The Median Price as an Index of Property Price Changes

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Abstract:

The most widely used measure of property price change in the residential market is the median. Increasingly the popular media are using this measure to communicate information about residential markets in the major capital cities. The median property price has virtually been elevated to the status of a 'Residential Property index' comparable to the 'All Ordinaries Index'.

The median is a valuable guide and has the attraction of being a simple measure to calculate, even if it is not always understood by readers of the financial press. When the median is examined for information content as a location in a distribution, it can be better understood and used more objectively. An alternative measure will be used to make a comparison.

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The Need For A Price Index

The residential property market is a source of major wealth for Australians, whether as home owners or investors. Residential property is sensitive to market cycles which are reflected in prices. Because property is a lumpy asset small percentages changes can translate into large dollar amounts. A homeowner who purchased when the cycle was in an up-phase and has to liquidate in a down-phase could end up with a very substantial loss. Due to the large entry and exit costs, as a percentage of the equity, associated with property transactions, a substantial price rise is needed to prevent a loss.

Most purchasers are not affected by market cycles as they merely buy and hold. For most homeowners their efforts are concentrated on reducing or eliminating their mortgage. Some fifty percent of Australian homeowners own their homes outright and this number is increasing. Equity in their home represents a major proportion of personal wealth for a substantial number of Australians, wealth that can be used to fund their retirement.

Releasing the equity from a property may be achieved by selling the property or using it as security to raise finance. Irrespective of which option is followed, the value of the property has to be established either by sale or valuation. The ageing phase of the Australian population during the coming decades is likely to see an increase in the number of people who will need to convert the equity in their property to a more liquid form.

The heterogeneous nature of property makes it difficult to determine the price of a particular property. This is usually the province of an experienced valuer who takes his benchmark from recent sales in the immediate area where they exist. A local sales database should therefore provide a mechanism for price determination. The professional valuer takes account of several factors to arrive at a price for a specific property. Some of these factors would include size of land and building, type of construction, age, condition and many others.

Sales transactions are the source for establishing benchmarks, however, it is impractical for most market participants to engage in the extensive analysis carried out by a professional valuer. Instead, an index of price for the area is used to communicate information about prices. The most commonly used index is the median price.

The Median Price

The median ranks all prices from lowest to highest and selects the centre-most price. The median is therefore that price below which fifty percent of sales lie. If the sales that have occurred are truly representative of all properties in the area for a given time period, then the median sale price will reflect the median property price for the area.

Statistical theory may be relied upon to add some support to the measure calculated. If the sample is sufficiently large, then the sample of sales is representative of the population of properties, and the median sale price will be a good estimate of the median property price. Assuming representative samples were drawn from the same population of houses at two different time periods, a change in the median price between the two time periods would be meaningful if the underlying population remained stable across the two time periods.

Given that no significant change in the population of properties has occurred across time, the change in the median price between the two periods communicates information about property prices in a narrow price range around the median. Properties beyond this range may be subject to different market pressures to those in the neighbourhood of the median.

A general observation of the property market over time indicates that sales activity is affected by the cycle. There is a tendency for properties at the high end of the price range to increase by a larger amount during a rising market and decrease by a larger amount during a falling market. The median does not capture price movements in the vicinity of the upper or lower quartiles.

One of the median's attractions is that it is not influenced by extreme values. Prices at the top end, which can be very large for some suburbs, or at the bottom end, do not exert any influence on the result.

