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**Developing stratified housing price
measures for New Zealand**

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**Developing stratified housing price
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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.

¹The 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, Tony Richards, Frances Krsinich, Chris Pike, Phil Briggs and Tim Hampton.. 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 © Reserve Bank of New Zealand.

1 Introduction

Housing market developments have an important impact on economic activity and inflation in New Zealand (see DeVairman and Dunstan 2008 and Smith 2009, forthcoming). 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.

Despite being well served with housing data, New Zealand does not currently have an official housing price index. 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. 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 housing 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.

Housing price 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 were 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. However, 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.

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 compositionally adjusted 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 Indices are an example;²
- (ii) Assessment information
Uses sales information and assessment information from administrative records to construct ratios from which house price indices are derived. The QV Quarterly House Price Index in New Zealand is an example of this approach;
- (iii) Stratification
This decomposes 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 expresses an average of the means as a real estate price index; and³
- (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**
Publishes 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**
Collect 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 Quarterly 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
Applies to	Residential houses and apartments sold by REINZ members	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 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

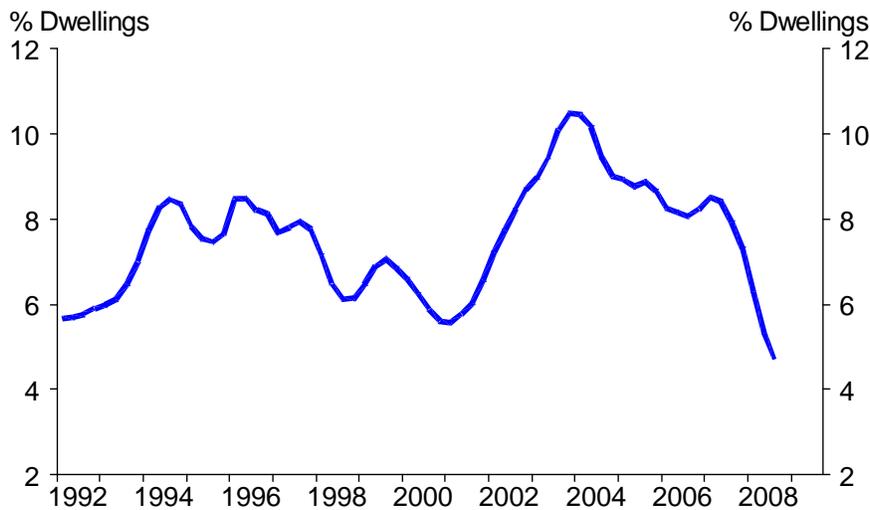
A major problem in measuring housing price growth results from the infrequency of transactions and the heterogeneous nature of the housing stock. The sample of dwellings transacted in any period may be far from

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)

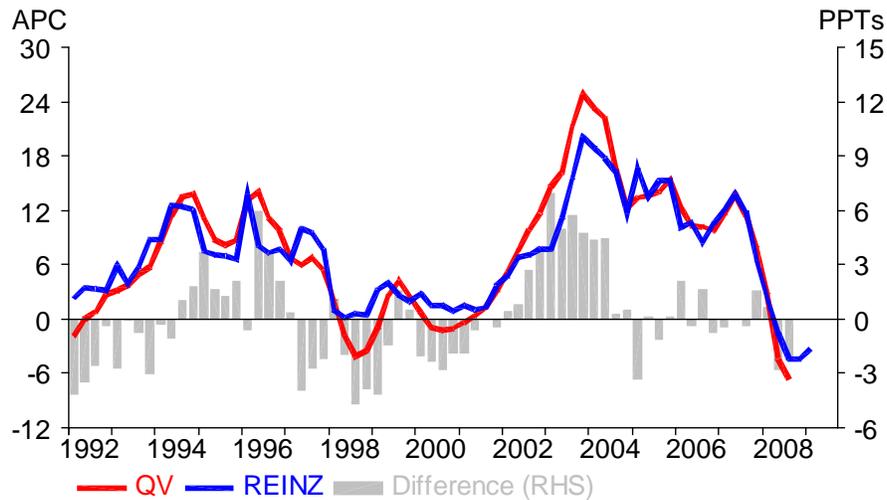


Source: PropertyIQ, Statistics New Zealand.

Figure 2 compares rates of annual housing price inflation from the QV Quarterly 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 a relevant comparison window. From this we construct strata, each of which group together suburbs by their median sales price (see section 6 for further details of the methodology). Each strata contains suburbs which accounted for 10 percent of transactions over the relevant comparison window. Strata one contains suburbs which recorded 10 percent of transactions with the lowest median sales prices over the comparison 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 but relatively higher in the June and December quarters compared to quarterly inflation from the QV Quarterly House Price Index.

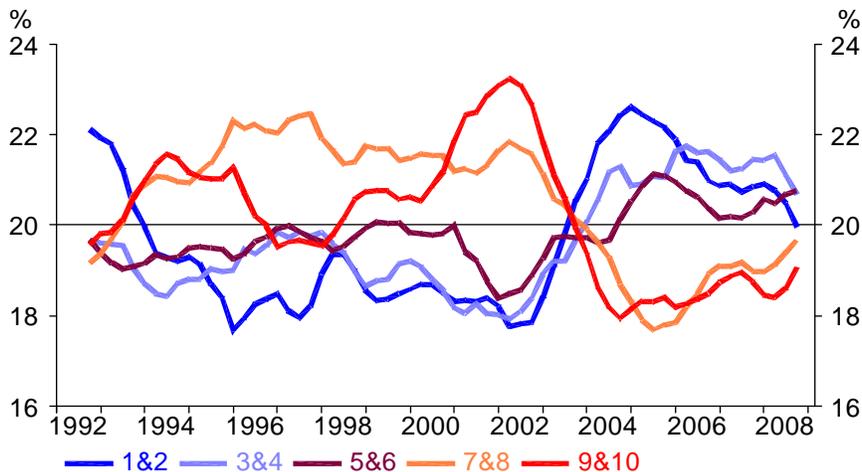
Appendix A compares the seasonal factors of monthly REINZ housing prices (which are obtained via X12) and the composition of house sales. In light of a seasonal pattern evident, we use X12 to seasonally adjust all of the data that we use in this analysis.

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.

