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Developing stratified housing price measures for New Zealand

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Developing stratified housing price measures for New Zealand

Chris McDonald and Mark Smith[1]

Abstract

Widely used measures of growth in mean or median housing prices will reflect changes in the composition of dwellings sold as well as changes in demand and supply conditions.

Using a suburb-level dataset from the Real Estate Institute of New Zealand we use stratification techniques to adjust for compositional change and derive a timely and robust measure of housing prices for New Zealand.

Results suggest this stratified measure produces estimates of housing price inflation that accord closely with the accurate but less timely figures obtained from the QV Quarterly House Price Index.

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[1]The views expressed in this paper are those of the authors and do not necessarily reflect the views of the Reserve Bank of New Zealand or the Real Estate Institute of New Zealand. Special thanks to Christine LeCren, Mike Elford and Mark Nissan (all REINZ), Tony Richards (RBA), Frances Krsinich and Chris Pike (Statistics New Zealand), Phil Briggs and Tim Hampton (both RBNZ). All errors and omissions are those of the authors. Reserve Bank of New Zealand, 2 The Terrace, PO Box 2498, Wellington, New Zealand; Telephone (04) 472-2029; Fax (04) 471-3995; Email: Chris.McDonald@rbnz.govt.nz, Mark.Smith@rbnz.govt.nz. ISSN 1177-7567

1 Introduction

Housing market developments have an important impact on economic activity and inflation in New Zealand. Given their close historical linkage with household consumption, changes in housing prices can provide a useful gauge of the extent of household expenditures. Obtaining timely signals on housing prices are important for analysis of the New Zealand economy.

Putting together measures of city-wide or nationwide average housing prices is not a straightforward exercise. The sample of dwellings transacted in any period may not be representative of the housing stock and the characteristics of the sample may change from period to period. Hence, changes in a simple mean or median from an evolving sample of dwelling sales may not be representative of the total dwelling stock and will not provide good estimates of the pure price change, as they will also reflect compositional effects.

In this paper, we utilise suburb level housing transaction data provided by the Real Estate Institute of New Zealand (REINZ) and use stratification techniques developed by Prasad and Richards (2006), to compute a mix-adjusted housing price measure for New Zealand.

Despite being well served with housing data, New Zealand does not currently have an official housing price index. Our aim is to develop a timely and representative housing price measure that will assist in analysing the housing market. It is not explicitly designed to be used as an official house price index.

2 Uses and types of housing price measures

There are a large number of potential uses for housing prices measures. Fenwick (2006) suggests the following:

- As a general macroeconomic indicator (of inflation);
- As an input into the measurement of consumer price inflation;
- As an element in the calculation of household (real) wealth, and
  As a direct input into an analysis of mortgage lender's exposure to risk of default.

House pricing measures can also provide useful information for monetary policy and financial stability purposes. Arthur (2006) notes that real estate bubbles (and the subsequent collapses) have repeatedly been related to financial crises and thus it is important to measure these price bubbles accurately. Furthermore, international comparability would be enhanced if housing price measures are derived using a common methodology and data sources.

An important consideration is that housing is not a homogenous asset and differences in characteristics and location need to be taken into account. There are a number of methods that are used to adjust for changes in the composition of dwellings being transacted at particular points in time, with the housing price measure commonly expressed as a real estate price index.

Diewert et al (2009) outline four methods for constructing real estate price indexes:

(i) Repeat sales
Uses information on real estate properties which trade on the market more than once over the sample period. As price movements for each transaction apply to the same property, this method attempts to hold the quality of the properties constant over time. Case Shiller Home price indicies are an example;[2]

(ii) Assessment information
Uses sales information and assessment information from administrative records to construct ratios from which house price indicies are derived. The QV Quarterly House Price Index in New Zealand is an example of this approach;

(iii) Stratification
This decompose the market into separate types of property, calculates mean/median prices for all properties transacted in that cell for the current period and the base period, and then use the ratio of the means as a real estate price index; and[3]

(iv) Hedonic methods
An empirical approach that uses the property characteristics to standardise property values.

[2] See www2.standardandpoors.com/portal/site/sp/en/us/page.topic/indices_csmahp/
[3] http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/6416.0Explanatory%20Notes1Mar%202009?OpenDocument

These methods differ on complexity, degree of coverage, data requirements and their transparency of calculation. They all have particular strengths and weaknesses.[4] As noted by Diewert et al (2009), a major problem with each of these approaches is that it is sometimes not possible to exactly match the quality of dwelling units over time due to the fact that the housing stock changes in quality due to renovations and depreciation.

3 Sources of New Zealand housing price data

In its monitoring of the New Zealand residential property market, the Reserve Bank uses a range of data sources.

Two of the major data providers are PropertyIQ and REINZ:

(i) PropertyIQ
Collects information on freehold property sales for a range of property types. Sales data for freehold open market houses are used to calculate the QV Quarterly House Price Index for New Zealand and selected regions. A similar methodology is used to calculate a Quarterly Price Index for houses, ownership flats, converted flats and home and income. PropertyIQ also produce a monthly Property ValueMap, which is calculated using settlements received in the preceding three months.

(ii) REINZ
Collects a range of information from its members. Each month REINZ publish sales numbers, median sales prices and days to sell for residential dwelling sales in New Zealand and selected regions.

Table 1 summarises the key features of the REINZ median and the QV Quarterly House Price Index. The REINZ median is published with a comparatively short lag and is available on a monthly basis. The method for calculating the REINZ median is also relatively straightforward. However, as the median does not adjust the sample of transactions, it can be sensitive to changes in the composition of dwellings sold.

The QV Quarterly House Price Index is constructed using a SPAR (Sales Price Appraisal Ratio) method. It uses sales and rating assessment information for freehold open market residential dwelling transactions. Compared to the

[4] See Diewert et al (2009) for further discussion.

REINZ median, it is more able to control for changes in the composition of sales each period, as it uses the ratio of sales price to the rateable value as the basis for its calculation.

Table 1 Features of the REINZ median and QV House Price Index

	REINZ	QV House Price Index
Frequency	Monthly	Quarterly
Release	Within 10 business days	3 ½ months
Price measure	Median sales price for the month	Sales price to valuation ratio weighted by number of properties
Property types	Applies to residential houses and apartments sold by REINZ member	Applies to residential dwelling category (RD) used for rating valuation
Transaction price recorded	When sale is recorded by REINZ member	Settlement date
Regional coverage	1852 NZ suburbs	Territorial Authority
Coverage	Sales of residential housing from REINZ members 85,000 pa average 1990Q1-2008Q3	Freehold open market sales 105,000 pa average

Source: REINZ, PropertyIQ.

Key features of the QV Quarterly House Price index are summarised in box 1. Another feature of the QV methodology is that periodic exogenous adjustments to allow for depreciation and renovations are made to the housing stock. Assuming these adjustments are fairly accurate and consistently applied this would largely mitigate one of the key drawbacks of the assessment information approach, namely that it does not allow for the changing quality of the housing stock.

Publication lags for the QV Quarterly House Price Index are considerably longer than for REINZ data series. This is partly a consequence of the additional data requirements and greater complexity of the QV method. Both methods also record the property transaction at different stages in the sales process. As the QV measure records the transaction when the change of property title takes place (which usually occurs five to seven weeks after the sale goes unconditional), the publication lag is longer to enable the transaction to be captured in the QV records.

Despite the longer publication lag, the more comprehensive data requirements and well established methodology of the QV Quarterly House Price Index suggests that it is an appropriate benchmark from which to adjudge a stratified housing price measure.[5] An added bonus of using monthly REINZ data is that it would be feasible to put together monthly stratified housing prices measures. The analysis in the remainder of this paper is largely carried out at a quarterly frequency to enhance comparability with quarterly QV data.

Box 1 An example of the SPAR method: The QV Quarterly House Price Index

The Quarterly House Price Index is calculated by taking freehold open market sales and applying the following methodology:

- For each Territorial Authority (TA), the sum of all sale prices are taken and divided by the sum of all current capital values of these properties to calculate a price to value (p/v) ratio.
- The p/v ratio is applied to the total capital values of all properties within the TA to calculate an estimated current total valuation for all properties within that area.
- The estimated current total valuation is divided by the number of properties within the TA to calculate an average current valuation for that TA.
- The percentage change between the current average valuation and the previous period's average valuation is calculated.
- This percentage change is used to calculate the current period's index for the TA.
- For index areas that combine TAs - like Total New Zealand - the total *current* valuations of the relevant TAs are combined and used to calculate the *current* average valuation for each quarter. These current valuations are then used as above to calculate the price index.

Source: PropertyIQ.

