SEASONAL INFLUENCES IN AUSTRALIAN HOUSING MARKETS

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ABSTRACT

This paper examines the impact of seasonal influences on housing market activity. Empirical tests examine the influence of a quarterly season on the demand for housing and the observed real house price changes. Empirical tests are specifically designed for a 'short' time-series, 1988-95. The explanatory power of the statistical tests is improved by 'stacking' regional data to perform more robust tests for seasonality. The results confirm significant seasonal influences. The volume of transactions and hence demand is greatest during the first quarter of a year and lowest during the last quarter. The observed real house price changes are highest in the first quarter of a year and lowest during the third quarter.

Keywords: Housing markets, seasonality, seasonal demand, seasonal price change, house price index

INTRODUCTION

Understanding the influence of seasonal influences in housing markets is important for several reasons. Firstly, seasonal influences are important in determining the demand and supply characteristics of housing markets. Secondly, seasonal influences might influence price changes that are observed in housing markets. The question of variations in demand and supply is important in understanding the influence of housing transactions within the general macro-economy. An understanding of the influence of seasonal factors on price changes for housing in specific regions is important for time-series analysis of specific house price series. Moreover it is important that market participants have an understanding of seasonal influences in specific housing markets so that correct decisions can be made.

There are several important issues related to tests of seasonality in Australian housing markets. The major Australian housing markets are the capital cities and large towns. In general, the large housing markets are expanding with many specific regional sub-markets comprising established and new housing. It is possible that there are distinct differences in the seasonal volumes of the supply of new and existing housing in these regions. In new housing areas, the transaction record is recent, creating a 'short' time-series with some associated difficulties for standard parametric tests of seasonality. Often the analyst may only have data available for a short period of time or be interested in a short specific time frame. In these circumstances, it is important to establish the likelihood of seasonal influences.

Towards this end, a specific data set is used in this study. A 'short' time-series from 1988-95 is used with a very evident trend and cyclical component. This specific data period is used to demonstrate how these techniques might be used with selected short time-series.

This paper makes two specific contributions to the literature dealing with seasonal influences in Australian housing markets. First, a method for analysis of demand within a housing market for seasonal influences and second, a methodology to establish whether seasonal influences impact upon the observed price changes between seasons. The empirical techniques demonstrate these methods with a specific 'short' time-series containing a period of volatility in both housing demand and real house price changes. The next section reviews the literature relating to seasonal studies of housing markets both in Australia and overseas. Section 3 of the paper comprises the empirical study. The paper concludes with some commentary on the likely causes of these seasonal influences and some suggestions for future research.

LITERATURE REVIEW

Whereas there is a significant international literature concerning seasonal influences in housing markets, there has been a distinct lack of empirical research within Australian housing markets. The international literature includes studies specifically examining seasonal influences and a number of important studies related to the informational efficiency of housing markets where seasonal influences are an important consideration in time-series analysis. There have also been studies in UK housing markets, where seasonal patterns of migration between housing markets have been identified.

The study of seasonal influences in housing markets has been examined in a number of U.S. studies that specifically examined seasonality. Rosen (1973) recognised that a number of factors such as household moving patterns, marriages and family formation rates contribute to housing seasonality. He concludes that seasonality of demand is the dominant factor. Harris (1989) reports empirical evidence of strong second and third quarter seasonality in a housing price model estimated for the period 1970-85, with prices at their lowest level during the fourth quarter. Reichert (1990) developed a reduced form price model to explain regional differences in new and existing housing prices. It is reported that the number of existing homes placed on the market during any given quarter varies significantly, although these influences were not so pronounced in the supply of new housing.

Seasonality has also been an important consideration in the large number of studies examining the informational efficiency of housing markets. In general, the methodology used in these studies has been to estimate indices for specific housing markets and to examine the serial correlation properties of the time-series. In using these techniques, seasonal influences in indices must be considered. In some US studies (Case & Shiller, 1989; Clapp, Dolde & Tirtiroglu, 1995; Dolde & Tirtiroglu, 1997), seasonal influences have been considered as an influence on quarterly real house price changes. These studies have not addressed the issue of varying volumes in the demand for housing between seasons, but acknowledge some seasonal influence in price changes between quarterly seasons by using annual index differences in serial correlation tests.

