HOUSE PRICE CONVERGENCE: A MELBOURNE CASE STUDY

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ABSTRACT

This study explores patterns of convergence/divergence in Australian house prices across four price tiers of the Melbourne metropolitan housing market. The data covers a 20 year period (1990-2010) that spans two housing cycles. To derive a measure of house price appreciation, the research methodology divided houses into four tiers based on price and then apply the Case-Shiller Weighted Repeat Sales (WRS) Index, which contains a Generalised Least Squares (GLS) correction for periods of heteroscedasticity. The results showed that during periods of slow growth in the housing market, there are no discernible patterns of divergence between houses in low and high priced tiers. However, during periods of strong growth, houses in the lowest tier experience lower rates of capital appreciation than houses in other tiers, so the gap between low and high priced houses increased.

Keywords: Convergence, Australian house prices, Housing cycles, Affordability, Repeat Sales Index, Price tiers

1 INTRODUCTION

For nearly two decades public discussion about Australian housing markets has been characterised by affordability concerns. A chief concern is the economic and social impact of polarisation. This has led to numerous studies exploring its consequences (Dodson, 2012).

This research explores the affordability issue from a different perspective. Using the seminal work of Case and Shiller (1987) repeat sales indices for four price tiers are calculated. These indices are then analysed with a view to determining the extent of polarisation, and in particular whether there is a concern that the Melbourne metropolitan housing markets are becoming more segmented.

Results from Boymal *et al* (2013) and Wood *et al* (2014) both indicate a growing divide in house prices. In particular Boymal *et al* (2013) showed that middle income earners are finding inner city markets less accessible. This paper explores convergence using econometric techniques that complements previous public discussion.

The economic and social economic consequences of house price convergence are significant. A particular concern is the impact on labour market efficiency. Given that high priced homes are typically located closer to inner city suburbs, low income earners are increasingly being pushed to outer suburbs on the urban fringe. This pattern of displacement makes it difficult for such workers to access employment that is concentrated in the city areas, which has implications for household income. Ultimately it represents a loss in potential national prosperity resulting from productivity losses.

A second related issue is the impact on household wealth. Despite the affordability concerns that have received a tremendous amount of attention, ownership rates has remained relatively constant at approximately 70 percent (Australian Bureau of Statistics, 2012). If divergence is observed then this suggests a growing equity divide.

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This would be reinforced by the market dynamics making it harder transition upwards. Furthermore, this phenomena has significant consequences for the wealth pool available to households upon retirement.

2 LITERATURE REVIEW

There is a strong theoretical rationale as to why housing prices should converge. There are equally credible explanations that explain why divergence might occur. Convergence theories rest on the assumption of substitutionary effects.

If dwellings are relatively over-priced it is expected that occupier and investor buyers will purchase cheaper properties that offer the same features. This will have the effect of increasing demand for cheaper properties thus driving up price. There are a number of assumptions associated with this theory. Perhaps the most significant of these is that supply remains constant (or at least insufficient) to offset the excess demand for cheaper properties. In the Melbourne metropolitan context this is probably a reasonable assumption. However the assumption that dwellings are in general homogenous is invalid. Importantly there are many tangible and intangible features that a repeat sales measure does not capture such as relative dwelling size and neighbourhood characteristics. Further, this argument does not take account of income growth or mortgage product development – both of which have had significant impact on the amount would-be purchasers can borrow.

An expectation that dwelling price segments diverge is based on the work of Smith and Ho (1996). As explained in Wood *et al* (2014), in periods of rising inflationary expectations it is reasonable to expect house prices in the dearest segment to grow quicker. The argument is based on the assumption that more expensive homes are owned by households earning higher incomes and the real user cost of higher priced homes will decline in such periods. In the Australian context this is relevant for the period prior to the Global Financial Crisis (GFC) where inflation was strong averaging close to 3% over the cycle.