4 The impact of compositional change

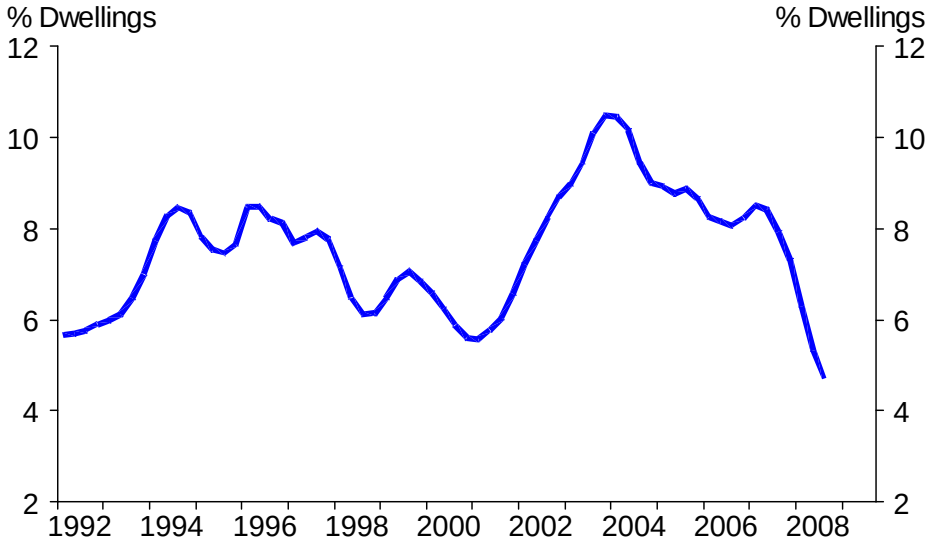
A major problem in measuring housing price growth results from the infrequency of transactions and the heterogeneous nature of the housing stock. The sample of dwellings transacted in any period may be far from

[5] We use the QV Quarterly House Price Index as the benchmark (rather than the wider QV Price Index) as this is the better known of the two measures. The two QV measures have a tight correlation: statistical analysis from the 1990 to 2008 period reports a correlation coefficient of 0.95 for quarterly movements and 0.99 for annual movements.

being representative of the housing stock and the characteristics of the sample may change from period to period. As a result, measures of growth in mean or median housing prices will reflect changes in the composition of dwellings sold as well as underlying changes in housing prices.

In New Zealand a relatively small fraction of the housing stock is transacted in any period: the average turnover is around 7 per cent per year, which equates to approximately 0.6 per cent per month (figure 1).

Figure 1 Dwelling turnover (annual)

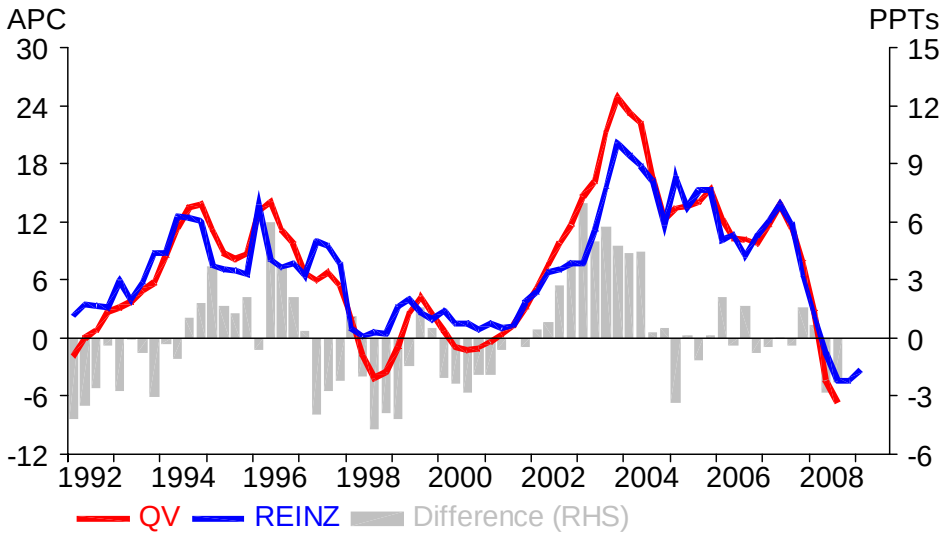


Source: PropertyIQ, Statistics New Zealand.

Figure 2 compares rates of annual housing price inflation from the QV house price index and REINZ median. It is likely that part of the difference in respective rates in housing price inflation is a consequence of changes in the composition of dwellings being transacted.

As table 1 highlighted, these data are constructed using different methodologies and source data. Hence, we would not expect rates of dwelling price inflation to line up exactly. However, there have been periods where the respective rates of housing price inflation have differed considerably.

Figure 2 Annual housing price inflation



Source: PropertyIQ, REINZ.

Seasonal changes in the composition of dwelling sales

If the composition of dwellings sold varies throughout the year, it is likely that monthly movements in REINZ housing prices will be seasonal. It also follows that if the composition in dwelling sales is seasonal, the difference between respective rates of quarterly QV and REINZ housing price inflation will be seasonal.

To investigate this, we categorise suburbs in the REINZ dataset by their median sale price over the 2005 to 2008 period. From this we construct strata, each of which group together suburbs by their median sales price (see section 4 for further details on the methodology). Each strata contains suburbs which accounted for 10 percent of transactions over this period. Strata one contains suburbs which recorded 10 percent of transactions with the lowest median sales prices over the 2005/2008 period, whereas strata ten includes suburbs with the highest 10 percent of median sales prices.

We find that the portion of housing sales is seasonal. The portion of sales from the cheaper priced suburbs tends to be higher from July to September and in January and February. As a consequence, quarterly rates of REINZ housing price inflation are generally lower in the March and September

quarters relative to quarterly QV housing price inflation, but relatively higher in the June and December quarters.

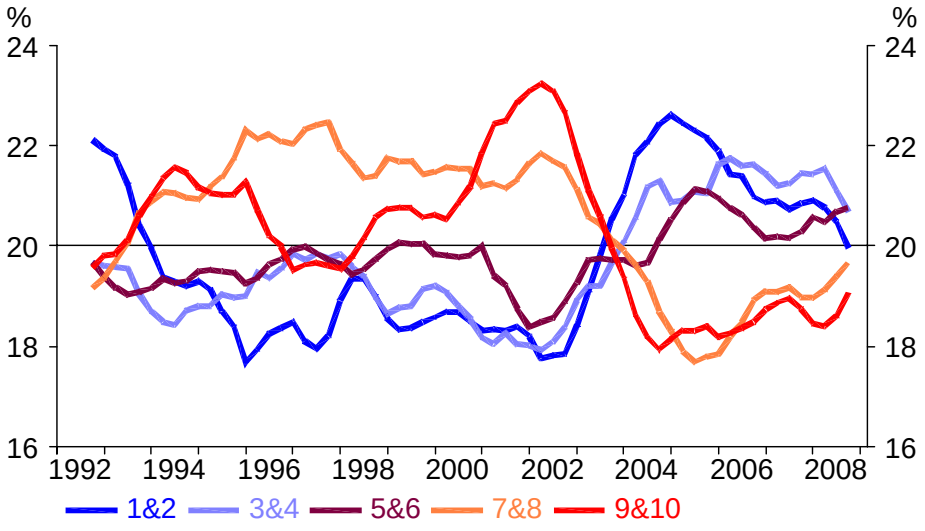
Appendix A compares the seasonal factors of monthly REINZ housing prices (which are obtained via X12) and the composition of house sales. In light of a seasonal pattern evident, we use X12 to seasonally adjust all of the data that we use in this analysis.

These results are consistent with findings reported by Prasad and Richards (2006) for Australian house price data. They found that periods when Australian median prices are seasonally high (typically the December quarter in most cities) tend to be when the proportion of sales in higher-priced suburbs is seasonally high.

Cyclical changes in the composition of dwelling sales

The composition of dwelling sales may also vary through the housing cycle. As shown in figure 3 the portion of sales for the lower strata increased over the 2001 to 2004 period. More recently, these strata have been declining as a share of total sales.