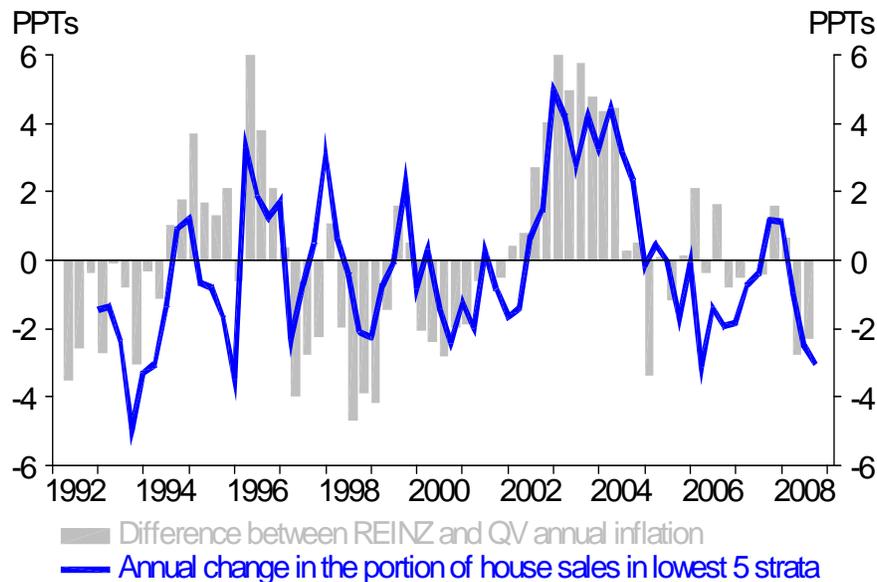
Figure 3
Portion of house sales by strata
 (12 monthly rolling averages, 2005/09 window used to derive strata)



Source: REINZ, Authors' 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
(2005/09 window used to derive strata)



Source: PropertyIQ, REINZ, Authors' 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:

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

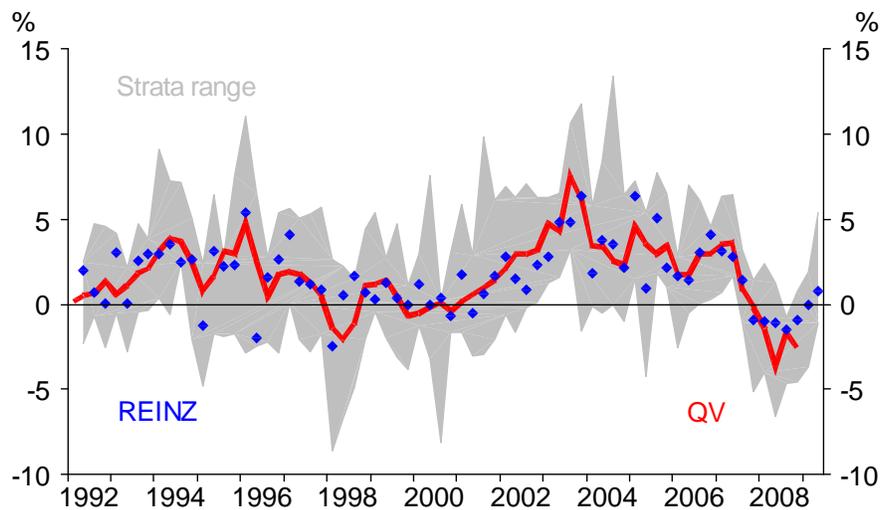
Where:

- $\Delta PQ_t - \Delta PR_t$ = 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).

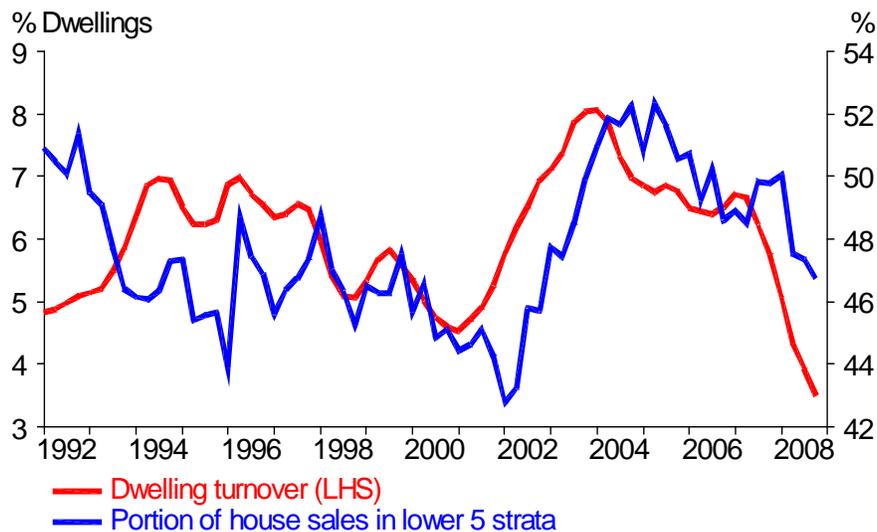
Figure 5
Quarterly housing price growth*



* Shaded areas show the range of quarterly percent movements for all ten strata.
Source: PropertyIQ, REINZ, Authors' 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 sum of sales for strata one to five.

Figure 6
Dwelling turnover and sales composition
(2005/09 window used to derive strata)



Source: REINZ, Authors' estimates.

To investigate this more formally the following regression is estimated:

$$\Delta(\text{LHS}_t / \text{HS}_t) = \beta_1 \Delta(\text{HS})_{t-3} \quad (2)$$

Where:

$\Delta(\text{LHS}_t / \text{HS}_t)$ = annual difference in the portion of low valued house sales.

$\Delta(\text{HS})$ = 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 suburb-level 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.

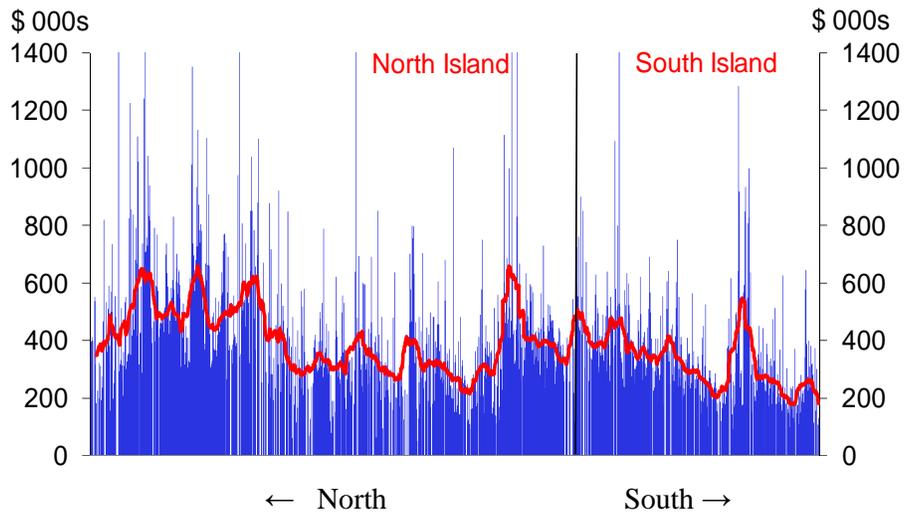
Table 2
Features of the REINZ suburb-level dataset

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.