It is important to note that in some of these studies, the evidence of seasonality of price changes is not statistically significant. Case & Shiller (1989) report evidence of price changes being highest in the second quarter and lowest in the third quarter of a year. They argue that much of this may be due to seasonality in the composition of types of homes sold over the year. In general, Case & Shiller's (1989) results for tests of seasonality are not statistically significant, possibly due to the fact that the 'short' time-series used limited the degrees of freedom available for use in standard parametric tests, an issue specifically addressed in this study.

Kuo (1996) extends on the Case & Shiller study by using the same data series to examine a Bayesian method to estimate the serial correlation and the seasonality of the price behaviour of the residential housing market. The empirical results suggest that seasonality is not a statistically significant influence on returns, although the returns to seasonal dummy variables are strongest for the second quarter of a year closely followed by the first quarter.

Alexander & Barrow (1994) examine the seasonality of regional house prices in the UK. They report evidence of seasonal influences on the causal flows of housing transactions between regions in the UK. It is found that causal flows tend to be northwards and that there is also some relationship with the migration patterns particularly in the south of England.

Whereas anecdotal evidence has suggested that important seasonal factors are apparent in Australian housing markets, there have been very few empirical studies. Rossini (2000) conducted the only empirical study in recent years. This study examined seasonal effects in the housing markets of Adelaide. The results suggest that there are significant seasonal effects on the volume of transactions with the summer and autumn quarters showing some statistically significant seasonal effects. There is little evidence of any statistically significant seasonal effect on price changes. Rossini suggests that if there is any seasonality in price changes, then it is too small to quantify at the sub-market level; however there is some evidence that property prices may be around 1% lower in winter than in other seasons.

METHODOLOGY

This study uses transaction data obtained from the Western Australian Valuer General's Office (VGO). In order that accurate price indices are constructed for statistical tests, the strata-title market segment is used. This market segment contains several very accurately measured property characteristics that enhance index accuracy. The study uses the aggregate Perth housing market and also thirteen specific regional sub-markets to test for seasonal influences.

In order to demonstrate the applicability of these methods with a 'short' time-series, data from the period 1988-1995 is used. This period was characterised by a house price "bubble" in the period 1988-89, a period corresponding with strong demand, a low supply of homes for sale and a rapid appreciation in house prices. The period of late 1989 through the early 1990s was characterised by a general economic recession and a period of very high interest rates with a resultant decline in real house prices. Figure 1 confirms the house price series for this period is characterised by two dominant trend components, the short upward trend of 1988 and early 1989 and the longer period of a decline 1990-95. The variation in sales volumes for the same period is shown in Figure 2. The trend and cyclical component for sales volumes is apparent, although not as pronounced as for the real house price series shown in Figure 1.

To test for seasonal variations in the demand for housing, a moving average procedure is used. The moving average method removes the trend component by taking a four period (annual) moving average through the time-series (Flaherty et al: 1999). An example of the calculations used for the moving average procedure is contained in Table 1. The moving average can then be used to compute ratios of the specific quarterly season volume to the relevant four period moving averages. This computed ratio is denoted as the variable γ, with this variable being used for statistical testing of seasonal volumes in Table 2.

In Table 2, the seasonal variation in the volume of transactions for the aggregate sample and all regions is tested according to the parametric one-sample t test and one-way ANOVA procedures. In the one-sample t test, the variable γ is used to test the null hypothesis that the mean γ for a quarterly sample is the same as the mean γ for the full sample (mean γ all periods). The one-way ANOVA procedure tests the null hypothesis that the seasonal means for the variable γ are all equal to 1. Since the sample period available is only from 1988-1995, the number of observations available for statistical tests is limited by the moving average procedure.

This problem of a limited number of observations can be overcome with a 'stacked' data procedure. In Table 2, the 'stacked regions' test involves stacking the 13 individual regional observation sets so as to increase the explanatory power. The procedure used was to stack the data for all 13 regions. The observations for region 1 are stacked above region 2 through region 13. This creates 338 observations for more robust tests of seasonality.