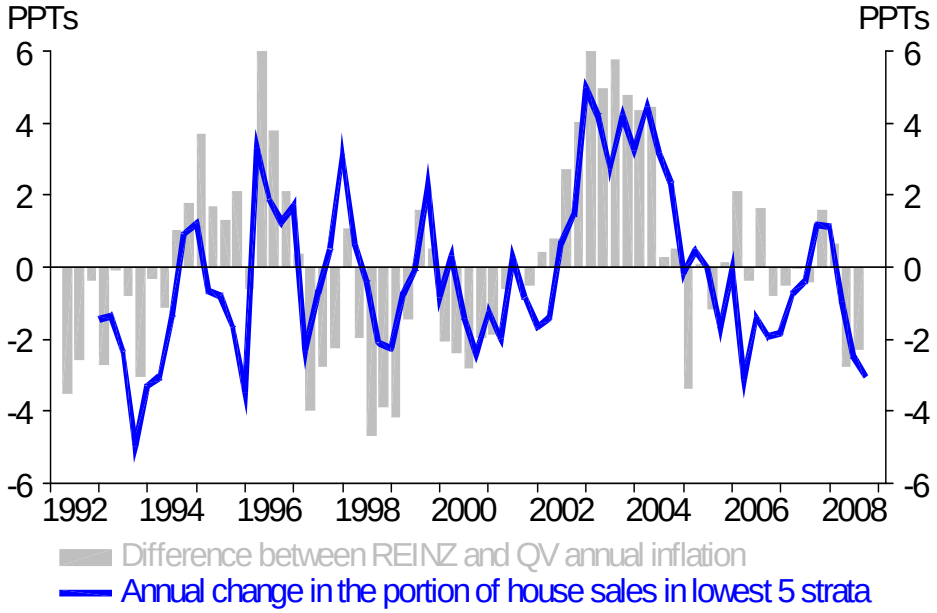
Figure 3 Portion of house sales by strata
(12 monthly rolling averages)



Source: REINZ, RBNZ estimates.

The portion of lower valued housing sales has tended to be positively correlated with differences in QV and REINZ measures of housing price inflation. Figure 4 shows that during the 2001 to 2004 period the increasing portion of house sales in the lower five strata (solid line) coincided with the QV Quarterly House Price Index generally producing higher rates of annual house price inflation than the REINZ median.

Figure 4 Sales composition and difference in house price inflation



Source: PropertyIQ, REINZ, RBNZ estimates.

We can formally test the proposition that compositional change between higher and lower-priced suburbs may be responsible for some of the variation observed in the REINZ median housing price measure. The following equation is estimated:

$$\Delta PQ_t - \Delta PR_t = \beta_1 \Delta(LHS_t / HS_t) \qquad (1)$$

Where:

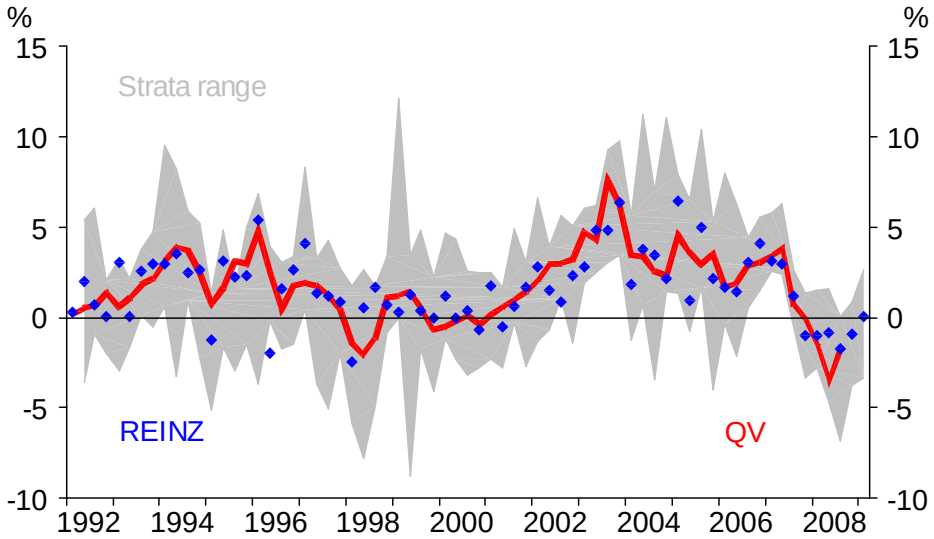
$\Delta PQ_t - \Delta PR_t$ = difference in quarterly housing price inflation (QV Quarterly House Price Index minus-REINZ median).

$\Delta (LHS_t / HS_t)$ = change in the portion of housing sales from the lowest 5 strata.

The composition of sales matters. The coefficient on the housing sales share (0.75) is statistically significant and correctly signed. A one percentage point increase in the share of less expensive dwellings contributes to a 0.75 percentage point increase in the gap of QV over REINZ measures of quarterly housing price inflation. Appendix B contains the equation listing and some summary statistics.

To illustrate the magnitude of the impact of compositional change, figure 5 compares the range of seasonally adjusted quarterly movements of all ten housing price strata of the REINZ sample (shaded area) alongside seasonally adjusted rates of quarterly inflation from the REINZ median (blue diamonds in figure 5), and the QV Quarterly House Price Index (red line). Movements in the aggregate REINZ median generally fall within the range of quarterly variation of all ten strata, suggesting compositional impacts are perhaps not as serious as could potentially be the case (see appendix C for an annual chart).

Figure 5 Quarterly housing price growth*

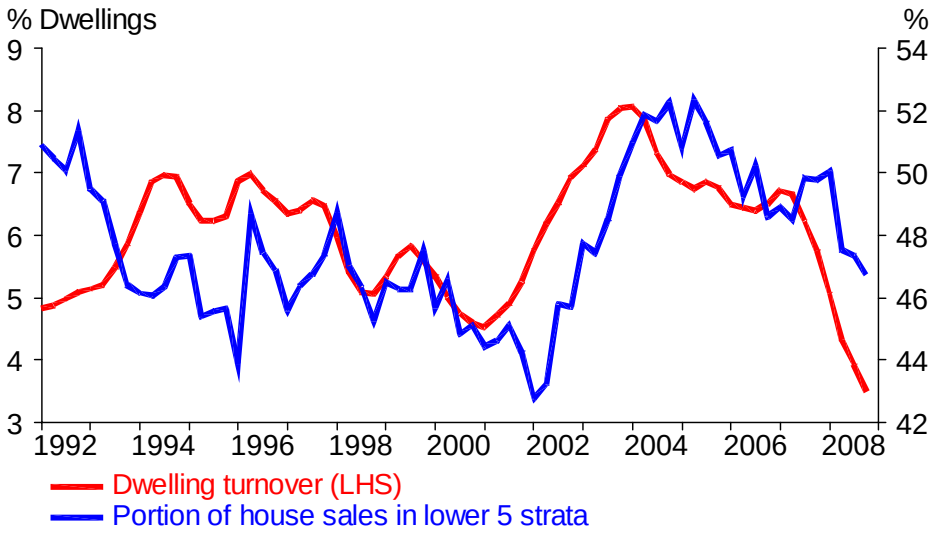


* Shaded areas show the range of quarterly percent movements for all ten strata.
Source: PropertyIQ, REINZ, RBNZ estimates.

Differences between annual growth rates in the REINZ and QV measures are more apparent during periods of very high, or very low, dwelling turnover. Compared to the REINZ median, the QV Quarterly House Price Index tends to record higher peaks and lower troughs in housing price

inflation. This is because sales volumes for cheaper properties tend to be more cyclical. Indeed, figure 6 shows a positive correlation between housing turnover and the portion of lower strata house sales. Lower strata house sales are the total sales for strata one to five.

Figure 6 Dwelling turnover and sales composition



Source: REINZ, RBNZ estimates.

To investigate this more formally the following regression is estimated:

$$\Delta(LHS_t/HS_t) = \beta_1 * \Delta(HS)_{t-3} \qquad (2)$$

Where:
$\Delta(LHS_t/HS_t)$ = annual difference in the portion of low valued house sales.
$\Delta(HS)$ = annual difference in house sales (000s).

The turnover coefficient of 0.27 is statistically significant. This suggests that increasing dwelling turnover tends to coincide with a pick-up in the portion of lower valued house sales, whereas declining dwelling turnover appears to do the opposite. Hence, in periods of low turnover (as occurred in 2008), the REINZ median tends to produce higher rates of house price inflation relative to the QV Quarterly House Price Index.

The following section looks at how the REINZ suburb level data can be used to construct an alternative housing price measure that adjusts for compositional changes. It outlines the technique we have employed, namely using the data to construct a stratified housing price measure.

5 The REINZ dataset

REINZ keep sales and price data for suburban areas. The number of suburban areas has been gradually increasing as the residential dwelling stock has grown. There have also been changes to suburban area boundaries, particularly since 2005 when the REINZ boundaries were changed to accord more closely with postcode areas. Of the 1852 suburban areas currently defined, at least one residential sale has taken place in more than 1720 suburbs.

