MEASURING HOUSING PRICES: AN UPDATE[1]

Introduction

Over the past few years, developments in housing prices have been of significant concern to policy-makers in many countries. Housing represents a major component of household wealth and movements in house prices can materially influence household spending and borrowing decisions. In light of the relevance of housing prices for macroeconomic developments, it is important to be able to assess movements in aggregate housing prices both accurately and on a timely basis.

However, the experience in Australia and in some other countries has been that measurement problems make it difficult to assess developments accurately with the available real-time data. The major problem in Australia has been with respect to compositional change, and the difficulties involved in inferring the price change for the overall housing stock from sales prices for the small fraction of dwellings that is transacted in any period. The compositional change problem is exacerbated by the poor timeliness of data, given the existence of a lag between when a sale is agreed and when it subsequently enters into a database of transactions.

This article summarises some research undertaken at the Reserve Bank on the measurement of aggregate housing prices, aimed in particular at improving upon measures of median prices, which are commonly used both in Australia and internationally.[2] Overall, there exist a number of feasible techniques – mix-adjustment, hedonic and repeat-sales methods – that appear to provide good measures of price changes. The article uses data for Sydney and Melbourne house prices as examples to demonstrate these methods and the improvements that can be achieved over median-based measures.[3]

Why Are House Prices Difficult to Measure?

House prices can be difficult to measure for a number of reasons, some methodological and some practical. These problems are most pronounced when using median price measures. Medians (or

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means) are commonly used measures internationally because they are easy to calculate and have a straightforward interpretation, representing the price in a 'typical' transaction.[4]

To be meaningful, measures of housing prices should be based on prices in actual transactions rather than on perceptions of valuations. However, only a relatively small fraction of the total housing stock is transacted in any particular period: in Australia, around 1½ per cent of the housing stock is transacted each quarter, and the average turnover is significantly lower in some other countries. Furthermore, the quality and composition of the small proportion of houses that are transacted may be quite different to the much larger stock of dwellings that are not transacted and for which prices cannot be observed. As a result, changes in the mix of properties sold over time can influence measures such as those based on median prices.

For example, even when there are no changes in the value of any houses within a city in a particular period, if the proportion of sales that occur in more expensive suburbs increases, the measured city-wide median price will increase. This type of compositional change can introduce significant noise into measures of aggregate house prices, particularly in the short term. For example, analysis of suburb-level transactions in Sydney and Melbourne indicates that around 60 per cent of the quarterly variation in median price changes can be attributed solely to changes in the mix of sales between higher- and lower-priced suburbs, rather than to price changes reflecting demand and supply conditions.[5]

Analysis of housing transactions indicates that some of the compositional change in Australia is seasonal in nature, with more expensive houses tending to be sold at particular times of the year (typically the December quarter) and less expensive houses sold in other periods (the March quarter). This seasonality in the mix of dwellings contributes to seasonality in median house prices, with median prices being higher in those quarters when the proportion of more expensive houses sold increases and pushed lower when this proportion falls. Indeed, seasonal effects alone can explain around one-half (for Melbourne) and one-third (for Sydney) of the quarterly variation in median house prices. Analysis of price data for several other countries (the United States, Canada and New Zealand) suggests that median price measures there are also subject to significant seasonality. This suggests that compositional change is a pervasive problem for median price measures.

There are other practical issues involved in measuring prices accurately. In particular, unlike prices in other asset markets, price information for housing transactions is typically not available on a timely basis. In most countries there is a significant lag between the agreement on a price and the settlement of the transaction: in Australia, the settlement period is typically between one and three months (depending on local conventions). When combined with reporting lags, price information is sometimes not available until several months after the initial agreement on the price.

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4 *Medians (or means) tend to be published by industry bodies, including the Real Estate Institute of Australia, the US National Association of Realtors, the Canadian Real Estate Organisation and the Real Estate Institute of New Zealand.*

5 *In addition to compositional change, changes in the average quality of housing over time can be important. If the quality of the housing stock tends to rise – for example, through renovations of the existing stock and the addition of higher-quality newly constructed houses – then the growth in a simple mean or median will tend to overstate the pure price change in housing. Such effects may be important for questions such as the longer-term performance of housing as an asset class, but they are unlikely to play a significant role in short-term movements in house prices.*

A particular 'real-time' problem may arise if there are systematic differences in reporting lags, so that initial samples of housing transactions are unrepresentative of the full set of transactions. For example, if – as appears to be the case in several Australian cities – more expensive houses tend to take longer to settle, initial estimates of median prices will be biased downwards. Estimates of median prices will then be subsequently revised upwards as information on sales of more expensive houses becomes recorded in the transactions database.