An important issue is whether seasonal variations in demand have any statistically significant influence on price changes between quarterly periods. Whereas the methodology for testing variations in demand is quite straightforward, the methodology for testing seasonal influences on price changes is more difficult. The statistical tests for seasonal influences on price changes are completed by using the first difference between quarterly periods. The first differences are derived from real house price indices. The index methodology used is derived from the explicit-time variable (ETV) hedonic procedure as discussed by Costello & Elkins (2000). The hedonic 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 indices.

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

where P_{it} is the transaction price of property i at time t, $i = 1,...,n$, and $t = 1,...,T$; $\beta_j, j = 1,...,k$, 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 $\hat{c}_1,...\hat{c}_T$ represents the logarithm of the cumulative price index over the time period T. Due to inflation being an important trend and cyclical component in this 1988-95 time-series, the sequence of time coefficients was deflated to represent real log price indices. The real log price coefficient $\hat{H}_t$ is calculated; $\hat{H}_t = \hat{c}_t - LN(CPI_t)$

The influence of aggregation might suggest that all sub-markets are subject to seasonal influences, whereas in reality some specific sub markets may be more or less subject to the influence of seasonal influences. Table 3 provides some descriptive statistics for the samples used in estimation of regional indices. The most important hedonic variables are the building area and age of the building as at the date of the transaction. Table 3 provides an analysis of the means of the selling prices and hedonic variables for the aggregate data and for individual regions. It is evident that all regions constitute independent samples with distinctly different mean selling prices and hedonic characteristics. All regions excepting region 13 have a mean selling price significantly different from the mean for the aggregate sample (at significance level of 5% or higher). All regions except regions 7 and 8 have significantly different mean building areas and all regions have significantly different mean building ages at the date of transaction.

Table 3 also provides some statistics for the index level differences and index accuracy. The variable x is the annual difference from the relevant real log price index, $x = \hat{H}_t - \hat{H}_{t-4}$. An important fact revealed by this variable is that a number of regions experienced negative average annual rates of real price growth during the sample period 1988-95. In fact, this is the case for more than 50% of the regional samples (regions 4, 5, 6, 7, 10, 11, 12).

The mean x result for each region was also subjected to the Wilcoxon signed rank nonparametric test. This procedure tests the hypothesis that an individual region's x variable distribution is the same as the distribution for all regions. Because there is only a small sample size for each region, this is a more appropriate test than a parametric procedure. The results confirm significantly different distributions for 6 of the total 13 regions.

The index accuracy ratios reported in Table 3 are calculated according to the procedure used by Case & Shiller (1989). 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. By reference to Case & Shiller's (1989) criteria, it is evident that the levels and annual differences of the estimated regional indices are all well measured. The quarterly difference is well measured for most of the regional indices.

In order to test for statistically significant differences in price changes between quarterly periods, the variable z was constructed. The variable z is the first difference from the real log price index: $z = H_t - H_{t-1}$ where $H_t =$ Hedonic index $\hat{c}_t - LN(CPI_t)$. The results for statistical tests are displayed in Table 4. To increase the explanatory power of these tests, the regional indices were stacked. The procedure used was to stack the data for all 13 regional indices where each region has 29 real log quarterly index differences for the sample period, quarter

4, 1988-quarter 4, 1995. This creates 377 quarterly index differences for more robust tests of seasonality.

RESULTS

The results shown in Table 2 confirm some significant seasonal influences on the demand for housing. The ANOVA results suggest seasonal influences exist. The null hypothesis is rejected for the aggregate sample and the majority of the regional samples. In this form, the ANOVA results do not provide detail as to the specific characteristics of the seasonal influence on demand, i.e., which quarters of the year have the highest or lowest volumes of transactions?

More information concerning specific characteristics of seasonal demand can be obtained from the one sample *t* test. This procedure tests the null hypothesis that the mean γ for a quarterly period sample is the same as the mean γ for all quarters. For the aggregate data, the volume of transactions is highest in the first quarter of a year and lowest in the last quarter of a year. These results are statistically significant at a level higher than 5%. These results are also confirmed when the data is disaggregated into the regional data sets. From the total 13 regions, 6 regions display a statistically significant result confirming the highest volume of transactions occurring in the first quarter of a year. The results for tests on the fourth quarter confirm the lower volume of transactions, with statistically significant results for 7 out of the total 13 regions.