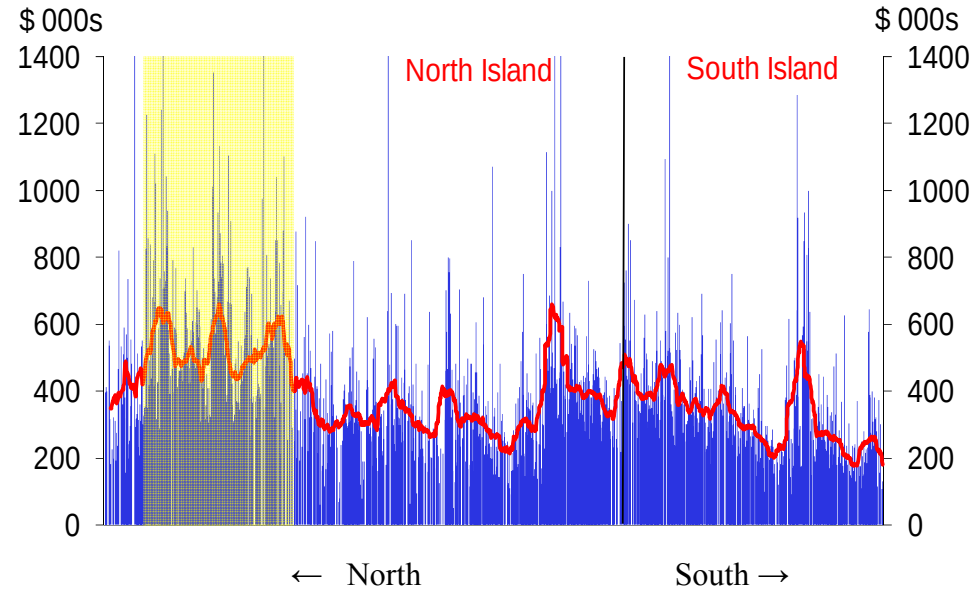
Table 2 Features of the REINZ suburb-level dataset

Features	**Variables**	**Observations**
Suburbs	REINZ sales areas	1852
Frequency	Monthly since January 1992	Approximately 200
Data provided per suburb	Median house sales price Monthly sales number Median days to sell	7,000 sales per month, on average

Source: REINZ.

Figure 7 summarises the 2008 average median housing price for each of the 1852 suburbs. There is considerable variation in median sales prices. Generally sales prices are higher in Auckland, but this is not universally so.

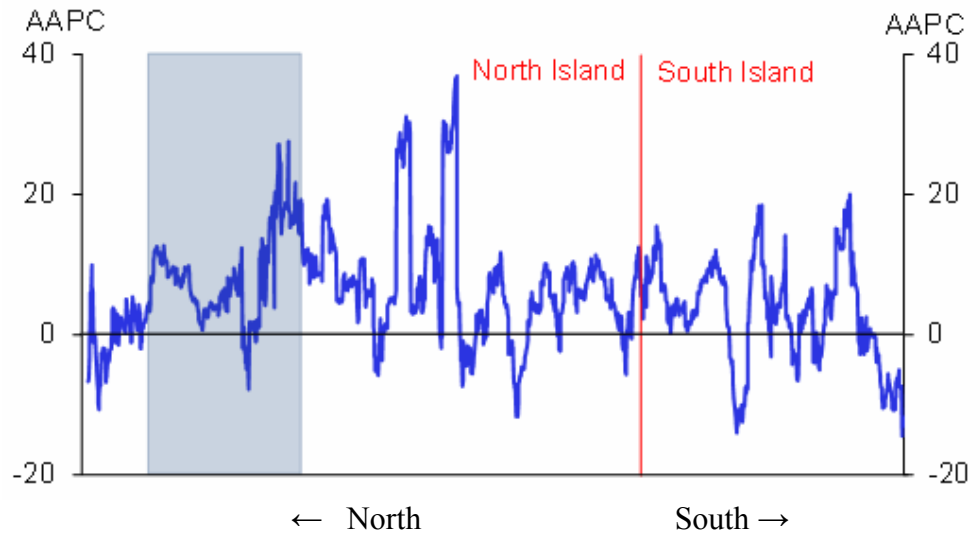
Figure 7 Median sales price by suburb



Note: Auckland suburbs in shaded area. Red line is a centred moving average (40 suburbs).
Source: REINZ, RBNZ estimates.

Average growth rates in housing prices by suburb (shown in figure 8) show considerable variation.

Figure 8 Annual average growth (2008 year versus 2007 year)

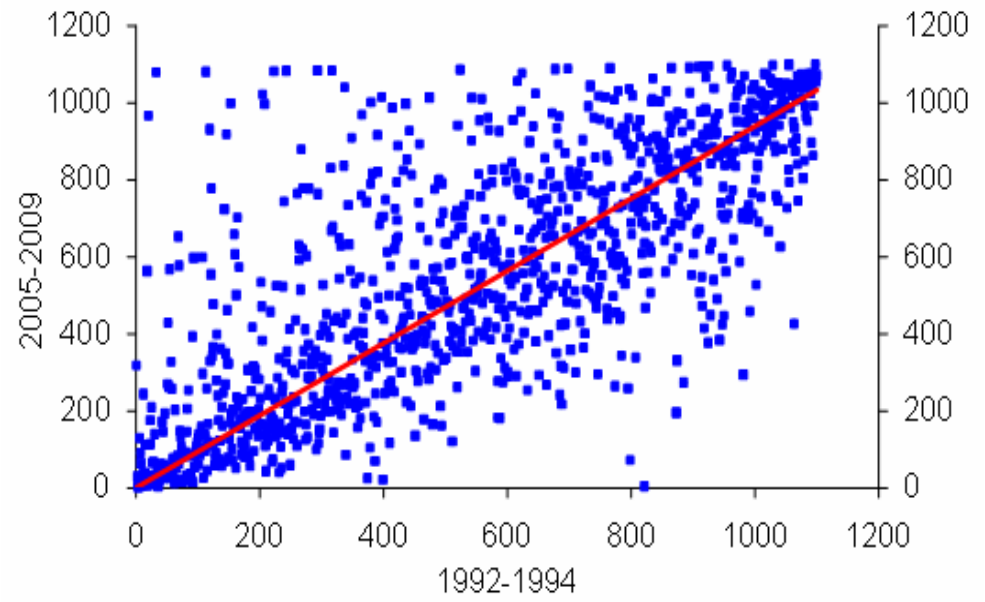


Note: Shaded area denotes Auckland suburbs.
Source: REINZ, RBNZ estimates.

Figure 9 summarises movements in relative prices for individual suburbs that have provided housing sales data since the early 1990s. Dots in the chart denote individual suburbs, with the scales in the chart ranking the suburb by their median sale price over the early 1990s and the post 2005 period (dots with high values represent suburbs that are amongst the most expensive, whereas those with low values are generally the cheapest).

The solid line in the chart denotes the trend relationship. Generally, suburbs that were amongst the most expensive (or cheapest) in the early 1990s are typically the most (least) expensive now.

Figure 9 Median price rankings



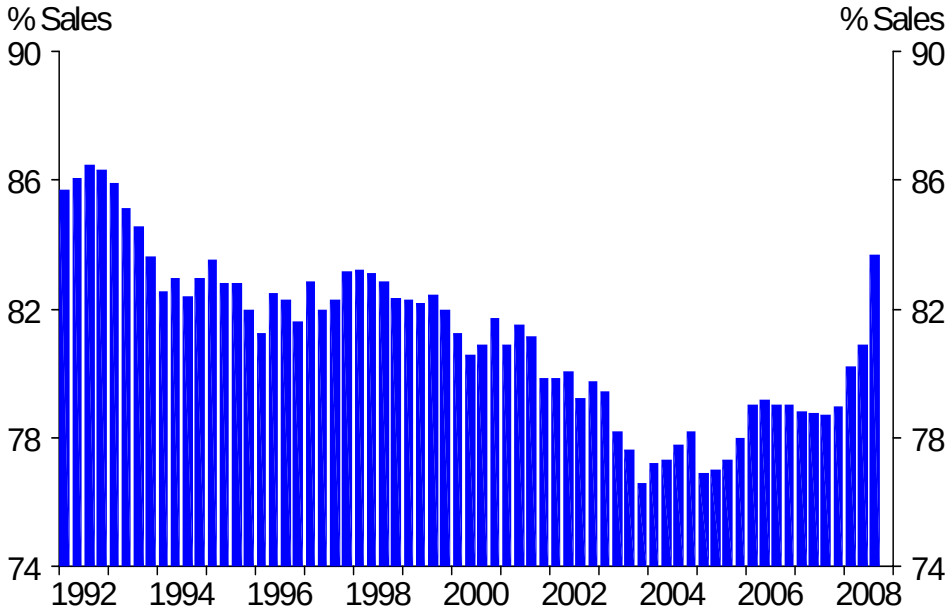
Note: Dots denote individual suburbs. Suburbs are ordered by median sales price for the period, with dots at higher values the more expensive suburbs.
Source: REINZ.