Interpreting changes in the median sales price as representative of price movements in a specific geographic region is asking a great deal from such a modest statistical measure. Figure 1 graphically illustrates what the median represents.
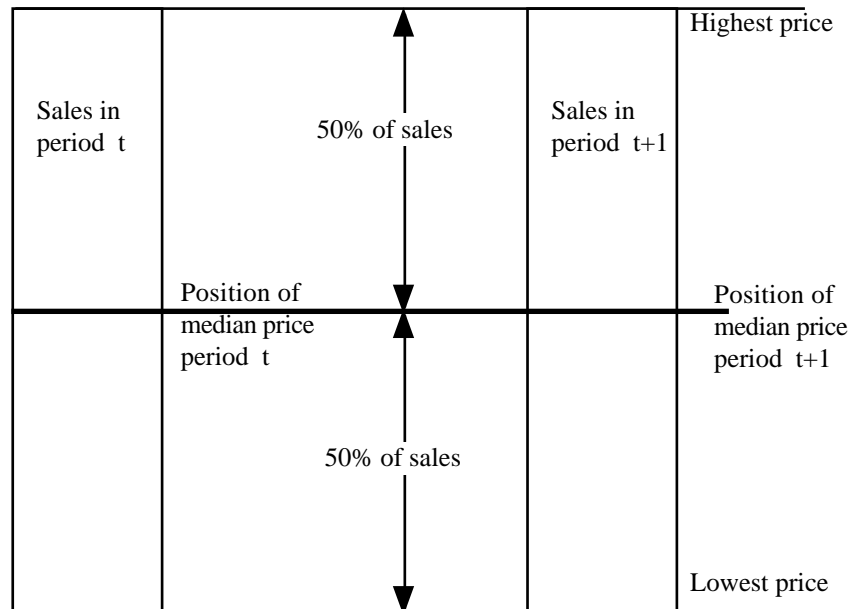

Figure 1 The Median as centre-most value

If the sales activity in period t+1 is biased toward the properties in the more expensive range, the median price will be higher in than period t, even if there is no price change in comparable properties in the two periods. Perceived price increases are the result of comparing two samples chosen from different strata of the population. This explains why, in a rising market when sales activity is more intense among properties in higher priced brackets, price increases based on the median are larger.

In addition to the obvious statistical biases inherent in the measure, the median has many other shortcomings, many of which were highlighted in a recent article in the Melbourne Age.[1] The single measure, frequently quoted in the financial media, does not distinguish between type of dwelling, that is, whether the property is a unit, flat or house.

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[1] Royce Millar, "Don't get stuck in the middle", *The Age*, 20 November, 2000.

Empirical Findings - An Analysis of South Yarra

To avoid sales activity being skewed to either the high or low end it is necessary to obtain a broader coverage of the data. One approach is to examine sales activity and prices in narrower bands. Percentile measures are presented in tables 1 and 2 for prices and sales volume.

Percentile	1995	1996	1997	1998	1999	95 to 96	96 to 97	97 to 98	98 to 99
10%	43	48	45	35	43	11.63%	-6.25%	-22.22%	22.86%
20%	43	49	74	89	83	13.95%	51.02%	20.27%	-6.74%
25%	**23**	**24**	**31**	**30**	**27**	**4.35%**	**29.17%**	**-3.23%**	**-10.00%**
30%	20	22	30	34	31	10.00%	36.36%	13.33%	-8.82%
40%	43	48	57	58	60	11.63%	18.75%	1.75%	3.45%
50%	**43**	**47**	**60**	**62**	**60**	**9.30%**	**27.66%**	**3.33%**	**-3.23%**
60%	42	48	59	62	60	14.29%	22.92%	5.08%	-3.23%
70%	46	47	58	60	63	2.17%	23.40%	3.45%	5.00%
75%	**19**	**24**	**29**	**31**	**28**	**26.32%**	**20.83%**	**6.90%**	**-9.68%**
80%	23	25	32	29	30	8.70%	28.00%	-9.38%	3.45%
90%	41	47	57	62	63	14.63%	21.28%	8.77%	1.61%
100%	43	47	59	61	59	9.30%	25.53%	3.39%	-3.28%
Total	429	476	591	613	607	10.96%	24.16%	3.72%	-0.98%

Table 1: Sales Volume for South Yarra and Percentage Changes on Previous Year

Note: December 1999 sales were not available from the sales data base, accordingly changes in sales volume between 1998 and 1999 should be ignored. Sales figures represent the number of transactions in a particular band, for example there were 30 sales in the price range bounded by the 20% and 25% percentile in 1998.