It is important to note that the seasonal trend is not so evident in all regions. Whereas the general pattern of highest volumes in the first quarter and lowest volumes in the fourth quarter of a year is evident for most regions, four of the regions (regions 4,7,9,11) display no statistically significant seasonal influence for any quarterly period. Region 5 displays the most evident seasonal influences with three statistically significant seasonal quarters and contrary to the general trend, the third quarter of the year has the highest volume of transactions. The stacked region test displays the highest levels of statistical significance due to the greater explanatory power of the tests through the use of more observations.

From these results, it does appear that the demand for housing is seasonal, especially in the summer months. The most likely explanation relates to yearly work patterns. More people have holidays and there are extended school breaks during the summer months. It is likely that many housing market participants plan their market activity to coincide with these periods and there are resultant variations in demand and supply for housing services during these periods.

This explanation is consistent with results for studies in countries in the Northern Hemisphere. Harris (1983) reports results of strong seasonal influences in the second and third quarters which corresponds with the northern hemisphere summer being the period between new school years and the extended holiday period. It is interesting that in this Australian study, the volume of transactions is lowest in the fourth quarter. This result is also consistent with some U.S. studies, but would appear not to relate to any summer / winter effect, but is more likely due to the influence of the Christmas period during December. Towards this end, it would be useful to examine the volume of transactions on a monthly basis so as to determine if the low volume of transactions is a specific quarterly seasonal influence or predominantly a December monthly influence.

There does not appear to be any obvious reason to indicate why some regions display greater seasonal variations in demand. Some of the regions with the most significant seasonal demand according to the ANOVA procedure are regions corresponding with older (well established) and more expensive housing (regions 2,3,5,6). In general, the regions on the periphery of the Perth metropolitan region (regions 10 11 12 13) display some seasonal influence on demand, but this is not as pronounced as in the more established areas. This apparent lower influence of seasonal demand may be due to the influence of building activity where the patterns of purchase and completion differ from what may occur with established housing.

The results for tests related to seasonal variations in price changes are shown in Table 4. These results indicate a general trend of first quarter changes (t = 1) being highest and third quarter changes (t = 3) lowest. In the aggregate sample, these differences are apparent, however only the price change for the third quarter is statistically significant at the 10% level. For the regional samples, only one region (region 12) displays a higher price change for the first quarterly period at a significance level of 10%. Two regions (regions 2 and 3) display a significant lower price change for the third quarterly period. Results for the one-way analysis of variance (ANOVA) technique are less convincing. The only statistically significant result applies to region 4, which incidentally does not display any significant one-sample *t* test results.

It is difficult to conclude that there are definite seasonal influences on price changes between quarterly seasonal periods on the basis of the results for the aggregate and regional samples. These results are consistent with those reported by Rossini (2000) where it was reported that there appeared to be a general trend of prices being lower in the winter period, although differences were too small to quantify at the sub market level.

This apparent lack of statistical significance is in large part the result of a 'short' time-series and the resultant low number of observations for specific quarterly periods. As a result, the stacked index procedure becomes particularly useful in testing the seasonal influence on price changes. It is apparent that the seasonal influence on price changes is only small. The explanatory power of these tests is increased with the 'stacking' procedure applied to regional indices. The results confirm statistical significance for the trend that is indicated in the aggregate data and individual regions. It can be seen that mean real quarterly differences are highest in the first quarter and lowest in the third quarter. These results are statistically significant at levels higher than 1%. In general, there is a trend of real house price changes being approximately 2% higher than the annual average in the first quarter and approximately 2% lower than the annual average in the third quarter. The stacked region results also suggest that the second quarter changes are lower.

These results also suggest some relationships between the varying levels of demand and price changes. The increased demand in the first quarter of a year is also accompanied by an increase in prices. Although this study does not specifically examine supply differentials, it might be inferred that the lowest demand associated with the last quarter of a year might also be accompanied by a resultant supply lag into the January period of the following quarter. This influence might be especially pertinent if the suggested Christmas effect is correct. This can only be established with a detailed analysis of monthly seasonal trends, but it would seem reasonable to infer that some part of the December period would be inactive in terms of new supply of homes for sale.