However, some movements in relative prices are evident, with a number of suburbs becoming considerably more (or less) expensive relative to other suburbs. Closer inspection of these outliers suggests some of the large relative price movement is attributable to changes in geographical boundaries for the particular suburb. Shifts in the composition of sales within the suburb are also likely to have had an influence.

Narrowing the comparison windows and filtering out suburbs that have low number of transactions still produces a relatively large number of suburb outliers. It suggests there is likely to be a fair amount of noise attributable to intra suburb factors.

The REINZ dataset is large, but it does not summarise records for all property transactions. Most residential property sales are conducted by a REINZ member, but not all. Over the 1990s and earlier this decade, a trend decline in the share of house sales conducted by a REINZ member organisation was evident. This is likely to reflect the growing prevalence of private sales. In particular, it could reflect a greater number of houses being moved into family trusts which are not captured in the REINZ dataset.[6] More recently, the trend decline evident in the REINZ sales share has ended.

Figure 10 REINZ housing sales as a portion of total freehold open market sales of residential dwellings



Source: REINZ and PropertyIQ.

[6] See Briggs (2006) for a discussion of the impact of family trusts on housing statistics.

6 A stratified measure of housing prices

Stratification involves dividing a population into groups (strata) such that observations within each group are more homogenous than observations in the entire population. Within each stratum, it then becomes more likely that an observed change in a characteristic of interest represents a true change rather than a spurious one due to compositional effects. Once strata have been defined, a measure of central tendency from each strata is weighted together to produce an aggregate price measure.

We follow the approach used by Prasad and Richards (2006), who constructed a stratified house price measure for Australia using housing transaction data provided by Australian Property Monitors. However, unlike Prasad and Richards, we have the luxury of having a reliable benchmark for house price inflation (the QV Quarterly House Price Index). We can adjust weightings patterns on the stratified measure to produce a measure that more closely follows the QV measure.

After some experimentation we have adopted the following methodology:

1) Order suburbs by their median sales price.

As noted earlier, we used data since the start of 2005 to order (or rank) suburbs. This provides a long enough period from which to capture transactions for individual suburbs, whilst also ensuring these suburb orderings are representative of current property trends. The choice to start the comparison period in 2005 was also influenced by the introduction of a large number of new suburbs into the REINZ dataset in early 2005. These were mostly from the reclassification by REINZ of a number of established large urban centres into a number of smaller suburban areas.

The emphasis of using stratification techniques was to produce a measure that would be better configured to better represent current property trends. However, historical estimates of property price inflation from this measure (particularly those prior to 2005), may not closely follow the QV Quarterly House Price Index.

We then divide the suburbs into strata, with each strata containing 10 percent of total house sales since 2005. As shown by figure 6, the portion of sales in the lower 5 strata has tended to fluctuate. From 2000 to about 2004,

proportionately more sales were in the lower strata suburbs. By contrast, the pick-up in sales in the mid 1990s was more concentrated in the higher strata suburbs. The fall in housing turnover since 2007 has been more sizeable in the lower priced suburbs. This has contributed to the REINZ median showing milder movements in housing prices compared to measures that make more allowance for the composition of housing transactions.

2) For each strata we combine median housing prices and dwelling sales for each suburb to construct a weighted average median sales price.

For strata n (where n = 1 to 10), a weighted average median sales price is calculated as follows:

$$P_n = \sum_{j=1}^{k(n)} P_{jn} Q_{jn} \Big/ Q_n \qquad (3)$$

This can also be expressed as

$$P_n = P_{1n} Q_{1n} / Q_n + P_{2n} Q_{2n} / Q_n + \ldots + P_{k(n)n} Q_{k(n)n} / Q_n \qquad (4)$$

Where:
k(n) = number of suburbs in strata n
P_{jn} = median dwelling price of suburb j in strata n
Q_{jn} = number of sales in suburb j in strata n
$Q_n = \sum_{j=1}^{k(n)} Q_{jn}$ = total number of sales in strata n

As the outliers in figure 9 suggest, there is likely to be some intra-suburb variability in the median prices reported by each suburb. We could allow for this by removing records for suburbs that show a high degree of price variability (or too few transactions). At this stage, we are unsure of the appropriate thresholds to use to filter the data. There is a risk that we could remove too many suburbs, considering the average number of monthly transactions per suburb is less than 4. What we have done is put more weight on suburbs with more transactions, as we believe prices in these suburbs would be more representative of underlying housing market trends.

Table 3 summarises the details of the various strata. For comparative purposes, we have collapsed the stratified measure into a quarterly frequency. Housing prices in all of the strata have more than doubled, and

have at least trebled in the more expensive strata. Over the entire period, the largest increase in property values was in strata ten, whereas the smallest was in strata three.[7]

Volatility in quarterly property price movements is high for some individual strata, particularly strata three which includes suburbs with a higher portion of apartments. Quarterly changes in housing prices for the middle to upper strata are most closely correlated with movements in the stratified housing price measure.

Table 3 Housing price strata (1992-2008)

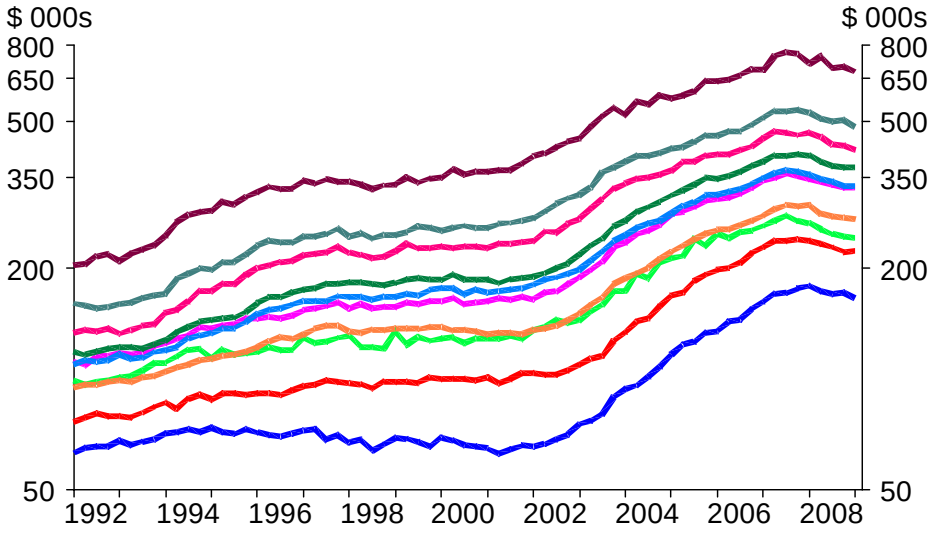
	Number of Suburbs	Average quarterly growth (percent)	Std deviation (quarterly growth)	Correlation with total (quarterly growth)
1	232	1.6	3.2	0.49
2	184	1.7	2.8	0.60
3	150	1.6	4.4	0.59
4	115	1.7	2.4	0.77
5	110	1.7	2.3	0.79
6	143	1.8	2.0	0.79
7	155	1.8	2.2	0.82
8	182	1.8	2.6	0.74
9	171	1.8	2.5	0.76
10	225	1.9	2.9	0.75
Total	1667	1.7	1.9	1.0
Memo:				
REINZ	1852	1.7	1.9	0.93
QV	n.a.	1.7	2.0	0.98

Source: REINZ, RBNZ estimates.

Figure 11 shows housing prices for each strata. Up until a few years ago, the rate of increase was generally stronger for the higher priced strata. Over the last few years, stronger proportionate growth in the lower priced strata is apparent. This may suggest some degree of convergence of property values over time. However, the levels difference between property values remains wide, with sales prices in the highest strata suburbs around four times higher than the lowest strata; in 1992 this multiple was 3½.

[7] This is partly via construction as higher strata may be the result of stronger growth in property values over an extended period of time.