An additional practical issue is that while most housing transactions databases contain information on the geographic location and transaction price of a sale, they often do not contain comprehensive information on the physical characteristics of sold dwellings. So while it may be possible to adjust for quarter-to-quarter shifts in the mix of properties sold by controlling for location, it is more difficult to adjust for other changes in composition or quality.

What Are the Alternatives?

The fact that median prices are affected by compositional change and seasonality is evidence that samples of observed transactions cannot be considered to be random. Since there exists no *ex ante* way of ensuring a random sample of housing transactions, techniques are required *ex post* to deal with the non-randomness. While median prices are widely used, alternative methodologies are employed in a number of countries to deal with the problem of compositional change and to obtain improved measures of housing prices (Table 1).

One means of controlling for changes in the mix of properties sold is to use the technique of stratification to construct a mix-adjusted measure of house prices. This is the methodology used by the Australian Bureau of Statistics (ABS) in its indices for established house prices. Mix-adjusted measures have also been used in a number of other countries including Canada, Germany and the United Kingdom, although there are differences between the approaches used in each country reflecting the diverse nature of housing markets across regions. Typically, small geographic regions (e.g., suburbs) are clustered into larger geographic regions (e.g., the inner suburbs, the northern suburbs, etc) and then a weighted average of price changes in those larger regions is taken: the ABS uses this approach in its indices. Another approach along these lines uses price-based stratification (Prasad and Richards 2006), based on the evidence of marked compositional change between lower- and higher-priced suburbs. This appears to be highly effective in reducing the influence of compositional change. In particular, houses and apartments sold in any period can be divided into groups (or strata) according to the long-run median price of their respective suburbs: for example, suburbs in Sydney and Melbourne are allocated into 10 different groups (deciles) with other suburbs that have similar-priced houses. The mix-adjusted measure of the city-wide average price change is then calculated as the average of the change in the medians for each group.

Regression-based approaches have also been used by researchers and are used in the official measures produced in some countries, including the United Kingdom and United States. One method is the hedonic approach which involves attempting to explain the price in each transaction by a range of property attributes, such as the location, type and size of a property, as well as the period in which it was sold. The index of house prices that results can be thought of as the average price level of the transactions that occurred in each period, after controlling

Table 1: Housing Price Series in Selected Countries

	Provider and background
Australia	*Medians*: produced by the Real Estate Institute of Australia and the Commonwealth Bank of Australia. *Mix-adjusted*: produced by the Australian Bureau of Statistics (groups houses mostly according to region) and Australian Property Monitors (groups houses and apartments according to the long-run average price of the suburb). *Repeat-sales*: produced by Residex.
Canada	*Means*: produced by the Canadian Real Estate Organisation. *Mix-adjusted*: published by the Bank of Canada/Royal Le Page (groups transactions by region and dwelling type).
Europe	*Median and means*: produced in most countries, with some countries making a rudimentary adjustment for quality by measuring prices in per square metre terms. *Mix-adjusted*: produced by Deutsche Bundesbank/Bulwien AG in Germany and Ministerio de Formento in Spain. Transactions tend to be grouped by region and dwelling type. *Hedonic*: produced by the National Statistical Institute of France.
New Zealand	*Medians*: published by the Real Estate Institute of New Zealand.
United Kingdom	*Medians*: produced by the Land Registry. *Mix-adjusted*: produced by Hometrack and Rightmove (both group transactions according to dwelling type and region) and the Office of the Deputy Prime Minister (where a hedonic regression is used to calculate a price for each group). *Hedonic*: produced using loan approvals data from Halifax and Nationwide.
United States	*Medians and means*: published by the National Association of Realtors. *Repeat-sales*: produced using mortgage lenders data by the Office of Federal Housing Enterprise Oversight and Freddie Mac.

for the observable attributes of the properties that were sold. Hence, a hedonic approach can take account of shifts in the composition of transactions in each period. In principle it can also control for quality improvements, although the ability to do so in practice will depend on the comprehensiveness of data on housing characteristics.