2.1 Concepts of convergence

A potentially insightful approach is that employed in the regional economics literature to study the dynamics of regional economy growth paths and whether per capita regional incomes converge (Barro and Sala-i-Martin, 1992; Young, Higgins and Levy, 2008). These studies distinguish between beta (β) and sigma (σ) concepts of convergence. β convergence occurs when the growth rates in lower priced tiers exceed those of higher priced tiers. σ convergence occurs when the dispersion in house prices between tiers narrows over time, and is typically measured by reference to the standard deviation of house prices[3]. Both types of convergence may initially appear to measure the same phenomenon however β convergence is a necessary but insufficient condition for σ convergence. Consider two houses: *A* and *B*.

- *House A* has an initial sale price of $200,000 and a repeat sale price of $220,000
- *House B* has an initial sale price of $300,000 and a repeat sale price of $324,000

The time interval between sales for both homes are identical. Furthermore assume that *House A* belongs to a lower tier than *B*. *House A* experiences a growth rate of 10% while *House B* experiences a growth rate of 8%. Since *House A* is appreciating faster than *B*, there is β convergence between the tiers. However, in absolute

[3] Young, Higgins and Levy (2008) demonstrates that beta convergence is a necessary but not sufficient condition for sigma convergence. Hill et al (2009) measures sigma (but not beta) convergence in the Sydney housing market over the period 2001 – 2006, and Cook (2012) estimates beta (but not sigma) convergence in UK regional house prices.

terms *House A* has a capital appreciation of \$20,000 while *B* has a capital appreciation of \$24,000 indicating a widening in the price gap between the tiers and hence σ divergence.

Therefore, in order for σ convergence to occur, there must be β convergence and the rate of β convergence must be sufficiently high to overcome differences in initial prices. This study examines both types of convergence in the Melbourne metropolitan housing market.

3 DATA

A property transaction data base for Melbourne was used to examine the changing distribution of suburban house prices over a 20 year period (1990 – 2010) that spans two housing cycles, and post-dates financial market deregulation in the 1980s. The analysis exploits two separate housing datasets that were obtained from the Office of the Victorian Valuer-General (VG). They are the:

1. Victoria Property Valuations dataset; and
2. Victoria Property Transactions dataset.

Supplied in a confidentialised format, the two datasets contain detailed property-level information on sales prices as well as neighbourhood and property characteristics that span a period of more than 20 years. The Property Valuations database is the main source for information on property-level housing, locational and neighbourhood characteristics as at 2008, while the Property Transactions database contains sales information on every transaction in metropolitan Melbourne from years 1990 to 2010. The data sets have been geocoded and merged to create a single dataset that matches each transaction's sales information (such as price) with property and location characteristics.

In the current study, only houses are considered. Other dwelling types such as apartments or vacant land were removed from the data set. Furthermore, as per Case and Shiller (1987), only transactions with one repeat sale were retained. Homes with more than one repeat sale were omitted from the analysis to allow computation of the repeat sale index. Additionally, standard 'data hygiene' practices such as the removal of duplicate and other erroneous records were observed. Over the sample time frame, there were 349,829 valid observations.

4 METHODOLOGY

To examine patterns of convergence/divergence across different price segments, observations were first divided into 4 'tiers' based on prices within the initial sale period. 25th, 50th and 75th percentiles were used as breakpoints and observations are allocated into one of four tiers with homes in lowest quartile allocated to the first 'tier', homes in the second quartile allocated to the second 'tier' and so on.

Computation of the (Tiered) Weighted Repeat Sales (WRS) index is a three stage process. The first stage generates the unweighted log price index. The following equation(s) was estimated for homes in each tier:

$$y_{it} = \beta_0 + \beta_1 x_{it} + \varepsilon_{it}$$

The dependent variable, y_{it} is the log price ratio between the initial and repeat sale. It is calculated thus:

$$y_{it} = ln(P_{2it}) - ln(P_{1it}) = ln\left(\frac{P_{2it}}{P_{1it}}\right)$$

Where P_{1it} records the initial sale price of house *i* in period *t* and P_{2it} records the repeat sale of the same house in a later period. The independent variable, x_{it} is a matrix of dummy variables. The i^{th} value assumes a value of -1 if an initial sale for house *i* occurred in period *t*, +1 for a repeat sale and 0 otherwise. That is:

$$x_{it} = \begin{cases} -1 \text{ if house } i \text{ had an initial sale in period } t \\ +1 \text{ if house } i \text{ had a repeat sale in period } t \\ 0 \text{ otherwise} \end{cases}$$

