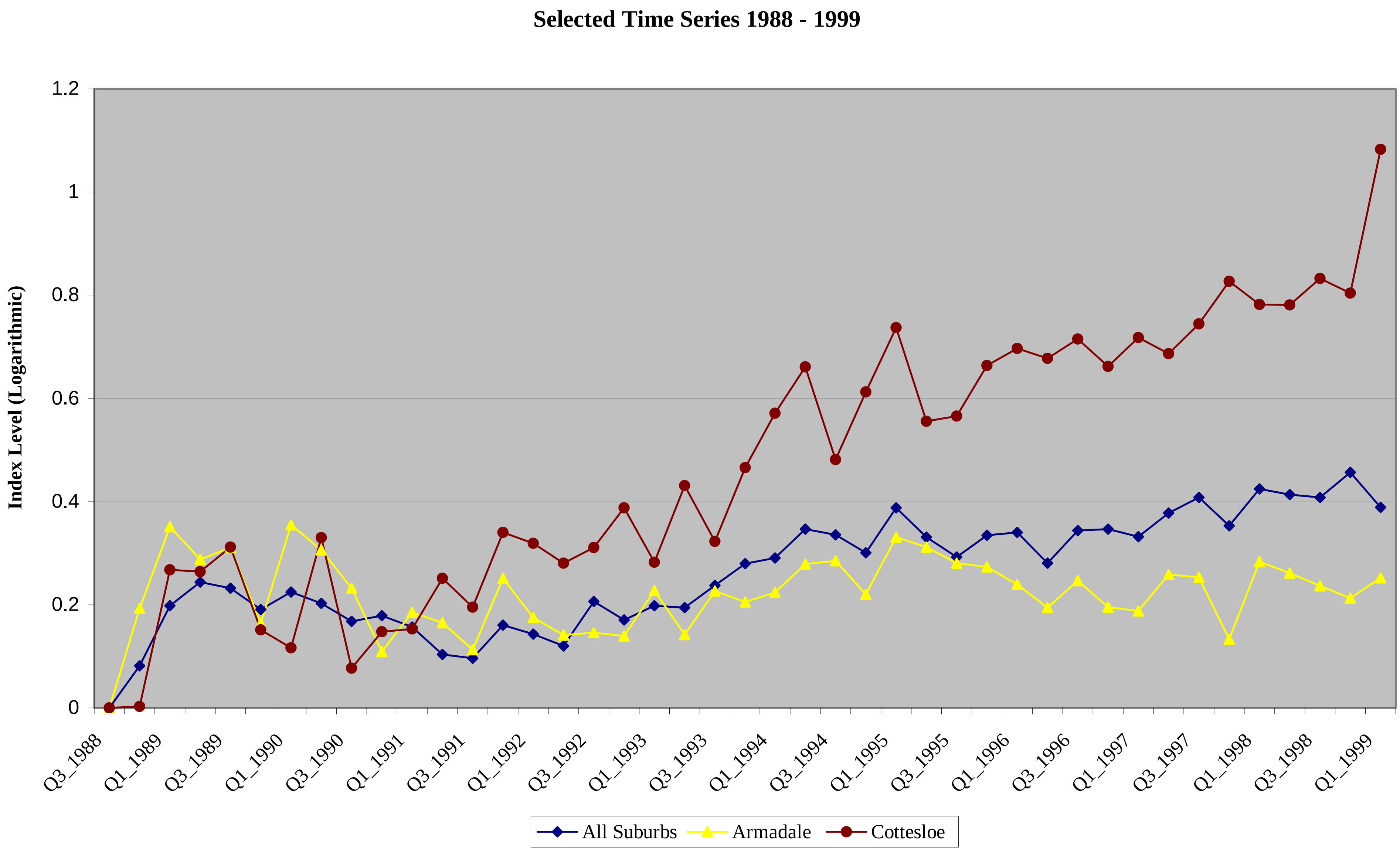
Notes:

1. Index accuracy ratios are calculated from the ordinary least squares (OLS) regression procedure used to construct the relevant index. Figures given are ratios of the standard deviation of a variable to the average OLS standard error for that variable. Further detail is available in the text.
2. The variable *z* is the annual difference for the relevant index, $z_{it} = \hat{c}_{it} - \hat{c}_{it-4}$ where $\hat{c}_{it}$ is the estimated logarithmic coefficient for the time dummy variables.
3. The one sample *t* test, tests the null hypothesis that the mean *z* for an individual suburb is the same as the mean *z* for All Suburbs.
4. The abnormal price change ΔPA_{it} represents the difference between the mean z_{it} for the relevant index and the average z at time t for all individual suburb indexes. More detail and full notation is available in the text.
5. The runs test analyses the sign of abnormal price changes during the sample period to test for independence of the changes for individual periods. Further detail is available in the text.