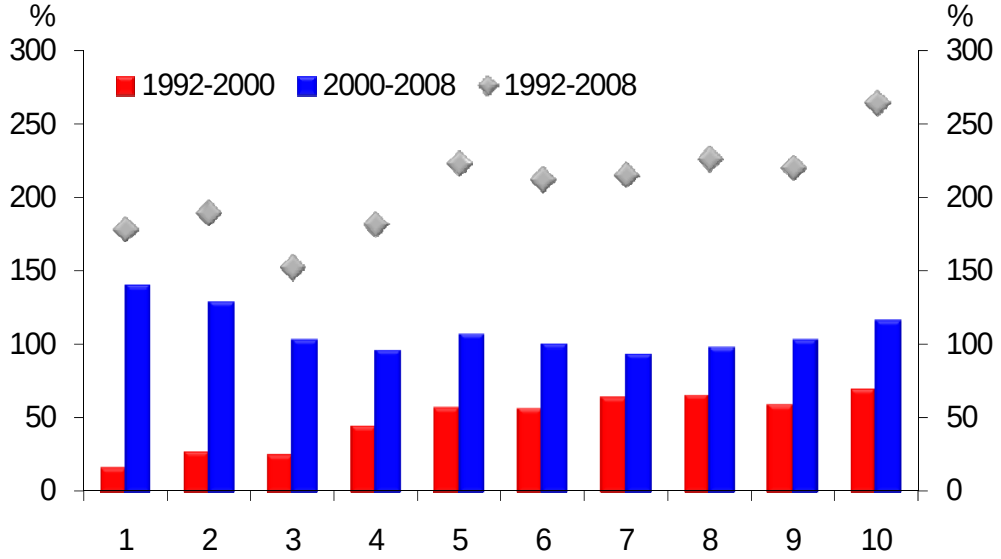
Figure 11 Median housing prices by strata
(log scale)



Source: REINZ, RBNZ estimates.

Figure 12 denotes the increase in housing prices for the various strata in the 1990s, and since the start of the decade.

Figure 12 Growth rates in property values by strata



Source: REINZ, RBNZ estimates.

3) A national average sales price is derived, being the weighted average sales price for all 10 strata.

$$P = P_1 * (Q_1 / \Sigma Q_{1,2,...10}) + P_2 * (Q_2 / \Sigma Q_{1,2,...10}) ... + P_{10} * (Q_{10} / \Sigma Q_{1,2,...10}) \quad (5)$$

Where:

$P_{j,n}$ = median dwelling price of strata j in suburb n

$Q_{j,n}$ = number of dwelling sales of strata j in suburb n

P_j = average median sales price in strata j

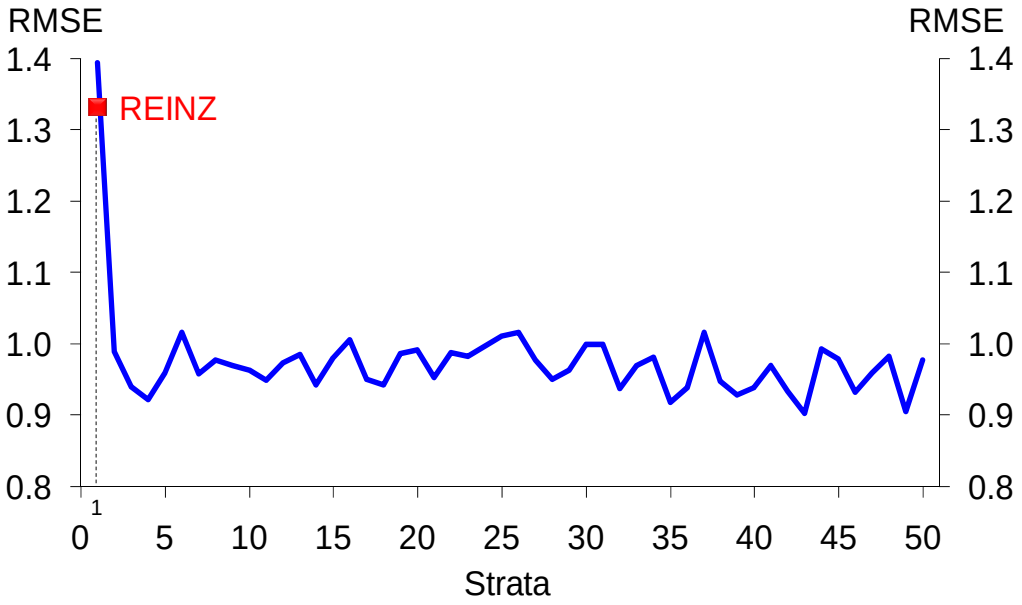
Q_j = number of dwelling sales in strata j

There are a number of different ways for grouping suburbs into strata, and for weighting together the strata into national measures. We have chosen to stratify using deciles, as this is a reasonably transparent approach and each of the strata contains a large sample of dwelling sales to draw upon. Having fewer strata can increase the impact of compositional changes. As mentioned previously, the decision to put more weight on suburbs that have more transactions within each strata is that these suburbs are likely to be more representative of underlying housing price trends.

One of the aims was to derive a housing price measure that closely follows more current rates of property price inflation of the QV Quarterly House Price Index, rather than matching up historical movements. The weighting choices that were used reflected this to some extent.

Figure 13 shows the root mean square error (RMSE) between quarterly QV housing price inflation and stratified measures using different numbers of strata. The red square in the chart shows the difference between quarterly inflation rates from the REINZ median (which is derived from just 1 strata) and the QV Quarterly House Price Index. Even dividing the dataset into 2 or 3 strata yields considerable improvement, in terms of minimizing the RMSE. There is not much difference using deciles, quintiles, or quartiles.

Figure 13 RMSE with QV Quarterly House Price Index by number of strata in national sample
(Quarterly percentage change)



Red square is REINZ median and blue is the RMSE for difference numbers of groupings.
Source: REINZ, PropertyIQ, RBNZ estimates.

7 How do the housing price measures compare?

The major objective was to use the REINZ data to get timely and accurate estimates of housing price inflation. Table 4 summarises the closeness of fit of quarterly growth rates of the stratified housing price measure to the QV Quarterly House Price Index, in terms of RMSE criteria. The RMSE between quarterly rates of QV housing price inflation and the REINZ median are also summarised in table 4.

The stratified housing price measure produces a closer fit to quarterly rates of housing price inflation from the QV Quarterly House Price Index than the REINZ median. Compared to the REINZ median, the stratified housing price approach minimises the difference in quarterly growth rates by about one-third. The improvement in fit is particularly noticeable over the latter half of the comparison period.

Table 4 Summary statistics for housing price measures (Quarterly changes)

	1992-1999	2000-2008	1992-2008
Average percentage change			
Stratified house price	1.4	2.0	1.7
REINZ median	1.5	1.9	1.7
QV house price index	1.4	1.9	1.7
Root mean square error with QV house price index			
Stratified house price	1.03	0.83	0.94
REINZ median	1.39	1.31	1.37

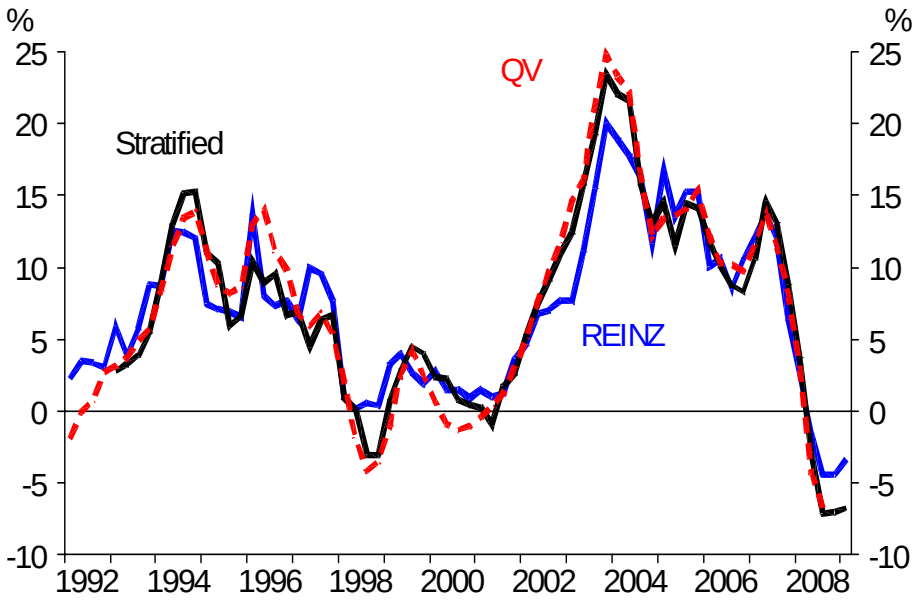
Source: REINZ, PropertyIQ, RBNZ calculations. All figures are seasonally adjusted.

Despite the REINZ data capturing the transaction at an earlier stage of the process, statistical analysis did not find evidence of a lead from the Stratified Housing Price measure to the Quarterly QV House Price Index.

Appendix D provides some summary statistics for annual housing price inflation. All three measures have tended to produce similar rates of annual housing price inflation since 1993. In the post 2000 period, however, the stratified housing price measure has tended to generate annual inflation rates that are more closely aligned with the QV Quarterly House Price Index.

Figure 14 compares rates of annual inflation from the stratified housing price measure (black solid line) alongside the QV Quarterly House Price Index (red dotted line) and the REINZ median (blue solid line).