Percentile	1995	1996	1997	1998	1999	95 to 96	96 to 97	97 to 98	98 to 99
10%	$92,720	$87,250	$109,000	$124,500	$140,000	-5.90%	24.93%	14.22%	12.45%
20%	$119,600	$112,500	$137,250	$147,500	$170,000	-5.94%	22.00%	7.47%	15.25%
25%	**$130,000**	**$125,000**	**$153,000**	**$159,000**	**$185,000**	**-3.85%**	**22.40%**	**3.92%**	**16.35%**
30%	$144,060	$132,628	$165,000	$170,000	$200,000	-7.94%	24.41%	3.03%	17.65%
40%	$160,400	$158,000	$200,250	$192,500	$241,000	-1.50%	26.74%	-3.87%	25.19%
50%	**$189,000**	**$197,250**	**$250,000**	**$225,000**	**$276,500**	**4.37%**	**26.74%**	**-10.00%**	**22.89%**
60%	$225,800	$239,000	$290,000	$290,000	$336,200	5.85%	21.34%	0.00%	15.93%
70%	$270,000	$290,000	$345,000	$340,000	$400,000	7.41%	18.97%	-1.45%	17.65%
75%	**$303,500**	**$337,625**	**$376,000**	**$365,000**	**$450,500**	**11.24%**	**11.37%**	**-2.93%**	**23.42%**
80%	$355,000	$370,000	$410,000	$398,000	$506,400	4.23%	10.81%	-2.93%	27.24%
90%	$481,500	$555,000	$645,000	$585,000	$770,000	15.26%	16.22%	-9.30%	31.62%
100%	$1,710,000	$1,950,000	$4,300,000	$6,750,000	$2,550,000				