It is more difficult to reconcile the results for the third quarter of a year. The results for sales volumes in Table 2 do not indicate any statistically significant differences in demand for the third quarter other than for one region (region 5). In addition there does not appear to be a clear trend evident. Some regions appear to have a higher volume of transactions than the annual average and some have a lower volume. The results for price changes in Table 4 suggest that changes in the third quarter of a year are lower than for the annual average. This result does not appear to be directly linked to any significant variation in demand for the third quarter, although some inferences can be made from the variations in demand earlier in the year.

A plausible explanation is that this result may be linked to supply issues in that the supply of housing available for sale in the winter months is characterised by more homes that have been for sale for longer periods ('old' supply). Since demand is clearly higher in the first quarter of a year, it is likely that the most attractive homes sell quickly and the least attractive homes are not sold and constitute a larger portion of the supply of homes for sale in the winter quarters of the year. Those sellers wanting to sell are therefore likely to accept lower prices in the winter period because of the lower demand during this period.

CONCLUSIONS

This paper examines the impact of seasonal influences on housing market activity. Empirical tests are used to examine the influence of a quarterly season on the demand for housing and the observed real house price changes during that season. The empirical tests use housing transactions for the period 1988-1995. This specific time-series has been chosen to demonstrate the applicability of statistical techniques to a 'short' time-series where there are significant trend components. Data is examined for the aggregate Perth housing market and 13 distinct spatial regions.

The results provide strong evidence that the highest demand for housing occurs during the first quarter of a year and the lowest demand occurs during the last quarter of a calendar year. Variations in real house price changes between quarterly periods are also examined. The results confirm some significant seasonal influences on real house price changes. The observed real house price changes are highest in the first quarter of a year and lowest during the third quarter. In general, there is a trend of real house price changes being approximately 2% higher than the annual average in the first quarter and approximately 2% lower than the annual average in the third quarter.

These results have important implications for analysis of Australian housing markets. It is likely that the pattern of seasonal variations in demand revealed by this study exists in most of Australia's major housing markets, although there are likely to be significant differentials between regions related to levels of new building activity. These results are also important for future studies related to issues of informational efficiency in Australian housing markets Typically these studies use tests of serial dependence with estimated house price indices to examine serial dependence properties. The results of this study indicate that tests using quarterly index differences are likely to be biased by seasonal influences in price changes. The use of annual index differences has the effect of removing this seasonal trend from the data.

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Table 1: Transaction Volumes for Aggregate Data-Moving Average Transformation Procedure

Period	Number of transactions (Y)	Four period moving average	Centred moving average (CMA)	Ratio of quarter to CMA = Y/CMA = γ
88:Q3	2,210			
88:Q4	2,917	2,355		
89:Q1	2,708	2,218	2,287	1.18
89:Q2	1,586	1,886	2,052	0.77
89:Q3	1,662	1,733	1,809	0.92
89:Q4	1,588	1,740	1,736	0.91
90:Q1	2,094	1,814	1,777	1.18
90:Q2	1,614	1,898	1,856	0.87
90:Q3	1,961	1,904	1,901	1.03
90:Q4	1,922	2,044	1,974	0.97
91:Q1	2,120	2,012	2,028	1.05
91:Q2	2,172	1,879	1,945	1.12
91:Q3	1,833	1,886	1,883	0.97
91:Q4	1,391	1,908	1,897	0.73
92:Q1	2,148	2,010	1,959	1.10
92:Q2	2,261	2,190	2,100	1.08
92:Q3	2,240	2,274	2,232	1.00
92:Q4	2,112	2,357	2,315	0.91
93:Q1	2,483	2,545	2,451	1.01
93:Q2	2,592	2,727	2,636	0.98
93:Q3	2,993	3,059	2,893	1.03
93:Q4	2,839	3,105	3,082	0.92
94:Q1	3,810	3,022	3,063	1.24
94:Q2	2,778	2,868	2,945	0.94
94:Q3	2,659	2,474	2,671	1.00
94:Q4	2,223	2,343	2,408	0.92
95:Q1	2,237	2,270	2,306	0.97
95:Q2	2,251	2,193	2,231	1.01
95:Q3	2,367			
95:Q4	1,916			