Figure 14 Annual housing price inflation measures



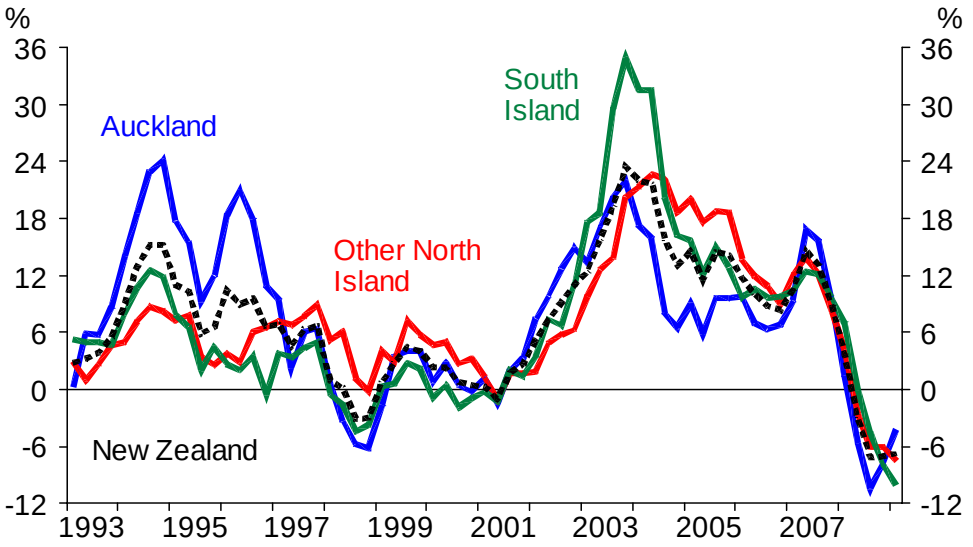
Source: ProperyIQ, REINZ, RBNZ estimates.

8 Some regional housing price measures

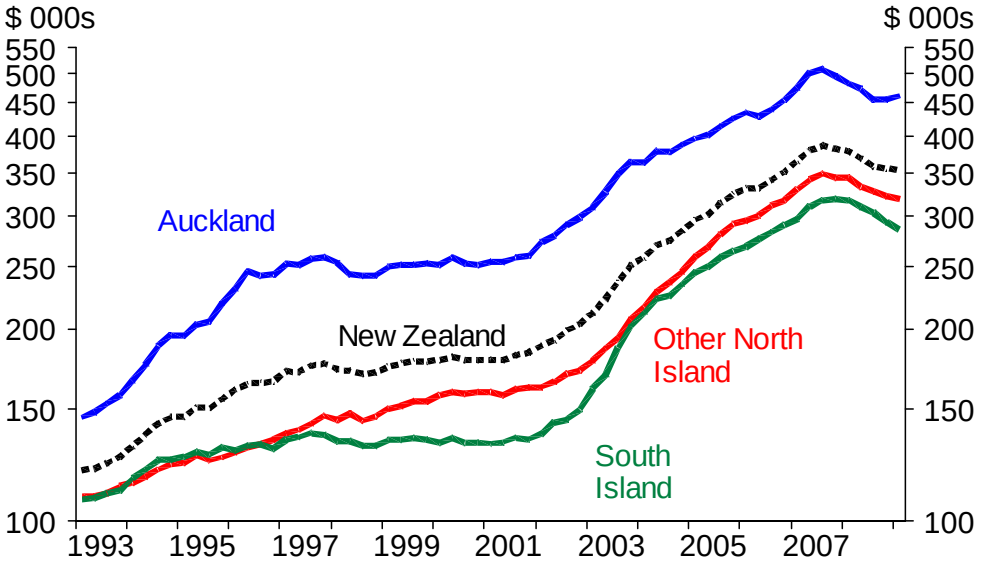
Figure 15 presents some preliminary housing price measures for 3 regions in New Zealand. These include suburbs in the greater Auckland area (323 suburbs), suburbs in the rest of the North Island (918), and all South Island suburbs (611). Housing price inflation has fallen sharply in all three regions over the past year, with the largest falls experienced in Auckland.

Figure 15 Stratified regional housing price measures

Annual percent changes



Levels
(log scale)



Source: REINZ, RBNZ estimates.

Comparing regional property prices since the early 1990s illustrates quite different trends. Annual housing price inflation in the Auckland suburbs was considerably higher than for other regions in the mid 1990s. Conversely, growth rates in housing prices were larger in the other regions (particularly South Island suburbs) in the most recent boom. Despite stronger growth in other regions, the gap in housing price levels between Auckland and the other regions has not closed a lot.

As a further crosscheck on the stratified New Zealand housing price measure, we weight together these regional stratified housing price measures by their share of total housing transactions. This regionally weighted measure produces estimates of housing prices that are very close to the stratified housing price measure for New Zealand (see Appendix E for further details).

9 Limitations of our approach and next steps

Limitations

We have managed to use stratification techniques to produce a measure of housing price inflation that is available in a monthly frequency and is timely, whilst also allowing for differences in the composition of dwelling transactions that occurs between suburbs.

However, there remain some limitations with this approach:

- Heterogeneity – while we have been able to control for differences in prices due to some inter-suburb factors, we are not able to control for intra-suburb differences. The trend towards larger dwellings and a greater number of apartments suggests intra-suburb factors will be important in ascertaining the general trend in property price movements in a particular area.[8] The method we have used is also sensitive to compositional shifts within strata.
- Coverage – while our sample is comprehensive, it represents only about 80 percent of all transactions incorporated in the QV Quarterly House Price Index.

[8] According to dwelling consent data, the average size of a new residential dwelling increased from around 150 square metres in 1992 to around 200 now.

- Changes in classification – changes in suburb boundaries and the reorganisation of sales data in some regional centres have made comparing changes in strata over time more difficult. This is most evident with the reorganisation in suburban areas that took place in 2005.

Next steps

The REINZ dataset is comprehensive, and there is scope to do more work on it. Future work is likely to follow three broad streams:

1. Stratification

This could include firming up the national housing price estimates, and to try and address some of the limitations of our approach. Work on regional housing price measures is at an early stage, and we will devote more time to calculating stratified regional housing price measures. Different regional splits will also be investigated.

We are also looking at different weighting schemes, including using the stock of dwellings (instead of the number of sales in each suburb) to weight together the housing price data. Initial investigation has shown that using this method produces housing price measures that accord very closely with the current stratified housing price measure.

REINZ also have suburb level information for sales of vacant residential land (commonly referred to as residential sections). We are investigating using stratification techniques to put together a national section price measure, and could develop some regional section price measures. We could also compute stratified days to sell measures that may provide some leading information on near-term property price movements.

2. Analysis of segments of the market

Analysing price movements in different segments of the market would be useful from a macro financial stability viewpoint. We can also use the suburb/regional/strata level data to investigate whether they provide useful information on future trends in housing market activity and inflation.

3. Other applications

We can also examine the importance of regional (versus national) factors in driving housing price movements. This would be useful in assisting our

understanding of how housing price shocks propagate and whether they are attributable to local or national factors. It would also be useful to examine the factors that determine differences in housing prices in particular suburbs.

The detailed nature of the dataset will also enable us to examine other techniques for deriving housing price measures, including hedonic and factor model approaches.

10 Conclusion

Each month REINZ publish a median housing price, which is released within a couple of weeks after the end of the month. While extremely timely and providing useful information on property price trends, movements in the monthly median can reflect changes in the composition of properties sold each month as well as changes in underlying prices.

Our investigation has shown that longer-term trends in housing prices are similar, irrespective of the housing price measure used. However, there can be sizeable differences in housing price inflation during turning points in housing market activity. Over these periods, obtaining timely and representative signals of the state of the property market is important to policymakers.

This paper shows that the portion of suburbs with less expensive houses being sold tends to be positively correlated with housing turnover. This means that the REINZ median tends to produce lower peaks and higher troughs in housing price inflation than the (accurate but less timely) QV Quarterly House Price Index.

The provision of suburb level data from REINZ allows us to employ stratification techniques to control for changes in the mix of high and low value suburbs reporting sales each month. From this we can produce a timely housing price measure that is robust to changes in the composition of dwelling sales.