Table 2: Percentiles for South Yarra Prices by Year and Percentage Changes
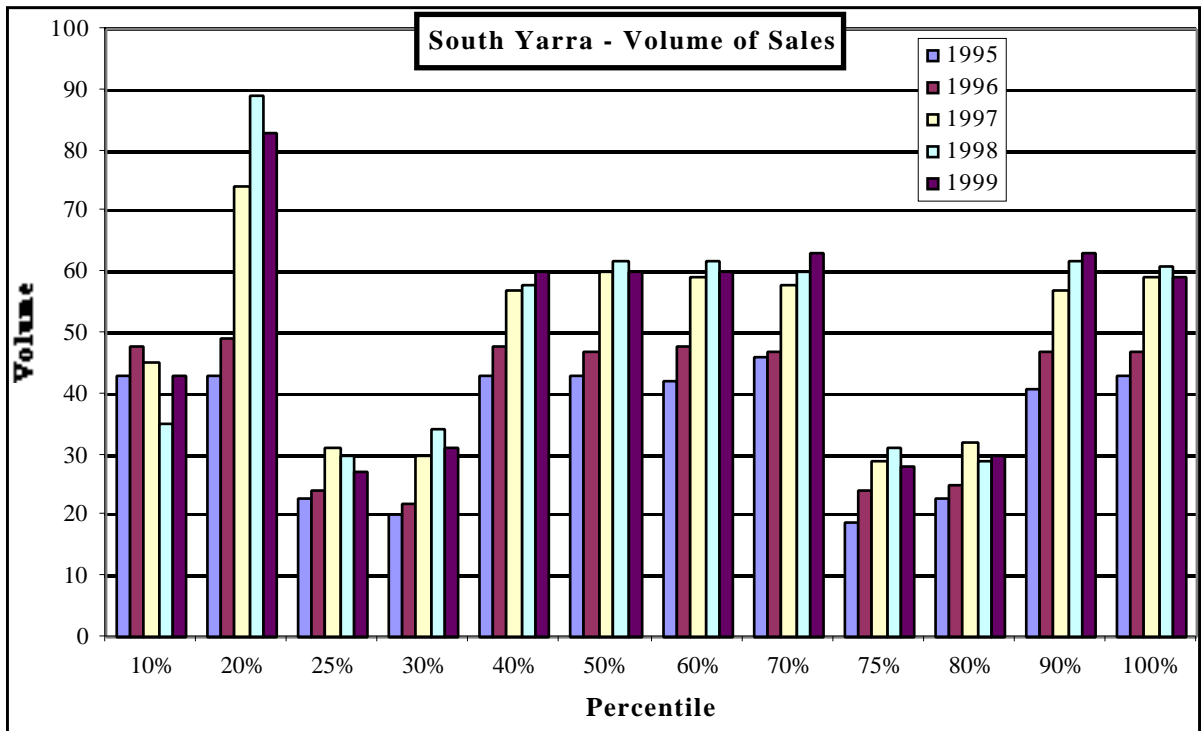
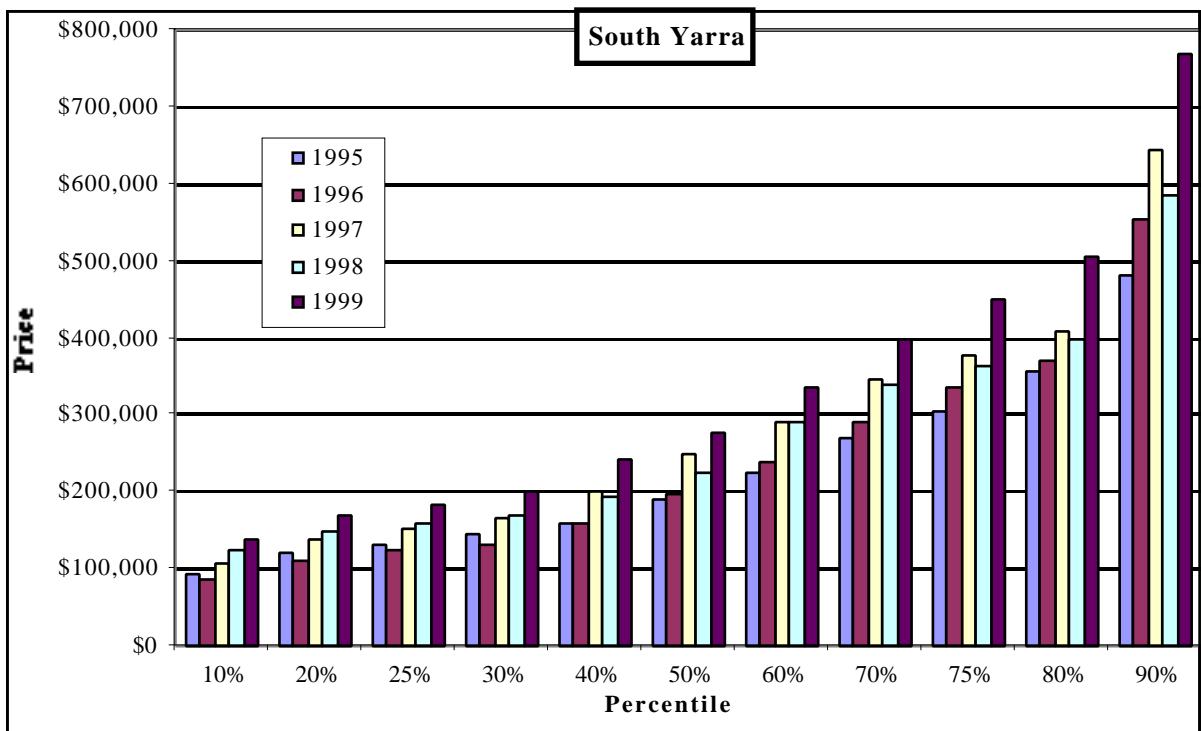**Figure 2: Percentiles by Volume of Sales**

Figure 3: Percentiles for Prices by Year

Table 2, and Figure 2, provide information on price movements for each percentile. In the 10% percentile, the region containing the lowest sale prices, it will be observed

that there was a reduction in price from 1995 to 1996 and each year thereafter prices increased by a moderate amount. This feature is present up to and including the 40% percentile.

The median price increase from 1995 to 1996 was 4.37% and 26.74% for the year ending 1997. The sales volume, for prices in the range 40% to 50% percentile, increased by 9.30% for 1996 compared with 1995. The year on year increase 96/97 in sales volume for this price range was 27.66%. The next year, 1998 saw only a modest increase in sales volume for this price range, 3.33%. An increase in the sales volume in a particular band, or percentile range, will also influence the median since the median is located exactly in the middle.