Table 2: Transaction Volumes-Statistical Tests for Seasonal Influences

Region Number	N Transactions	Mean γ all periods	Seasonality One Sample t tests Mean z for Quarter t				One Way ANOVA
			Q1 Mean γ (t)	Q2 Mean γ (t)	Q3 Mean γ (t)	Q4 Mean γ (t)	F Prob.
All regions	68,799	0.994	1.105 (2.901)†	0.967 (-0.591)	0.993 (-0.048)	0.896 (-2.873)†	5.729 0.005
1	5,951	0.987	1.083 (1.740)	0.966 (-0.348)	0.978 (-0.152)	0.908 (-2.606)†	1.916 0.157
2	9,001	0.996	1.137 (2.967)†	0.964 (-0.504)	0.982 (-0.990)	0.882 (-2.713)†	5.171 0.007
3	10,220	0.999	1.111 (3.768)†	0.991 (-0.250)	0.955 (-1.718)	0.920 (-2.027)	7.015 0.002
4	5,813	0.989	1.067 (1.747)	1.004 (0.376)	0.957 (-0.938)	0.912 (-2.445)	2.801 0.064
5	6,253	0.988	1.070 (2.450)†	0.924 (-1.519)	1.097 (3.721)†	0.857 (-3.079)†	9.286 0.000
6	4,139	1.003	1.171 (3.258)†	0.976 (-0.529)	0.972 (-1.316)	0.868 (-3.322)†	8.223 0.001
7	2,600	0.990	1.017 (1.068)	0.991 (0.022)	1.048 (1.466)	0.898 (-1.304)	1.431 0.261
8	4,996	0.990	1.106 (2.761)†	0.961 (-0.530)	1.002 (0.412)	0.877 (-1.905)	3.990 0.021
9	4,319	0.992	1.090 (2.267)	0.907 (-1.775)	0.980 (-0.251)	0.987 (-0.118)	3.105 0.047
10	3,606	0.996	1.171 (5.898)†	0.890 (-2.023)	1.043 (1.745)	0.868 (-3.381)†	13.694 0.000
11	6,604	0.991	1.081 (1.453)	0.990 (-0.012)	0.967 (-1.208)	0.910 (-1.540)	1.727 0.191
12	2,215	0.985	1.151 (1.746)	0.953 (-0.399)	0.937 (-0.767)	0.877 (-2.745)†	2.576 0.080
13	3,082	0.995	1.071 (1.492)	1.011 (0.416)	1.033 (0.571)	0.847 (-2.696)†	3.364 0.037
Stacked Regions	NA	0.993	1.102 (7.992)†	0.964 (-1.966)	0.997 (0.415)	0.893 (-8.027)†	43.538 0.000

† denotes statistical significance at a level of 5%.