β_1 is therefore a vector of unweighted log price indices. Anti-logging provides the original price index in 'levels'. The second stage of the modelling process estimates the GLS weights for the third stage. The following equation(s) were estimated for each of the 4 tiers:

$$\varepsilon_{it}^2 = \beta_0 + \beta_1(Holding\ Period)$$

The Holding Period represents the amount of time (quarters) between the initial and repeat sale of a home. The predicted residuals, $\hat{\varepsilon}_{it}^2$ are required as GLS weights. The third stage estimates the weighted log price index via:

$$y_{it}^* = \beta_0^* + \beta_1^* x_{it} + \varepsilon_{it}^*$$

where:

$$y_{it}^* = \frac{y_{it}}{\hat{\varepsilon}_{it}}$$

The dependent variable, y_{it}^* represents the GLS weighted log price ratio. By dividing each observation by its expected residual (which scales up over time) homes with a longer holding period are essentially given less weight, which reflects the notion that homes with a longer holding period are more likely to experience unmeasured quality changes therefore representing a potential source of bias. The GLS weighting mitigates this bias.

Note that β_1^* is a vector of weighted log price index numbers for a given tier. Once again, anti-logging provides the WRS index in 'levels'.

The decision to use a repeat sales index as opposed to say a hedonic regression pricing model was based on several considerations. Firstly, the index is easy to calculate as it relies only on transaction prices. Furthermore, a comparison of the same housing unit at different times reduces bias due to composition effects. The addition of the GLS weight also helps to reduce this bias as previously explained. By contrast, a hedonic regression while potentially controlling for such effects would incur specification issues such as the identification of appropriate variables, model fit and so forth.

In Case and Shiller (1987), additional information such as the number of bedrooms and a measure of quality for each house were available. To control for compositional effects, only homes with no change in the number of bedrooms and little change in quality between initial and repeat sales were retained. Unfortunately, this information is unavailable with the current dataset and thus represents an area for improvement in further investigations.