Based on the information presented in Table 2, it would be more profitable to a purchaser to enter the market in 1996 and purchase properties in the low price range. Purchasing property close to the median during the later part of the 1990s produces only modest gains. The reduction in the median price for the 1998 year, however, does not accurately reflect price movements for South Yarra during that year. The volume of sales was greater for properties in the lower price ranges, causing the median to be biased downward.

Improving the Index to Obtain a More Accurate Measure

The median is a single, freely available and easy to calculate, measure that provides, at best, a very general benchmark of price movements. Decisions based on this measure are unlikely to produce good results over time.

In a low inflation environment price decreases represent a genuine loss of value for the property owner and price increases, greater than the inflation rate, represent a gain in value. When inflation is low price distortion due to inflation is not significant. When inflation is high prices should be adjusted for inflation to obtain an accurate assessment of changes in value.

Buyers enter the market to purchase a property that fulfils certain criteria. Those who purchase two bedroom units are not in the market for three bedroom houses. There are many sub markets which experience different demand and supply pressures at different times. A trend during the 1990s in Australia's major capital cities was for inner urban living. This reduced the pressure on prices in outer suburbs and led to strong capital appreciation in the inner suburbs. A slight change in preferences can translate into significant price increases, or decreases, in particular sub markets.

To capture the dynamics of sub markets an index of value should distinguish among sub markets. This is only possible if adequate information is collected and accurately recorded in an up to date sales database. The REIV database contains most of the information necessary to track movements in the various sub markets.

To distinguish among sub markets a database should contain information about location, type of dwelling (house, unit, etc.), size of land and building, type of construction, date of sale, age, condition, and sale price. The REIV database has provision for each of these characteristics, with the exceptions of age and condition. The database is maintained through the support of affiliated agents. A sale is reported by the selling agent and the information is placed in the database.

Unfortunately not all characteristics of the property are supplied by the agent. One of the most important variables to include is building area, this variable was not reported for South Yarra during the period of analysis. A reasonable proxy for building area is the number of rooms, particularly if the sample is large. The variable set most commonly reported, in addition to sale price, where those that were easy to obtain for

the agent. These included land area –which is available from the certificate of title, number of rooms, type of dwelling and construction type.

Some of these variables were not always reported, for example, land area was recorded for approximately thirty percent of reported sales for South Yarra in the period 1995 to 1999. The absence of a complete set of characteristics for each property significantly reduces the options available to construct indices that require a broader set of property characteristics.

A Regression Based Index

Using the available characteristics for the South Yarra data a regression equation was estimated, the results are provided in table 3.

	Coefficients	*Standard Error*	*t Stat*	*P-value*		
Intercept	121826.59	45290.93	2.69	0.00734	Observations	629
House	-54434.71	31133.28	-1.75	0.08088	Std Error	166183
Unit	56599.54	75773.75	0.75	0.45538	R Square	0.593
Yr_1995	-222505.59	22435.39	-9.92	0.00000	Adj R Square	0.586
Yr_1996	-171718.71	22815.52	-7.53	0.00000	F	89.95
Yr-1997	-104526.71	21305.59	-4.91	0.00000		
Yr_1998	-83325.41	23644.65	-3.52	0.00046		
Brick	21629.65	24240.75	0.89	0.37259		
W_Board	-43427.27	28423.50	-1.53	0.12706		
No_Rooms	43873.18	6054.21	7.25	0.00000		
LandArea	837.94	50.63	16.55	0.00000		

Table 3: Regression Equation for South Yarra Data

The data represents five years of sales, 1995 to 1999. The 1999 year is captured by the constant term. Construction includes the variables Brick, W_Board and other, the latter being absorbed in the constant.

It will be observed from table 3 that the t-stats are significant for the intercept, the year of sale, No_Rooms and LandArea. Both No_Rooms and LandArea have very large t-stats, particularly LandArea, indicating the importance of these variables. It was noted previously that No_Rooms is a proxy for the preferred variable, building area.

The year of sale variables all have negative coefficients with 1995 being the largest negative value. This is consistent with expectations of price increases over time.

The coefficient of Brick construction is positive while that of W_Board is negative. Both variables are benchmarked against the variable *other* (other type of construction which might be concrete or some other material).