An alternative regression-based approach is the repeat-sales methodology. Rather than focusing on the price *level* in each transaction, this approach relies on the observed *changes* in price for those properties that have been sold more than once. Using a regression framework, it seeks to identify the common component in price changes over time. One limitation of a pure repeat-sales approach is that it uses only the data from those transactions involving properties for which there is a record of an earlier sale. An additional factor is that estimates of price changes in any quarter will generally continue to be revised based on sales that occur in subsequent quarters.

In principle, both regression approaches can provide a broader control for compositional change than a mix-adjusted measure, as they can control for more characteristics of sales than a
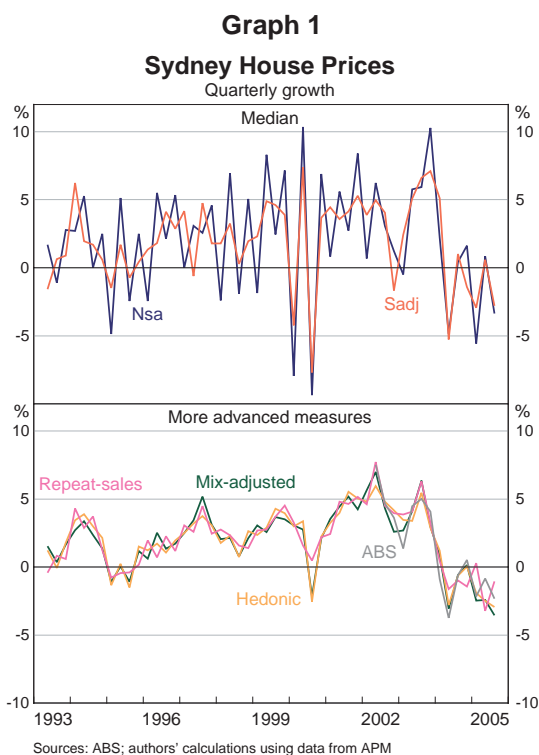
mix-adjusted measure. However, the possible advantages come at a cost of requiring the use of statistical techniques that are more complex, more data-intensive, and often require assumptions on the part of the researcher.

What Do the Alternatives Look Like?

Graphs 1 and 2 show quarterly changes in various measures of house prices for Australia's two largest cities, for June quarter 1993–September quarter 2005. The top panels show the quarterly growth in the standard median price measure as well as the change in a seasonally adjusted median measure. The bottom panels show the mix-adjusted, hedonic and repeat-sales measures for the two cities, as calculated by the authors. For comparison, the house price index published by the ABS is also shown from the start of 2002.[6]

It is apparent that median prices are considerably more noisy than the more advanced measures of price changes. As was noted earlier, movements in median price measures will reflect changes in the mix of dwellings sold as well as pure price changes. This compositional change adds volatility to measures of city-wide median prices. In contrast, by controlling for compositional change, the more advanced measures are smoother, providing a clearer indication of price trends in the housing market. Overall, using a measure of the average deviation from the trend growth in prices, it would appear that these measures contain around 70 per cent less noise than the raw median measure.[7]

Graph 1

Sydney House Prices

Quarterly growth

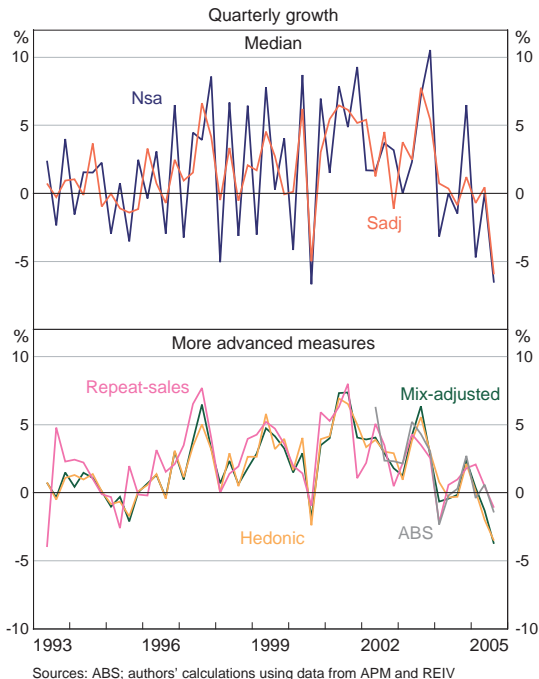Sources: ABS; authors' calculations using data from APM