Table 3: Descriptive Statistics – Regional Indices

	Hedonic Variables			Index Accuracy			
Region *N* sample	Sale $'000 Mean *Std dev* (t)	Area sqm *Mean* *Std dev* (t)	Age years *Mean* *Std dev* (t)	*X* *Mean* *Std dev* (Z)	Level	Quarterly Difference	Annual Difference
All Regions 68,799	104.8 *63.4* *n.a.*	88.7 *32.2* *n.a.*	13.8 *11.7* *n.a.*	0.001 *0.081* *n.a.*	16.7	4.4	9.2
Region 1 5,951	92.0 *63.7* (-15.6)	75.1 *30.8* (-34.1)	19.7 *15.6* (29.3)	0.009 *0.095* (-1.081)	6.7	2.2	5.0
Region 2 9,001	125.2 *70.7* (-27.3)	92.4 *34.6* (10.2)	14.1 *10.9* (2.8)	0.010 *0.075* (-1.466)	7.1	2.6	4.4
Region 3 10,220	121.8 *100.5* (17.1)	82.2 *40.0* (-16.6)	18.8 *12.6* (40.4)	0.010 *0.077* (-2.402) †	7.6	2.4	4.2
Region 4 5,813	117.2 *55.3* (17.1)	92.5 *31.3* (9.2)	12.8 *10.0* (-8.0)	-0.004 *0.080* (-1.105)	6.0	2.8	4.3
Region 5 6,253	84.8 *28.6* (-55.2)	83.5 *23.2* (-17.9)	12.7 *9.1* (-9.6)	-0.009 *0.076* (-2.619) †	6.0	3.5	6.1
Region 6 4,139	88.9 *24.3* (-42.1)	91.5 *24.9* (7.1)	10.5 *10.3* (-20.8)	-0.007 *0.079* (-2.571) †	5.3	2.8	4.7
Region 7 2,600	77.2 *24.5* (-57.5)	88.3 *20.0* (-1.2)	9.6 *8.4* (-25.6)	-0.011 *0.068* (-1.393)	3.2	2.2	3.4
Region 8 4,995	108.5 *56.9* (4.5)	89.6 *33.9* (1.9)	15.2 *14.4* (7.0)	0.016 *0.092* (-2.691) †	6.5	2.5	4.4
Region 9 4,319	137.0 *66.8* (31.7)	107.6 *35.7* (34.8)	10.1 *10.1* (-24.0)	0.018 *0.083* (-3.532) †	6.3	2.1	3.8
Region 10 3,607	99.1 *33.0* (-10.5)	99.8 *24.5* (27.1)	10.1 *7.5* (-29.4)	-0.002 *0.080* (-0.529)	4.7	2.3	3.9
Region 11 6,604	78.9 *34.2* (-61.6)	80.6 *25.4* (-25.9)	13.4 *10.4* (-2.8)	-0.012 *0.077* (-3.075) †	5.1	2.3	4.4
Region 12 2,215	78.4 *29.5* (-42.1)	84.6 *21.1* (-9.3)	10.8 *9.5* (-15.0)	-0.005 *0.081* (-0.793)	2.9	1.8	2.8
Region 13 3,082	105.8 *33.2* (1.6)	105.7 *24.8* (38.0)	6.9 *5.9* (-64.3)	0.000 *0.092* (-0.264)	5.7	2.3	4.5

† denotes statistical significance at a level of 5%.

Table 4: Real House Price Changes – Statistical Tests for Seasonal Influences

Index Quarterly Sample	All Quarters ***Mean z*** *std. Z*	Seasonality One Sample *t* tests Mean *z* for Quarter *t* t = 1 Mean *z* *(t)*	t = 2 Mean *z* *(t)*	t = 3 Mean *z* *(t)*	t = 4 Mean *z* *(t)*	One Way ANOVA F *Prob.*
Aggregate Sample	0.005 *0.036*	0.014 *(0.482)*	0.003 *(-0.154)*	-0.017 *(-2.259)*	0.017 *(0.934)*	1.407 *0.264*
Region 1	0.006 *0.040*	0.026 *(0.960)*	0.001 *(-0.288)*	-0.010 *(-1.644)*	0.009 *(0.301)*	1.020 *0.400*
Region 2	0.007 *0.041*	0.020 *(0.724)*	0.004 *(-0.300)*	-0.022 *(-4.376)†*	0.024 *(0.983)*	2.152 *0.119*
Region 3	0.007 *0.041*	0.011 *(0.223)*	0.011 *(1.368)*	0.021 *(-2.014)*	-0.022 *(0.641)*	1.674 *0.198*
Region 4	0.003 *0.046*	0.003 *(0.000)*	-0.009 *(-1.089)*	-0.024 *(-1.462)*	0.005 *(0.067)*	3.480 *0.031*
Region 5	0.003 *0.040*	0.019 *(1.000)*	-0.004 *(-0.689)*	-0.014 *(-1.159)*	0.009 *(0.382)*	0.931 *0.440*
Region 6	0.003 *0.042*	0.015 *(1.011)*	-0.001 *(-0.487)*	-0.016 *(-1.049)*	0.013 *(0.504)*	0.871 *0.469*
Region 7	0.001 *0.041*	0.025 *(1.610)*	-0.007 *(-0.881)*	-0.018 *(-1.342)*	0.002 *(0.090)*	1.467 *0.247*
Region 8	0.009 *0.047*	0.010 *(0.025)*	0.013 *(0.276)*	-0.017 *(-1.918)*	0.029 *(0.866)*	1.203 *0.329*
Region 9	0.008 *0.045*	0.041 *(1.569)*	-0.003 *(-0.949)*	0.001 *(-0.645)*	-0.007 *(-0.842)*	1.966 *0.145*
Region 10	0.005 *0.043*	0.023 *(0.921)*	-0.001 *(-0.447)*	-0.003 *(-0.564)*	0.002 *(-0.186)*	0.560 *0.646*
Region 11	0.000 *0.037*	0.020 *(1.231)*	-0.015 *(-1.874)*	-0.010 *(-0.616)*	0.004 *(0.383)*	1.374 *0.274*
Region 12	0.004 *0.049*	0.036 *(2.409)*	-0.016 *(-0.631)*	-0.007 *(-0.583)*	0.002 *(0.276)*	1.620 *0.210*
Region 13	0.005 *0.042*	0.027 *(1.462)*	-0.006 *(-0.103)*	-0.008 *(-0.278)*	0.005 *(0.642)*	0.989 *0.414*
Stacked Regions [5]	0.005 *0.042*	0.024 *(4.203)†*	-0.002 *(-1.960)*	-0.013 *(-4.940)†*	0.009 *(0.901)*	14.646 *0.000*