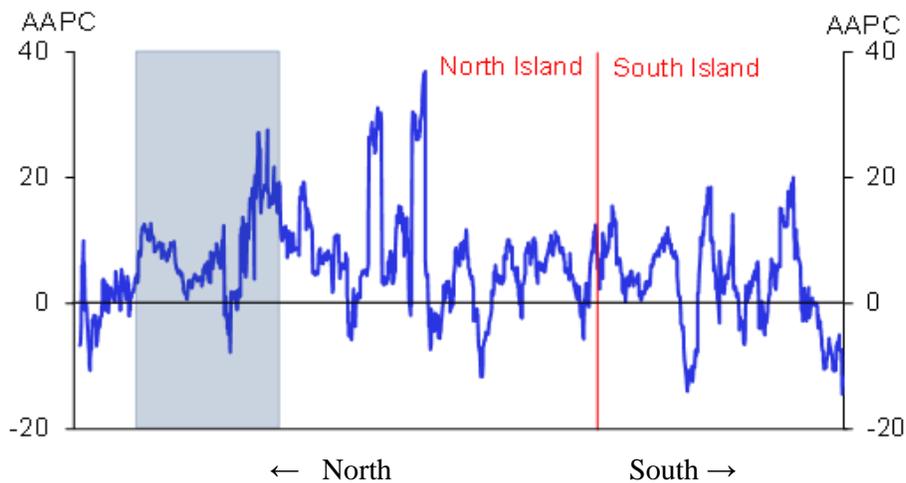
Figure 7
Median sales price by suburb



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

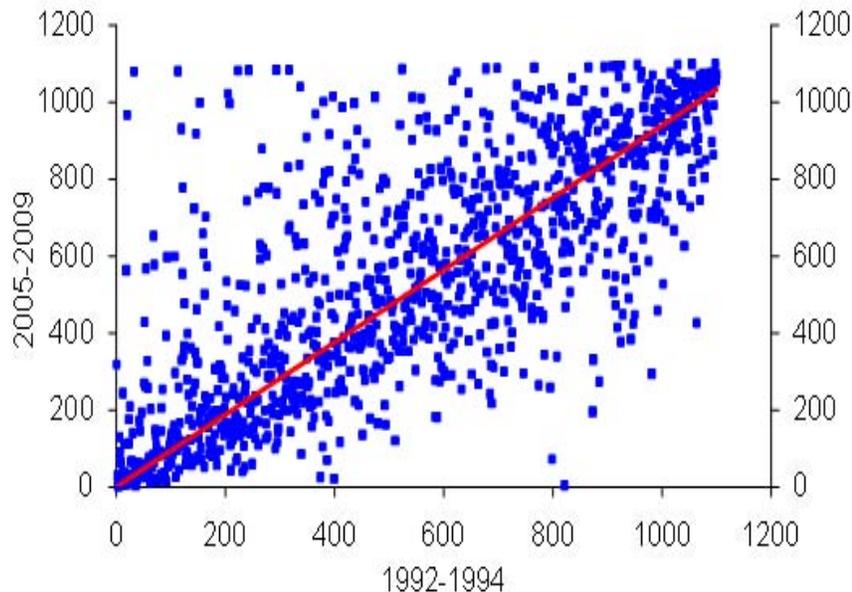


Note: Shaded area denotes Auckland suburbs.
 Source: REINZ, Authors' estimates.

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, Authors' estimates.

However, some movements in relative prices are evident, with a number of suburbs becoming considerably more (or less) expensive relative to other suburbs. Narrowing the comparison windows and filtering out suburbs that have low number of transactions still produces a relatively large number of suburb outliers.

Closer inspection of these outliers suggests some of the large relative price movement is attributable to changes in geographical boundaries for the particular suburb.

Table 3 summarises the number of suburbs in the dataset who record a sale for each year, alongside a cumulative tally of suburbs who have already recorded at least one sale, and the number of suburbs which first record a sale in the dataset.

Table 3
Comparison window used for stratification

Year	Suburbs with sales	Suburbs with at least 1 sale up until...	New suburbs		Window
			Sales	%	
1992	958	958			1
1993	983	1053	95	9	1
1994	976	1102	49	4	1
1995	982	1129	27	2	1
1996	1007	1186	57	5	2
1997	1007	1200	14	1	2
1998	877	1208	8	1	2
1999	1016	1235	27	2	2
2000	946	1259	24	2	2
2001	942	1272	13	1	2
2002	1020	1288	16	1	2
2003	1035	1295	7	1	2
2004	1095	1333	38	3	2
2005	1471	1597	264	17	3
2006	1490	1678	81	5	3
2007	1492	1713	35	2	3
2008	1293	1724	11	1	3
Average	1094	1308	48	4	

Source: REINZ, Authors' estimates.

Closer investigation of the suburb-level dataset identified three distinct periods:

- Window 1 (1992-95)

This is at the start of the dataset with a fairly large portion of suburbs registering their first sale.

- Window 2 (1996-2004)

The number of new suburbs recorded by the dataset as having registered a transaction stabilises.