Three variables are used to take account of dwelling type; House, Unit and Flat. The variable Flat is absorbed into the constant and is therefore the benchmark variable. Relative to this variable we would expect the coefficients of House and Unit to be positive. While neither of these variables are significant in the model, House has an unanticipated negative sign.

The model on the whole is satisfactory, with a good F-stat and the R^2 indicates that approximately 60% of the variation in sale price is explained by the property characteristics included in the model. The explanatory power of the model would improve considerably if the number of property characteristics was increased.

Descriptive statistics for sale price indicate significant variation in the data. Some of the extreme values, particularly at the high end, should be excluded from the model to prevent distortion of the results. Properties priced close to one million dollars and above, while not unusual, are not the norm for South Yarra. The data is extremely positively skewed, a skewness coefficient of 2.27.

Mean	$411,938
Standard Error	$10,300
Median	$340,000
Mode	$350,000
Standard Deviation	$258,325
Kurtosis	7.08
Skewness	2.27
Range	$1,851,000
Minimum	$69,000
Maximum	$1,920,000
Largest(2)	$1,730,000
Smallest(2)	$70,000
Count	629

Table 4: Descriptive Statistics for Price (South Yarra)

Determining Price Change Using the Regression-based Index

The estimated regression equation may be employed to examine price changes for a particular type of property over time. The equation may be used for any dwelling type, any construction type, any given number of rooms or land size. To illustrate, a brick house with six rooms and a land area of 260 square metres is used as the representative property. A land area of 260 square metres is approximately the average land area for properties in the sample. The calculations are provided in table 5.

		1995	1996	1997	1998	1999
Intercept	121826.59	1	1	1	1	1
House	-54434.71	1	1	1	1	1
Unit	56599.54	0	0	0	0	0
Yr_1995	-222505.59	1	0	0	0	0
Yr_1996	-171718.71	0	1	0	0	0
Yr_1997	-104526.71	0	0	1	0	0
Yr_1998	-83325.41	0	0	0	1	0
Brick	21629.65	1	1	1	1	1
W_Board	-43427.27	0	0	0	0	0
No_Rooms	43873.18	6	6	6	6	6
LandArea	837.94	260	260	260	260	260
Property Price		$347,620	$398,407	$465,599	$486,800	$570,125
Price Change			14.61%	16.87%	4.55%	17.12%

Table 5: Determination of Price Change for a Given Property

This approach produces similar results, but with important differences, to the median measure (refer Table 2 above). The increase, using the representative property, is significantly greater than that of the median for the year ending 1996. However, the median indicates a price increase of 26.74% for the year ending 1997 but the representative property showed on increase of only 16.87%.

For the year ending 1998 the median produces a price decrease of 10% while the representative property method shows and increase of 4.55%. The sales volume for the 1997 and 1998 years were similar but there was heightened activity in the lower prices rages, below the median range, which caused the median to be lower in 1998. This does not mean, however, that the price of comparable properties in 1997 and 1998 experienced a decline in 1998.

The median measure is deficient for 1999 as only eleven months of data were available. This deficiency, however, is unlikely to impact on prices as December sales will not significantly change the overall price movements. For the available data, the results are similar for the two approaches; the median is suggesting an increase in prices of 22.89% while the representative property method suggests a more modest increase 17.12%.

Conclusion

The median is the most widely used measure in Australia as an indicator of property price movements. While the method has the advantage of simplicity, in terms of its calculation and interpretation, it possess some serious limitations. Examination of the volume of sales transactions in the various percentile bands sheds additional light on the reliability of the median.

An improved method for measuring property price changes requires the collection of data in addition to price. Most of this data is already available in databases such as that maintained by the REIV in Victoria. If this database is improved to incorporate the required information, price movements may be more accurately determined using the representative property method discussed above.

The database could then be used to automatically generate an index of price changes for different types of dwellings based on a representative property in any geographic region. This would provide valuable information for home buyers and investors, enabling them to more effectively allocate their financial resources.

The regression approach that has been adopted is equivalent to providing a point estimate of the expected or mean value of price. But remember that the use of the mean is not really acceptable for skewed distributions. As such, the regression approach to generating price index series for different property types could be attacked on the grounds that it is an index series of the mean price.