† denotes statistical significance at a level of 5%

Figure 1: Real House Price Index - Aggregate Sample: 1988 - 95

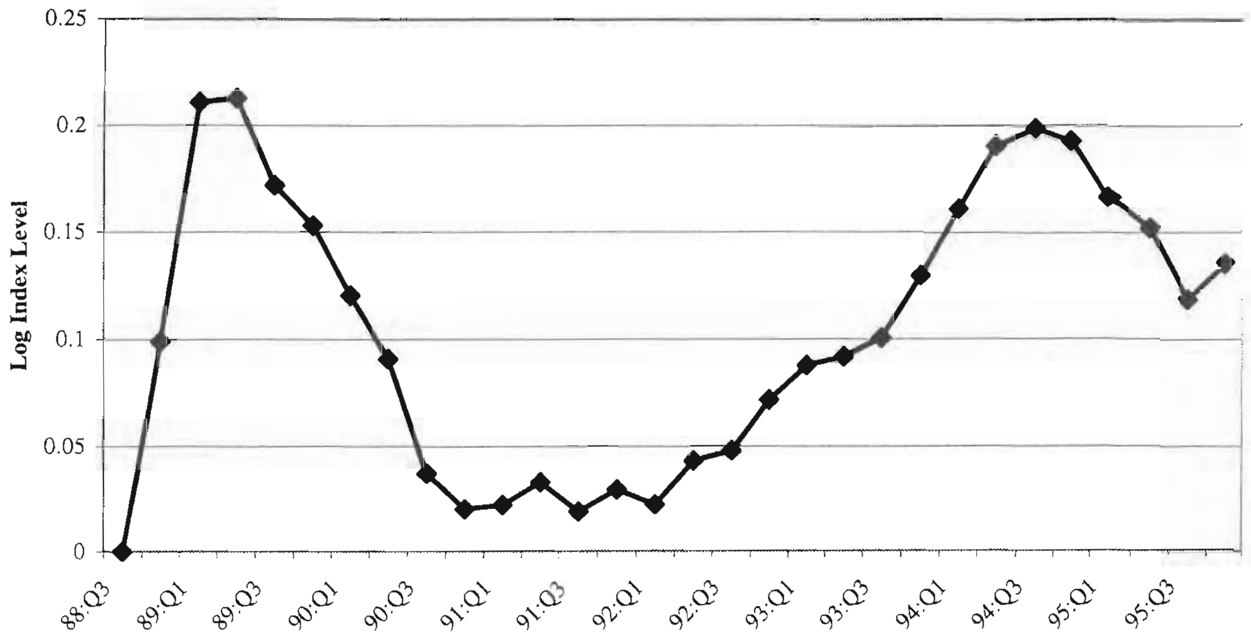

Figure 2: Volume of Transactions-Aggregate Sample: 1988-95