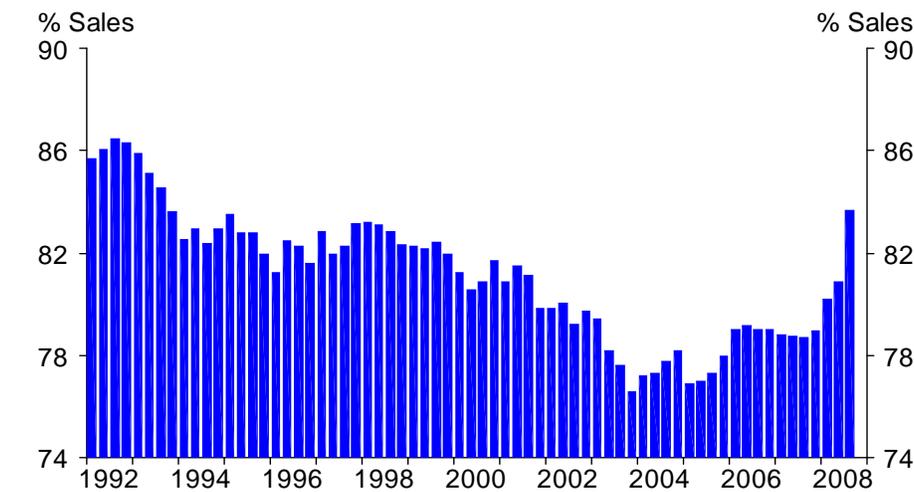
- Window 3 (2005-June 2009)

The reorganisation of suburban areas in 2005 resulted in a number of new suburban areas recording sales. These were mostly from the reclassification by REINZ of a number of established large urban centers into a number of smaller suburban areas.

The stratification that we do will need to take this into account.

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, with a greater number of dwellings 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 housing price measure.

We broadly follow the approach used by Prasad and Richards (2006), who constructed a stratified housing price measure for Australia using housing transaction data provided by Australian Property Monitors. The REINZ dataset differs from that used in the Australian study, in that we do not have access to unit record information. This has necessitated a slightly different approach. 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 median sales price over the comparison window.

We use three comparison windows to order (or rank) suburbs.

- Window 1 (1992-1995)
- Window 2 (1996-2004)
- Window 3 (2005-June 2009)

These represent periods where the suburb level classifications remained fairly constant. Using three comparison windows (rather than the full sample) will provide a more accurate assessment of price trends pertaining to that particular window. Linking together the stratified house price readings for each window will also enable us to produce a housing price measure that will provide more representative estimates over the full data sample.

In each window, we divide the suburbs into strata, with each strata containing 10 percent of total house sales over the relevant period. 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 higher priced suburbs. The fall in housing turnover since 2007 has been more sizeable in lower priced suburbs. This has contributed to the REINZ median showing milder recent movements in housing prices.

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

We assume that the median price reported for the suburb is representative for all of the sales in that suburb that month.

This can be expressed as:

$$P_{ij} = P_j \tag{3}$$

Where:

P_{ij} = median dwelling price of property i in suburb j.

The sales price for the strata is the median of all sales within the strata:

$$P_n = \text{median}(P_{11n}, P_{21n} \dots P_{i1n}, P_{12n}, P_{22n}, \dots, P_{i2n}, \dots, P_{1jn}, P_{2jn} \dots P_{ijn}) \tag{4}$$

Where:

P_n = sales price for strata n.

P_{ijn} = median dwelling price of property i in suburb j in strata n.

This method assigns more weight to suburbs where there are more transactions. As the sales price for the strata is the median observation it will tend to filter out extreme sales prices for suburbs that may result from intra-suburb changes in sales composition.

Table 4 illustrates a hypothetical example of the effect of different weighting schemes on the strata price.

Four methods are compared:

- An unweighted median, where the price for the strata is the median sales price reported for all suburbs in the strata.
- An unweighted mean, where the price for the strata is the average sales price reported for all suburbs in the strata.
- A sales weighted median, where the price for the strata is the median for all sales in suburbs. This is the approach that we have adopted.

- A sales weighted mean, where the price for the strata is the sales weighted average for all suburbs within the strata.

Table 4
Deriving prices for strata

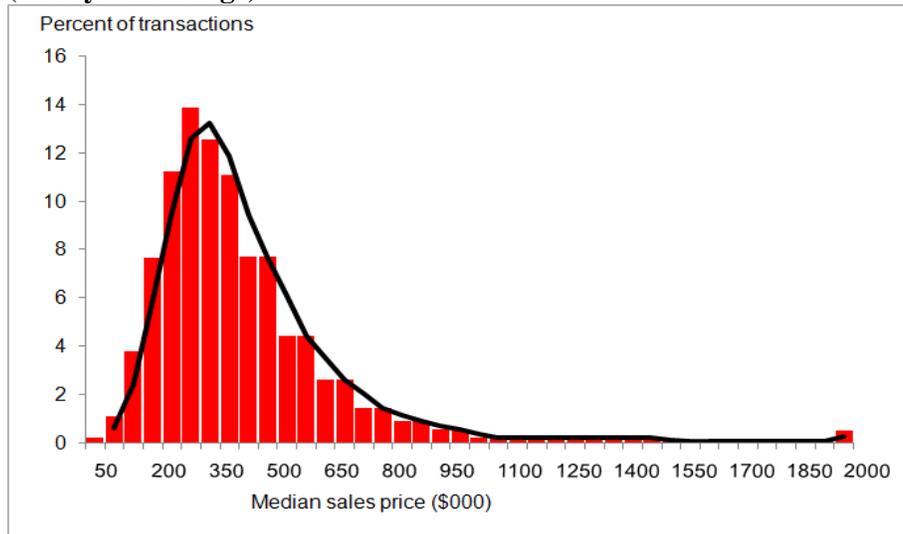
T=0	Suburb A	Suburb B	Suburb C
Sales	4	1	2
Price (\$000)	300	500	350
Unweighted price		Sales weighted	
Mean	383	Mean	343
Median	350	Median	300
T+1			
Sales	5	1	2
Price (\$000)	290	400	325
Unweighted price		Sales weighted	
Mean	338	Mean	316
Median	325	Median	290
Percent movement in price for strata			
Unweighted		Sales weighted	
Mean	-11.7	Mean	-7.9
Median	-7.1	Median	-3.3

The sales weighted median tends to put more weight on suburbs where there are more transactions. As suggested by table 3, most of the sales occur in suburb A, hence the sales weighted median is \$300,000 for t=0. An unweighted median sales price is \$350,000, despite the centre of the sales distribution being lower than this.

The sales weighted median also tends to filter out outliers in the sales distribution and reflect the central tendency in sales prices. As the outliers in figure 9 suggest, there is likely to be some intra-suburb variability in the median prices reported by each suburb. Viewing the price distribution of house sales within New Zealand shows a positive skew (see figure 11). As a consequence, median sales prices for the distribution will be lower than the average price.⁷

⁷ We do not have electronic records for individual sales.