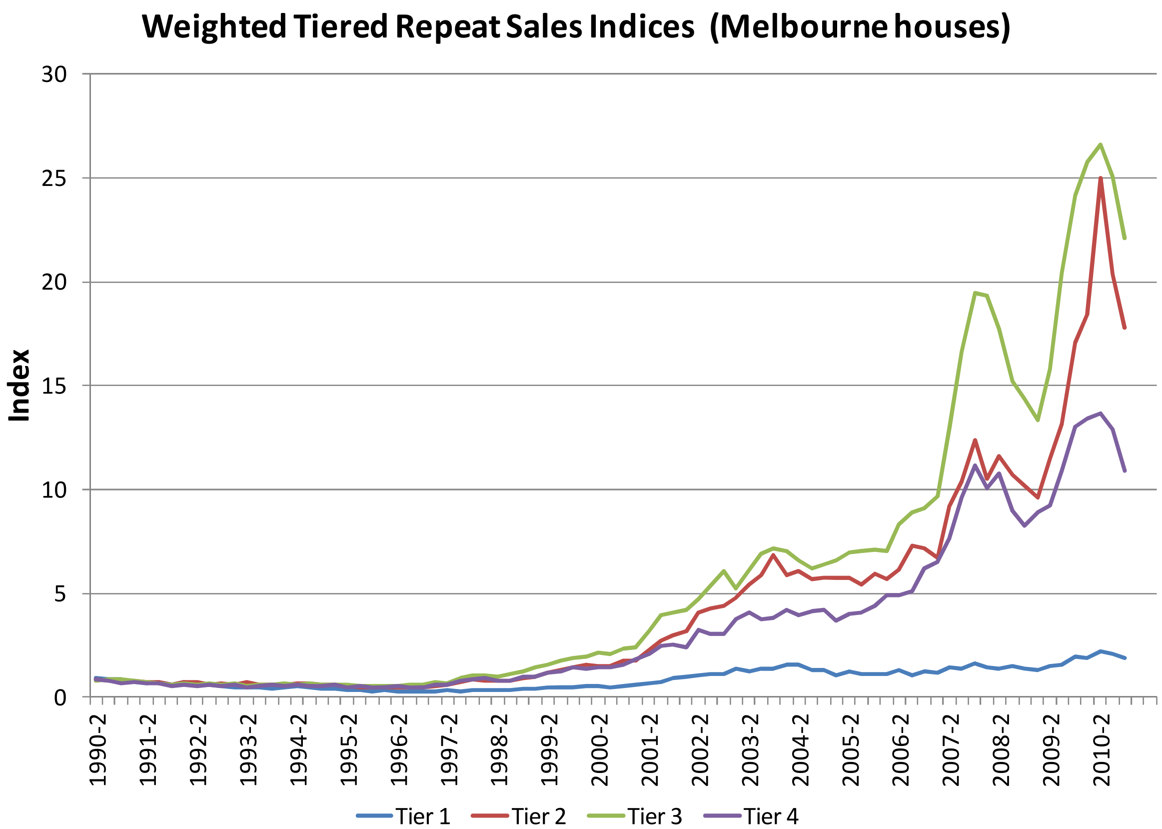
5 RESULTS

As previously mentioned, the dataset spans across two housing cycles in the Melbourne property market: a stagnant period from 1990 to1996 followed by a period of sustained growth that came to an end in 2007 with the onset of the Global Financial Crisis when house prices plateaued before returning to an upward trend.

5.1 Sigma (σ) divergence

While the dispersion in house prices between different price tiers remained relatively minor (and stable) during the stagnant period, the same cannot be said of the latter boom cycle. This is depicted in Figure 1 which shows the WRS index for each of the four tiers across the modelling period.

Figure 1



During 'bearish' market conditions (1990-1997), houses in the lowest tier continued to exhibit patterns of capital appreciation that were slightly lower than houses in other tiers (which do not exhibit any pattern of divergence between themselves). However, the degree of divergence is relatively minor when considering the overall rates of capital appreciation over latter periods. During this period, prices across the four tiers do not vary by a margin of more than 1 index point[4].

From 1998 onwards, the degree and pattern of divergence became substantially more distinct with the first (lowest) tier lagging behind the second, third and fourth tiers. Interestingly the best performing submarket was Tier 3. Furthermore, Tier 2 ranked second above Tier 4 in terms of capital appreciation. During the peak of 2007, the WRS index for Tier 3 reached a maximum of 19.43 points, followed by Tier 2 at 12.39 points then Tier 4 at 11.18 points with Tier 1 lagging farthest behind at 1.62 points. More importantly the difference between Tier 3 and Tier 1 during this period was 17.81 points. By 2010, this difference grew to 24.33 index points with Tier 3 reaching a maximum of 26.57 points followed by Tier 2 at 25.00 points, Tier 4 at 13.64 points and Tier 1 at 2.24 points.

The WRS indices suggests σ divergence in the Melbourne property market, which has important ramifications because it means that high priced homes have typically become even more expensive while low priced homes have generally fallen further behind.

5.2 Beta (β) convergence

Although the WRS indices indicate a widening gap in house prices (σ divergence), there is evidence to suggest the rate of growth in lower tiers exceeds those in higher tiers (β convergence). Monthly compound growth rates[5] for houses in the four tiers across the two housing cycles are reproduced in Table 1.

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[4] Normalised at 1.

[5] Calculated as $r = \left(\frac{x_t}{x_0}\right)^{\frac{1}{t}} - 1$ where *r* represents the compound growth rate; x_0 the initial sale price; x_t the repeat sale price; and *t* the number of months between sales

Table 1 Monthly compound growth rates for houses across the four price tiers between 1990 - 1997; and 1998 - 2010