As noted earlier, one problem with the standard city-wide medians for most state capitals is that they are subject to significant seasonality. Given that it seems improbable that pure price changes should be seasonal, seasonal adjustment of median price measures should represent a 'bare minimum' improvement to standard median price measures. Not surprisingly, a seasonally adjusted median produces a smoother measure of price changes than a non-seasonally adjusted

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6   *The measures calculated by the authors are based on a dataset from late 2005, so for comparability the ABS estimates shown are from the same time. All data are referenced by contract date rather than settlement date: the ABS index is not shown prior to 2002, when it was calculated on a settlement-dated basis.*

7   *The measure of the trend used is based on the quarterly change in a centred five-quarter moving average of the level of prices (see Prasad and Richards 2006 for further details), although the conclusions are robust to other assumptions about the calculation of the trend.*

Graph 2

Melbourne House Prices

Quarterly growth

Sources: ABS; authors' calculations using data from APM and REIV

median, because the former removes the effect of seasonal influences on the mix of dwellings sold. However, the advanced measures still provide much smoother measures of price changes than the seasonally adjusted median, and appear to contain around 50 per cent less noise than the seasonally adjusted median. This indicates that they are also controlling for some non-seasonal shifts in the mix of sales between higher- and lower-priced houses.

It is also noteworthy that the advanced measures all point to similar movements in housing prices, with the correlation coefficients between quarterly changes in the three measures being around 0.9, and they are also all quite highly correlated with the ABS series. Most analysis has found that location is the most important price-determining characteristic of a dwelling, and each of the advanced measures adjusts either explicitly or implicitly for the location of transactions. Accordingly, it is not particularly surprising that the growth rates of these measures are highly correlated.

Overall, the work in Hansen (2006) and Prasad and Richards (2006) shows that both mix-adjusted and regression-based measures are feasible for Australian cities and can substantially improve on a city-wide median measure of house prices. Prasad and Richards have also considered the real-time performance of mix-adjusted measures by calculating initial estimates of house price movements for Sydney that would have been available one month after the end of the quarter. The analysis shows that, although initial sample sizes are typically less than 50 per cent of final sample sizes, initial estimates of the change in the mix-adjusted measure are typically relatively close to final estimates, and involve far smaller revisions than initial estimates of changes based on the standard city-wide median. The real-time performance of hedonic measures and repeat-sales measures is also likely to be better than median measures.[8] The reason that revisions to the more advanced measures will be smaller than revisions to a median is that the former can control for bias in the initial samples of data, such as the fact that initial data samples typically overweight houses in less expensive suburbs.

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8 *However, estimates of the change in prices in any quarter from repeat-sales methodology will be subject to the 'end-point problem', i.e. that estimates of price changes in any period can continue to be revised as information on sales in subsequent quarters becomes available.*

Conclusions

It is important to have good measures of aggregate housing prices to understand the effects of changes in housing prices on the broader economy. The experience of the past few years has been that compositional change is a major problem affecting simple measures of Australian housing prices, especially in real-time data. However, the results of this research show that more advanced measures of house prices – based on mix-adjusted, hedonic and repeat-sales methodologies – provide better estimates of pure price changes and significantly reduce the problems associated with compositional change.

More broadly, there has also been significant progress in improving published estimates of aggregate city-wide and nationwide housing prices in Australia, so that there is now less focus on noisy measures of city-wide median prices. The official series for established house prices from the ABS are now calculated on a contract-dated (rather than settlement-dated) basis, and the ABS has drawn on new data sources to improve the timeliness of its indices. There has also been progress outside the ABS with private sector providers now publishing estimates of mix-adjusted and repeat-sales indices within one month of the end of each quarter. Many of the problems apparent in house price data in earlier years have been ameliorated, although all of the existing measures would benefit from more timely availability of source data on housing transactions. ⊀