Figure 11
Distribution of house sales in New Zealand by sales price
(2008 year average)



Source: REINZ, Authors' estimates.

If the sales distribution is skewed and tends to move around, rates of housing price inflation from a median based measure would tend to be less volatile than a mean sales weighted measure. Consequently, a median sales weighted measure of housing prices is likely to be more useful in detecting trends and turning points in housing price inflation.

Table 5 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. Volatility in quarterly property price movements is high for some individual strata, particularly strata one and ten which are more diverse given they are at the ends of the distribution. Quarterly changes in housing prices for the middle to upper strata are most closely correlated with movements in the stratified housing price measure.

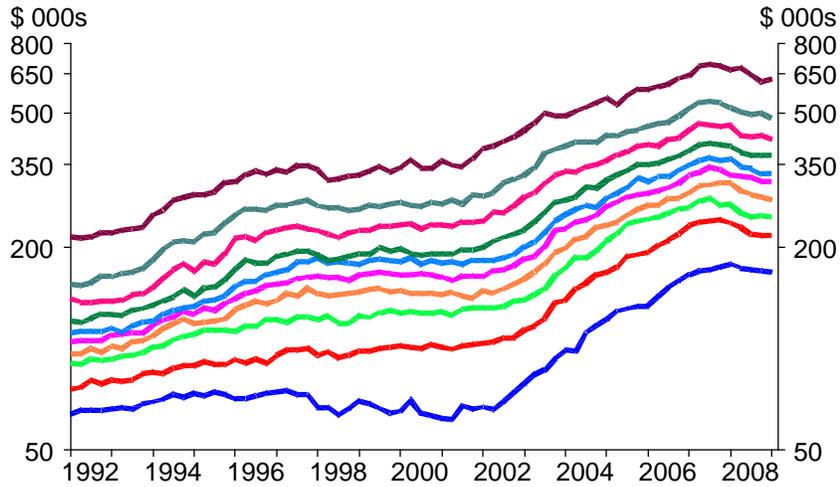
Table 5
Housing price strata (1992-2009Q2)

	Number of Suburbs	Average quarterly growth (percent)	Std deviation (quarterly growth)	Correlation with total (quarterly growth)
1	232	1.5	3.9	0.43
2	184	1.6	3.0	0.58
3	150	1.5	2.8	0.61
4	115	1.6	2.8	0.62
5	110	1.7	2.6	0.71
6	143	1.6	2.8	0.72
7	155	1.7	2.8	0.79
8	182	1.7	3.2	0.73
9	171	1.7	2.9	0.79
10	225	1.6	3.3	0.66
Total	1667	1.6	2.1	1.0
Memo:				
REINZ	1852	1.7	1.9	0.74
QV	n.a.	1.7	2.0	0.90

Source: REINZ, Authors' estimates.

Figure 12 shows housing prices for each strata. Over the 1990s, stronger growth in property values was evident in the higher priced strata. Over the last few years, stronger proportionate growth in the lower priced strata has been 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 closer to 3½.

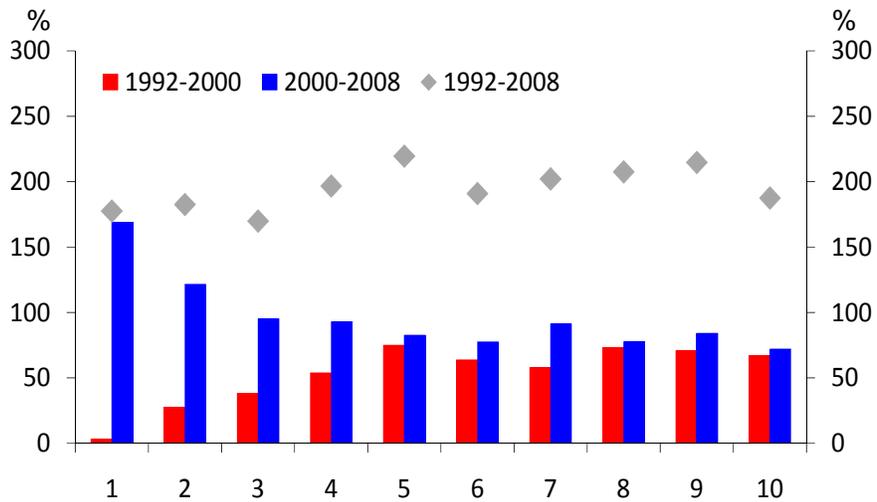
Figure 12
Median housing prices by strata
(log scale)



Source: REINZ, Authors' estimates.

Figure 13 denotes the increase in housing prices for the various strata in the 1990s, and since the start of the decade.

Figure 13
Growth rates in property values by strata



Source: REINZ, Authors' estimates.

3) The national sales price is the average sales price for all 10 strata.

$$P = \sum_{j=1}^n P_n / Q_n \quad (5)$$

Where:

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

P_j = weighted median sales price in strata j

Q_n = number of strata dwelling sales in strata j

As the strata in each comparison window contain the same number of transactions, the national sales price within that particular window is an unweighted average of the sales prices for each of the strata.

4) We link across comparison windows to form a housing price index.

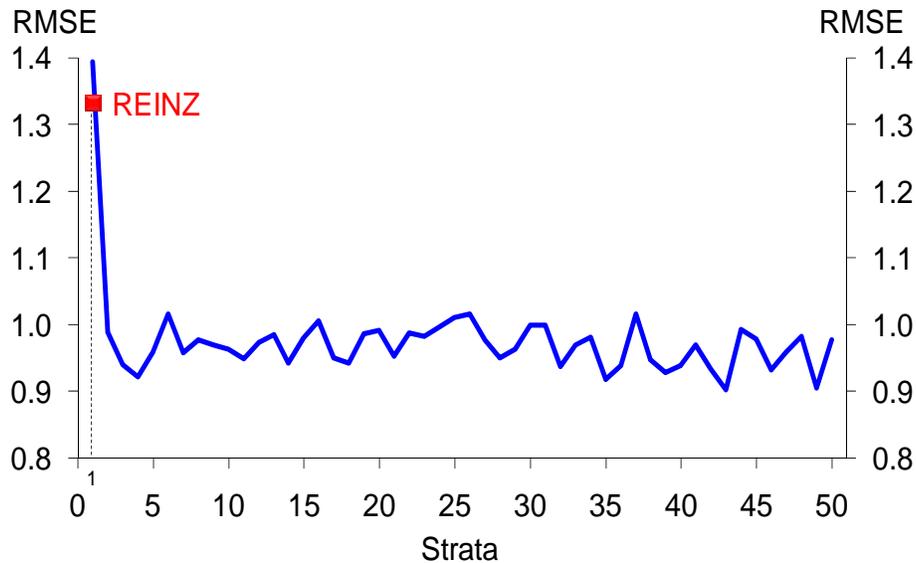
To generate a stratified housing price time series we link the stratified housing price measures across the comparison windows. We convert the linked series to an index, with the expression base of 1000 starting in 1992.