	1990 - 1997				*1998 – 2010*			
	Tier 1	*Tier 2*	*Tier 3*	*Tier 4*	*Tier 1*	*Tier 2*	*Tier 3*	*Tier 4*
Mean	0.00898	0.006642	0.007254	0.006915	0.015354	0.010617	0.010359	0.011241
Standard Error	0.000251	0.000212	0.000127	0.000173	0.00079	0.00052	0.000183	0.000297
Median	0.006941	0.006496	0.00707	0.006992	0.009695	0.00863	0.008661	0.008914
Mode	0.004759	0.002845	0.006471	0.004917	0.010096	0.007862	0.007805	0.007999
Standard Deviation	0.023116	0.019379	0.011488	0.015217	0.060426	0.039968	0.01366	0.020946
Sample Variance	0.000534	0.000376	0.000132	0.000232	0.003651	0.001597	0.000187	0.000439
Kurtosis	1031.408	2164.002	300.8155	286.4618	2340.354	3633.668	159.5783	283.6017
Skewness	24.55276	18.37502	0.875095	-3.55468	42.25648	50.50925	-2.7061	5.121074
Range	1.410873	1.966295	0.670072	0.851537	3.855446	3.571462	0.57235	1.125558
Minimum	-0.25464	-0.75796	-0.31819	-0.46771	-0.20027	-0.85053	-0.38643	-0.48153
Maximum	1.156229	1.208333	0.351882	0.383828	3.655172	2.72093	0.185916	0.644031
Sum	76.43773	55.2375	58.91425	53.67467	89.75837	62.6949	57.58599	56.02336
Count	8512	8317	8122	7762	5846	5905	5559	4984

Among the four tiers, houses in the lowest tier exhibited higher average monthly compound growth rates (0.898%) than houses in other tiers during the relatively stagnant period of 1990 – 1997. This growth rate increased to 1.53% over the post 1997 boom cycle, once again exceeding the growth rates of houses in other tiers. By contrast, the average monthly growth rate across Tiers 2, 3 and 4 during the 1990 – 1997 period was 0.694% with Tier 1 homes exceeding other tiers by a margin of 0.204% or a ratio of 1.29:1. The average monthly growth rate across Tiers 2, 3 and 4 during the 1998 – 2010 period was 1.074% with Tier 1 homes exceeding other tiers by a margin of 0.456% or a ratio of 1.42:1.

This indicates that despite the widening gap in house prices, houses in the lowest tier experienced rates of growth that were higher than houses in other tiers and this rate of growth increased by an even greater margin during strong expansionary cycles.

6 CONCLUSION

This study examines patterns of convergence/divergence in the Melbourne housing market over two cycles: a relatively stagnant period from 1990 to 1997; and a period of strong growth from 1998 onwards. In the literature, two types of convergence have been proposed: Sigma (σ) and Beta (β) convergence. σ convergence occurs when the gap between high and low priced homes shrinks while β convergence occurs when low priced homes appreciate at a faster rate than high priced homes. β convergence however, does not necessarily imply σ convergence. In order for σ convergence to occur, β convergence must be sufficiently high to offset differences in relative underlying values.

The Melbourne housing market exhibits elements of β convergence. However, the overall gap between high and low priced submarkets continues to grow indicating σ divergence. Furthermore, this gap tends to widen when house price inflation picks up across the metropolitan housing market, but is stable when city wide house prices are flat.

These results have potentially important implications for the distribution of wealth. Australia is a nation with its population concentrated in the state capitals, a high rate of home ownership, and household wealth portfolios that are dominated by property holdings. If replicated across the country's major urban centres, this pattern of divergence may contribute to a more unequal wealth distribution.

The efficiency of urban labour markets can also be affected. Given that more expensive houses are typically located closer to the city, low wage workers are increasingly displaced as they can only afford to buy in cheaper submarkets on the urban fringe. Those residing in outer suburban areas could find that jobs are less accessible, while employers with establishments on the urban fringe may experience difficulties filling vacancies given thin labour markets.

The growing divide in property prices has clear socio-economic implications highlighting the need for a better understanding of the driving factors behind these patterns of divergence. While the dataset covers the better part of two housing cycles, the Australian housing market may now be entering a phase of stagnation. Improved prospects for first home buyers and less attractive tax preferences during long periods of house price stagnation could reverse this divergence. On the other hand if structural factors, wherein low paying jobs are increasingly pushed to outer ring suburbs and high paying, skills intensive jobs remain concentrated in city areas are responsible, then this pattern of divergence is likely to persist. These questions require answers from a future program of research.

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