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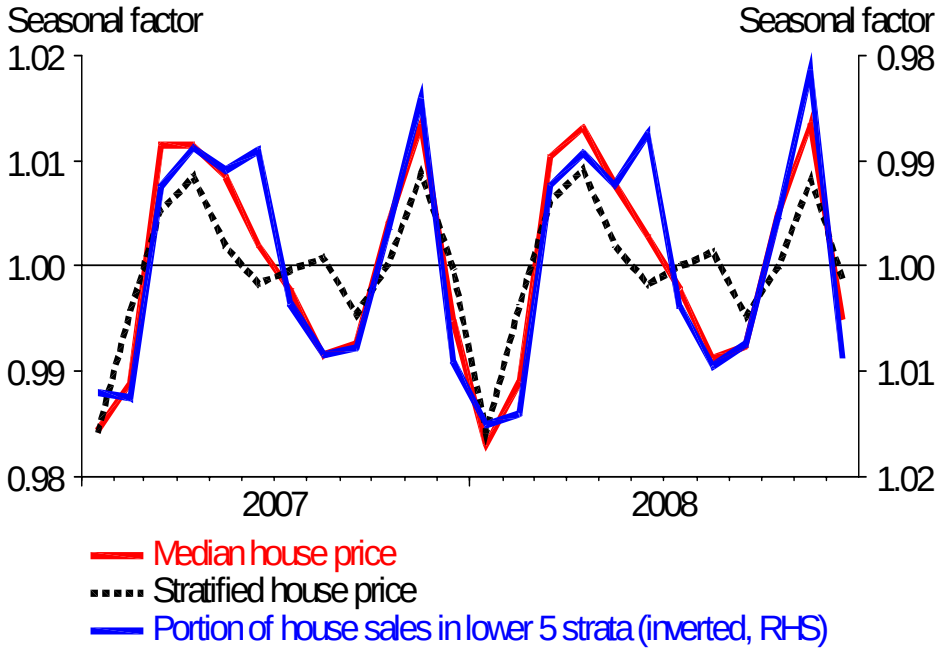
Appendix A Seasonality of housing prices and sales

Figure A1 shows the seasonal factors for the monthly REINZ median housing price (red line) and the seasonal factor for the portion of housing sales in the lowest 5 deciles (blue line). These were obtained via running X12. These confirm a relationship between composition and prices at a seasonal level. The median housing price tends to be higher in Q2 and Q4, coinciding with a smaller portion of less expensive dwellings tending to be sold over these quarters. The monthly stratified housing price measure (black dotted line) shows a slightly less pronounced seasonal pattern, which suggests that this technique does not wholly remove seasonality.

Regressions of the monthly percentage change of the unadjusted REINZ median housing price shows that the seasonal factor is positively signed and statistically significant.

Figure A.1 Seasonal factors [9]



Source: REINZ, RBNZ estimates.

[9] Note, the seasonal factor is the actual divided by the seasonally adjusted. Therefore, a number above 1 implies an above average month.

Appendix B Equation summary

Composition of house sales and difference between the QV Quarterly House Price Index and the REINZ median measures of housing price inflation

$$\Delta PQ_t - \Delta PR_t = \underset{(7.85)}{0.748} * \Delta (LHS/HS)_t \quad (1)$$

Where:
$\Delta PQ_t - \Delta PR_t$ = difference in quarterly housing price inflation (QV-REINZ).
$\Delta (LHS/HS)_t$ = change in the portion of housing sales from the lowest 5 strata.

All figures are seasonally adjusted.
t-stats in brackets
Sample: 1992q2 – 2008q4, Number of observations = 67.

Sum Sq = 64.7022, Std Err = 0.9897, LHS Mean = -0.0175, Res Mean = 0.0285
R Sq = 0.4829, R Bar Sq = 0.4829, F(1, 66) = 61.6426, %RMSE = 330.328
D.W.(1) = 2.4809, D.W.(4) = 1.8638

Change in composition of housing sales equation

$$\Delta(LHS/HS)_t = \underset{(4.79)}{0.271} * \Delta (HS)_{t-3} \quad (2)$$

Where:
$\Delta(LHS/HS)_t$ = annual difference in the portion of low valued housing sales.
$\Delta(HS)_{t-3}$ = annual difference in housing sales (000s), lagged 3 quarters.

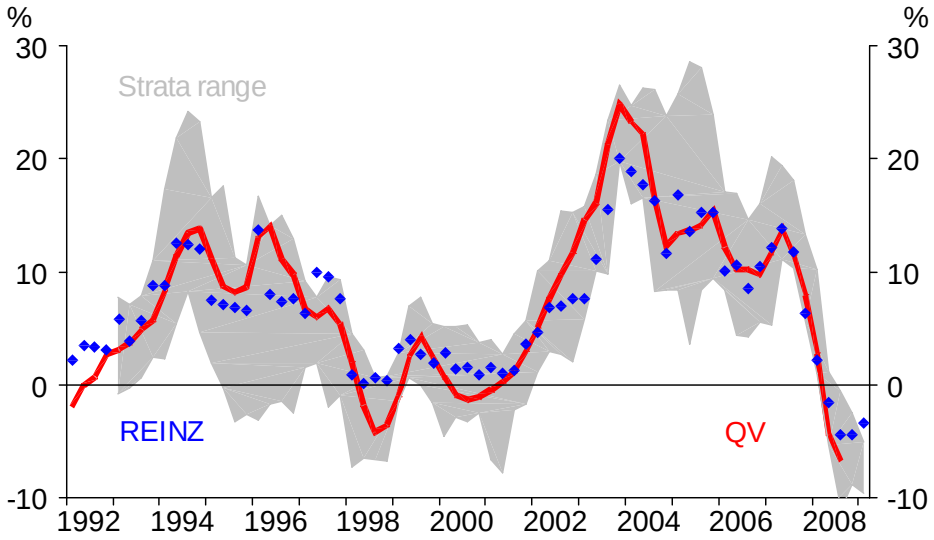
All figures are seasonally adjusted
t-stats in brackets
Sample: 1993q1 – 2008q4, Number of observations = 64.

Sum Sq = 229.046, Std Err = 1.8895, LHS Mean = -0.1712, Res Mean = -0.2541
R Sq = 0.2626, R Bar Sq = 0.2626, F (1, 63) = 22.4403, %RMSE = 391.604
D.W.(1) = 0.8803, D.W.(4) = 1.5190

Appendix C Strata ranges of housing price inflation

All ten strata in shaded area

Figure C.1 Annual housing price inflation



Source: PropertyIQ, REINZ, RBNZ estimates.

Appendix D Annual summary statistics

Table D.1 Annual housing price inflation

	1993-1999	2000-2008	1993-2008
Average percentage change			
Stratified house price	6.0	8.7	7.5
REINZ median	6.5	8.2	7.5
QV house price index	6.3	8.7	7.6
Root mean square error with QV house price index			
Stratified house price	1.76	1.32	1.53
REINZ median	2.64	2.72	2.68

Source: REINZ, PropertyIQ, RBNZ calculations.

Appendix E Regional housing price measures

Figure E1 compares annual housing price movements in the stratified housing price measure (aggregate) with a weighted average housing price measure, which is a housing sales weighted measure of the regional stratified measures derived in section 6.

Bivariate cross correlation coefficients are 0.99 for annual housing price movements, 0.93 for quarterly movements, and 1.00 for the levels relation.

Figure E.1 New Zealand stratified housing price measure versus weighted regional stratified measure
(Annual percentage changes**)**

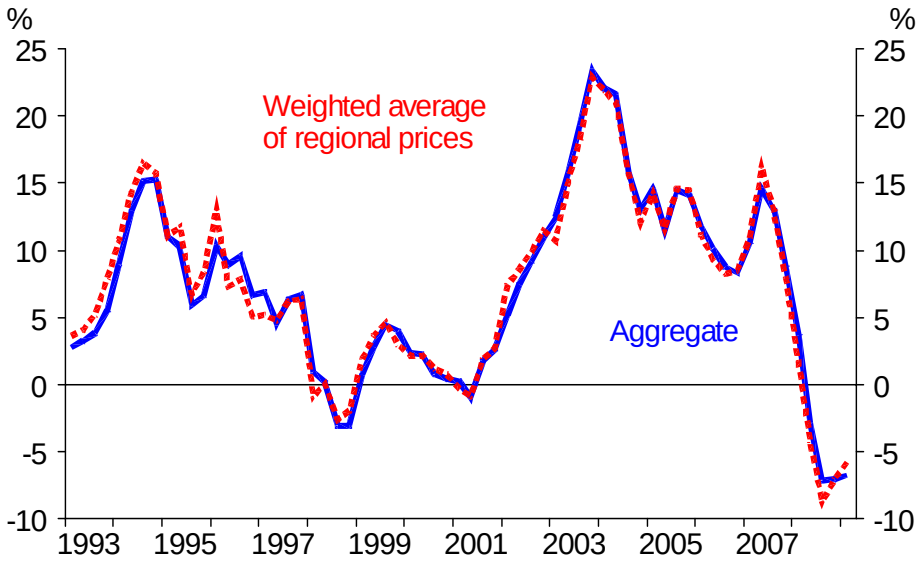


Figure E.2 shows the housing sales shares of the various regional areas, defined as the sales each month as a portion of total monthly national sales. Dotted lines show the average sales share for the three regional areas.

Figure E.2 Share of total New Zealand housing sales by region