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 because 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 14 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 14
RMSE with QV Quarterly House Price Index
By number of strata in national sample
(Quarterly percentage changes)



Red square is REINZ median and blue is the RMSE for difference numbers of groupings.
 Source: REINZ, PropertyIQ, Authors' 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. As table 6 suggests the stratified housing price measure generates closer quarterly reading of housing price inflation to the QV Quarterly House Price Index.

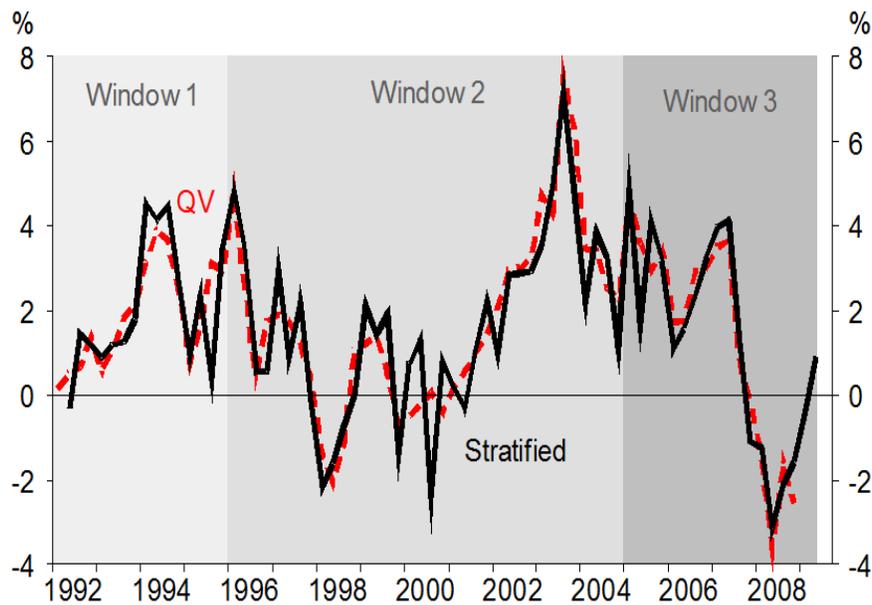
Table 6
Root mean square error with QV Quarterly House Price Index
(Quarterly changes)

	1992-1995	1996-2004	2005-2009
Stratified house price	0.90	0.97	0.75
REINZ median	1.18	1.45	1.35

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

Figure 15 compares quarterly movements in the stratified housing price measure with the QV Quarterly House Price Index. With the exception of the 2000 to 2001 period the stratified housing price measure closely tracks the QV measure. The higher volatility of the stratified housing price measure over 2000 and 2001 was during a period of low dwelling transactions. It is possible that outliers in the sales distribution may have more of an influence on the housing price measure over this period compared to periods of higher housing turnover.

Figure 15
Quarterly housing price inflation



Source: REINZ, PropertyIQ, Authors' calculations.

Another objective is to produce a housing price measure that provides a clear indication of short-term trends in property prices. Table 7 summarises the deviation of the quarterly (and monthly) percentage changes in housing prices from their short-term average.

The stratified housing price measure generally tends to be superior to the REINZ median as an indicator of short-term price trends. However, both measures are inferior to the QV quarterly house price index as an indicator of short-term price movements. Monthly readings of the stratified housing

price measure have increasingly become more reliable indicators of short-term price trends.

Table 7
Deviation in property prices from short-term trend
(Monthly and Quarterly percentage changes)

<i>Root mean square error</i>	1992-1995	1996-2004	2005-2009
<i>Quarterly percent changes</i>			
Stratified housing price	0.84	1.19	1.00
REINZ median	1.31	1.33	1.26
QV quarterly house price index	0.51	0.78	0.86
<i>Monthly percent changes</i>			
Stratified housing price	1.59	1.57	1.03
REINZ median	1.29	1.70	1.28

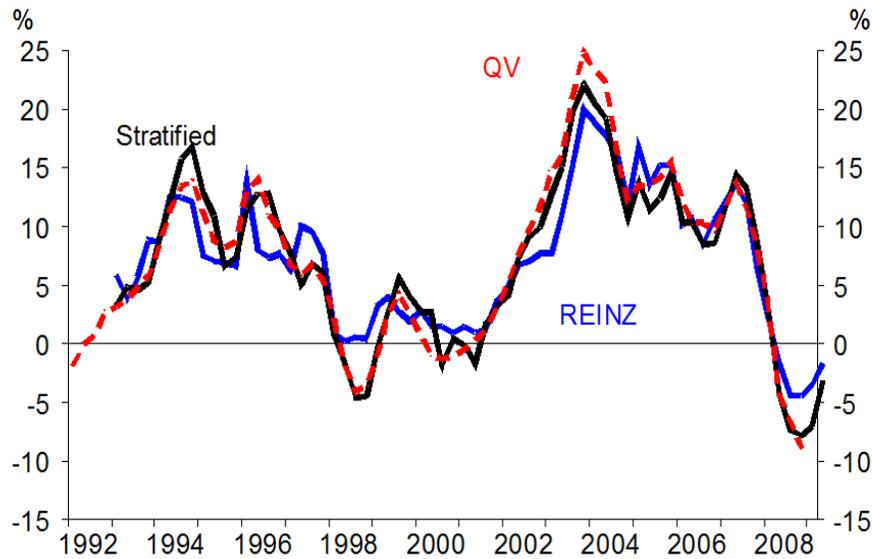
Source: REINZ, PropertyIQ, Authors' calculations.

Note: All RMSEs are relative to a centred 12-month moving average and are calculated from seasonally adjusted data.

Figure 16 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). The stratified housing price measure more closely maps to annual inflation rates produced by the QV measure.

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 QV Quarterly House Price Index.