† Statistically significant at 5% level

‡ Statistically significant at 10% level

Chart 1


Selected Time Series 1988 - 1999
Index Level (Logarithmic)
1.2
1
0.8
0.6
0.4
0.2
0
Q3_1988
Q1_1989
Q3_1989
Q1_1990
Q3_1990
Q1_1991
Q3_1991
Q1_1992
Q3_1992
Q1_1993
Q3_1993
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Q3_1997
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Q3_1998
Q1_1999
All Suburbs
Armadale
Cottesloe

Chart 2

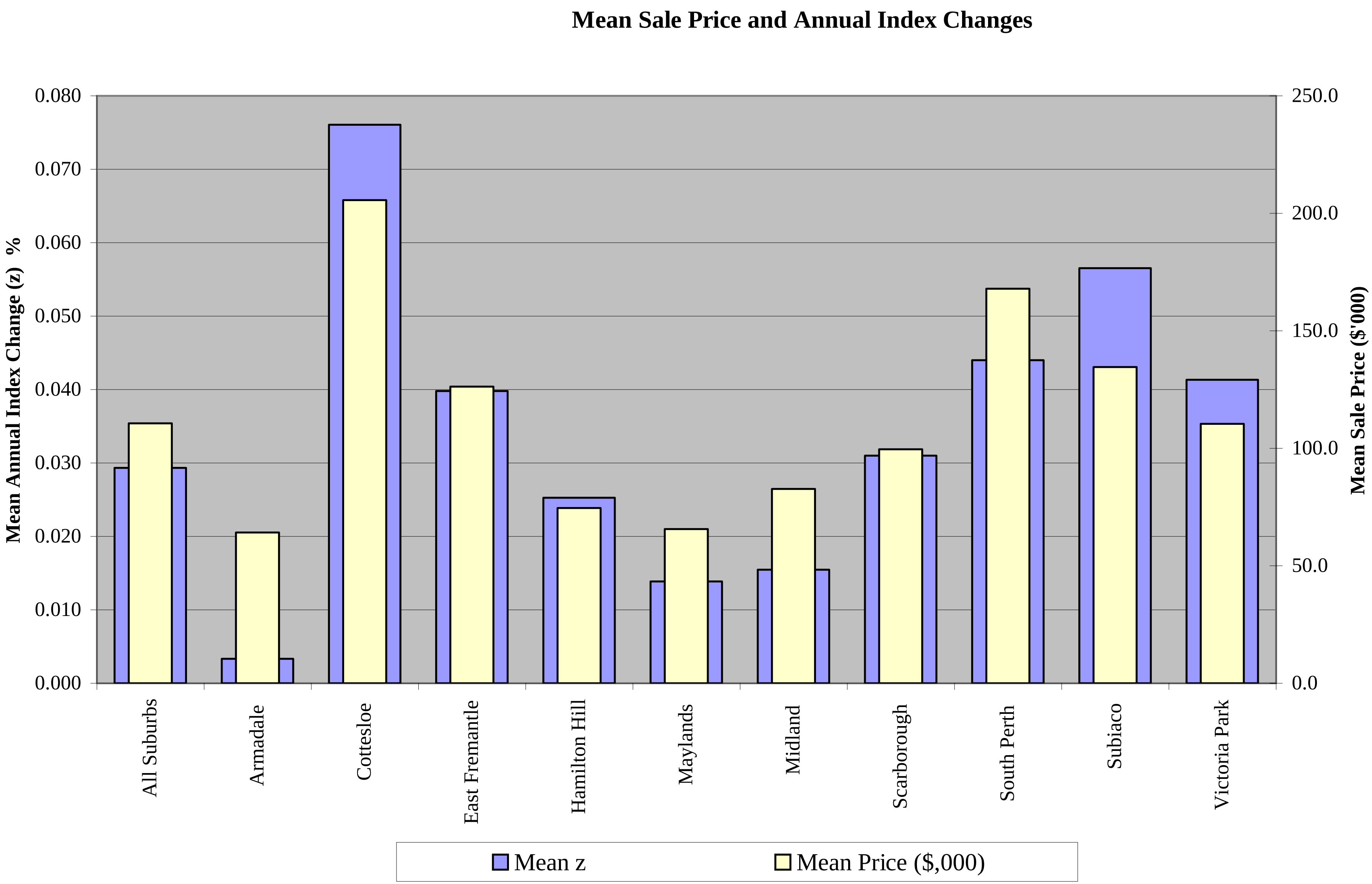
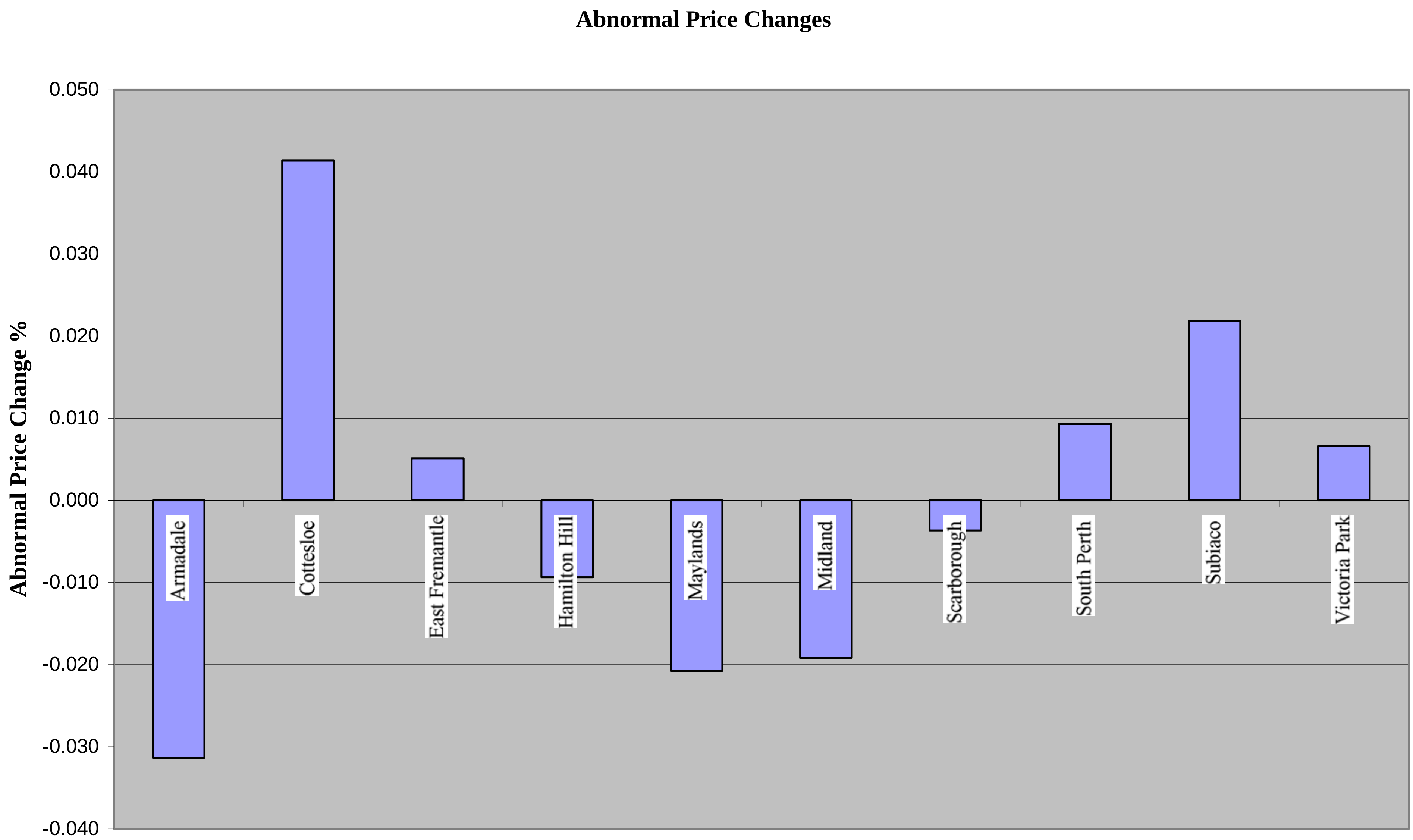

Mean Sale Price and Annual Index Changes
Mean Annual Index Change (z) %
Mean Sale Price ($'000)
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
250.0
200.0
150.0
100.0
50.0
0.0
All Suburbs
Armadale
Cottesloe
East Fremantle
Hamilton Hill
Maylands
Midland
Scarborough
South Perth
Subiaco
Victoria Park
Mean z
Mean Price ($,000)

Chart 3


Abnormal Price Changes
Abnormal Price Change %
0.050
0.040
0.030
0.020
0.010
0.000
-0.010
-0.020
-0.030
-0.040
Armadale
Cottesloe
East Fremantle
Hamilton Hill
Maylands
Midland
Scarborough
South Perth
Subiaco
Victoria Park