Figure 16
Annual housing price inflation measures



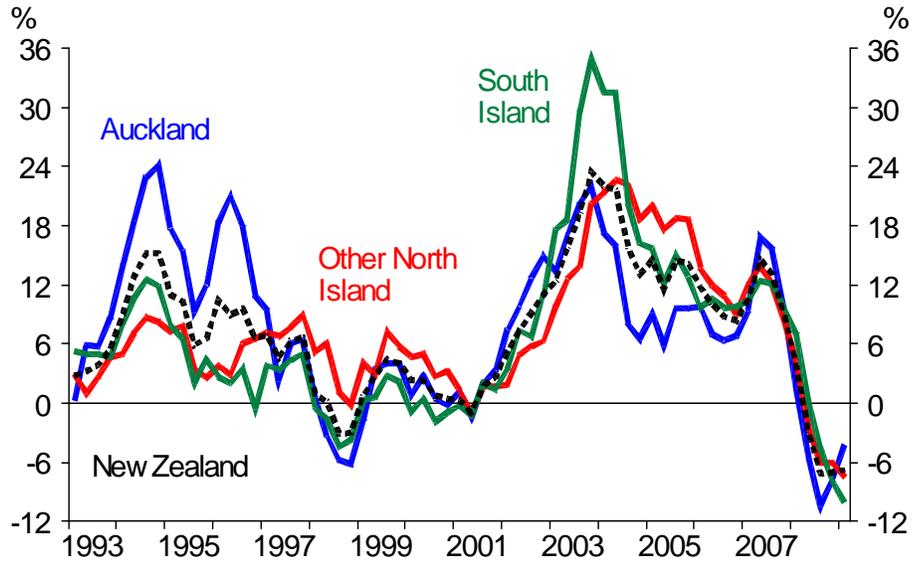
Source: PropertyIQ, REINZ, Authors' estimates.

8 Some regional housing price measures

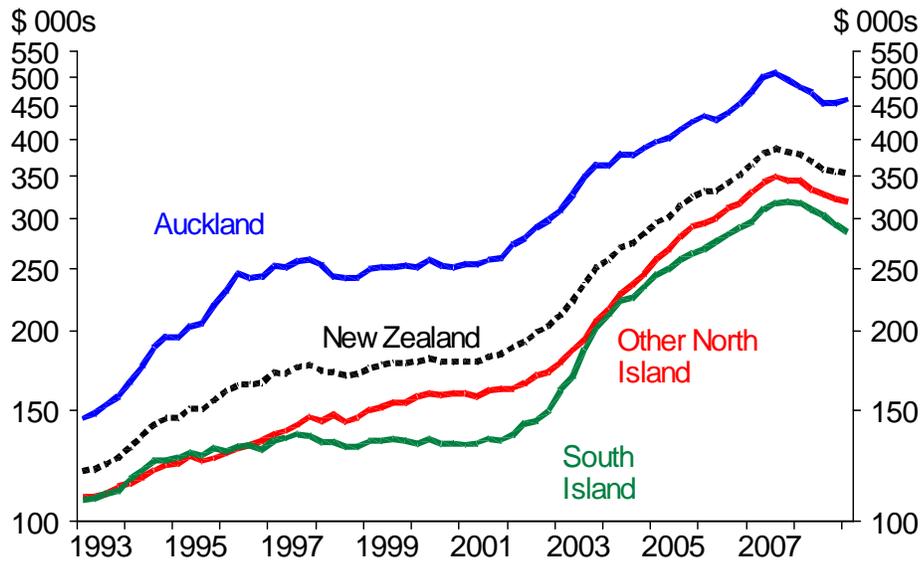
Figure 17 presents some preliminary housing price measures for 3 regions in New Zealand. These include suburbs in the greater Auckland area (323 suburbs), suburbs in the rest of the North Island (918), and all South Island suburbs (611). Housing price inflation has fallen sharply in all three regions over the past year, with the largest falls experienced in Auckland.

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.

Figure 17
Stratified regional housing price measures
 (Annual percent changes, 2005/09 window used to derive strata)



Levels
 (log scale, 2005/09 window used to derive strata)



Source: REINZ, Authors' estimates.

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 D 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 using the suburb-level dataset. 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
- Coverage – while our sample is comprehensive, it represents only about 80 percent of all transactions incorporated in the QV Quarterly House Price Index.
- Changes in classification – changes in suburb boundaries and the reorganisation of sales data in some regional centres has necessitated that we use different comparison windows from which to derive strata. This has made it more difficult to compare price trends across different strata over time.

Next steps

The Bank has recently obtained a detailed dataset from REINZ which contains records for individual residential sale transactions. While we have

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.

yet to quantitatively assess the properties of this data it holds some promise as a means to further improving our current stratified housing price measures. However, it is likely to be some time before robust measures using the individual transaction data are developed and tested.

Future work is likely to follow three broad streams:

1. Stratification

We will use individual transaction data to derive stratified housing price measures. If these are an improvement on the suburb-level estimates we will adopt the new measures. We will also investigate the appropriate timing to extend the comparison window (currently 2005/09Q2) used to derive current readings of the stratified housing price measure.

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 (rather than sales volumes) from which to categorise the strata used in the calculation of housing price measures. 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 information for vacant residential land (commonly referred to as residential sections). We have used stratification techniques on the suburb-level dataset to put together a national section price measure, and will look at developing a similar measure using the individual transaction dataset.

2. Developing housing price measures using other approaches

The more detailed nature of the REINZ dataset will also enable other techniques for deriving housing price measures to be examined, including hedonic and factor model approaches. This is also a work in progress.

3. 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.

4. 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.

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. This will greatly assist in the analysis of housing market developments within the New Zealand economy.

With more detailed residential transaction data having recently become available, there remains scope to further improve the quality of housing price measures available. This is an area for future work.

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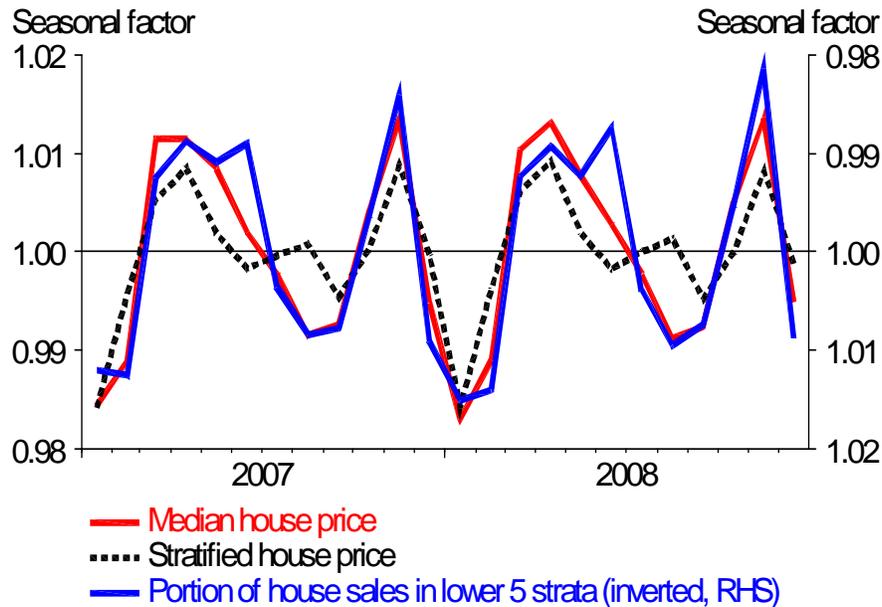
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Appendix A Seasonality of housing prices and sales

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, Authors' 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

$$\Delta PQ_t - \Delta PR_t = 0.748 * \Delta (LHS/HS)_t \quad (B1)$$

(7.85)

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

$$\Delta(LHS/HS)_t = 0.271 * \Delta (HS)_{t-3} \quad (B2)$$

(4.79)

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

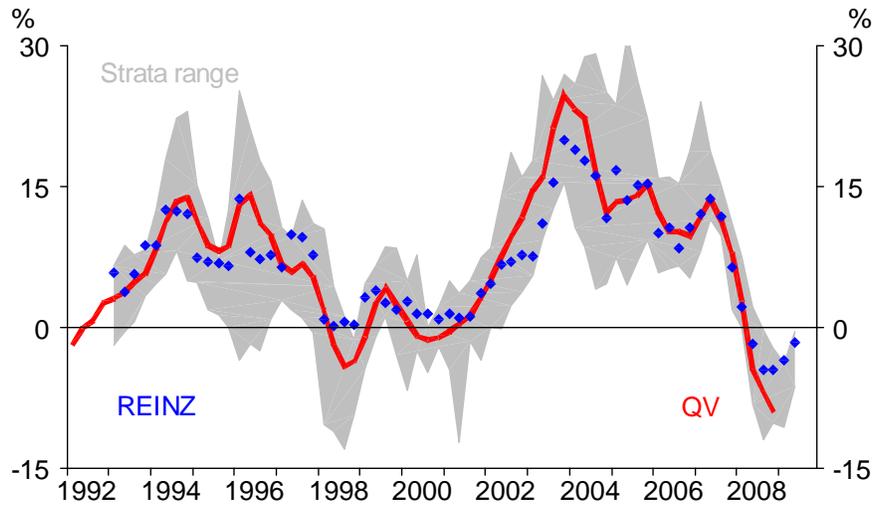
R Sq = 0.2626, R Bar Sq = 0.2626, F (1, 63) = 22.4403, %RMSE = 391.604

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



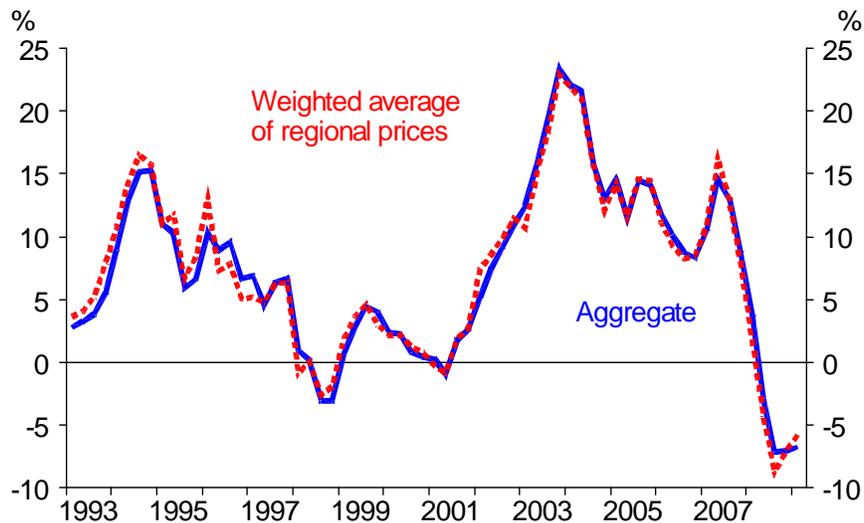
Source: PropertyIQ, REINZ, Authors' estimates.

Appendix D Regional housing price measures

Figure D1 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.

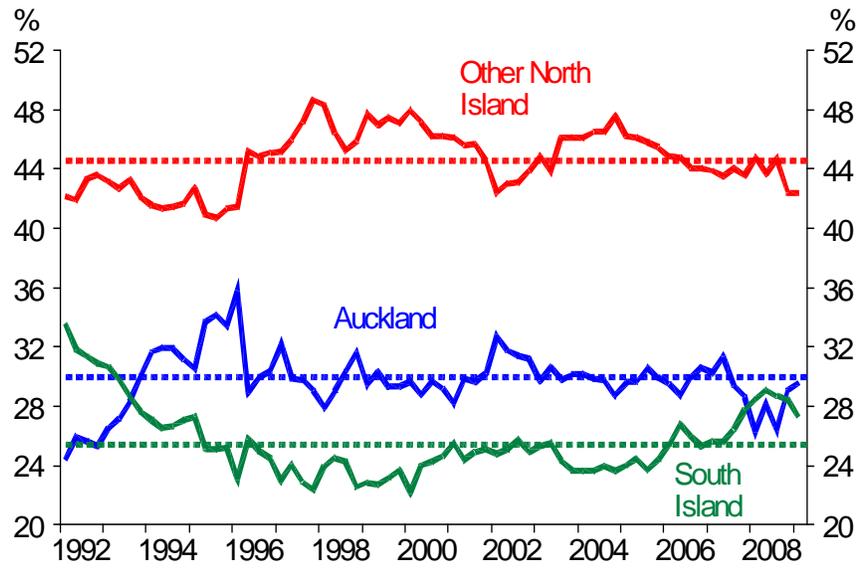
Figure D.1
NZ stratified housing price versus weighted regional stratified measure
(Annual percentage changes)



Source: REINZ, Authors' estimates.

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



Source: REINZ, Authors' estimates.