Comments on session "Aggregation issues", David Fenwick, Chair, with three papers:

1. Henning Ahnert and Adrian Page, "Euro area residential property prices: the aggregation of non-harmonised national data"

2. Stephan V Arthur, "Experience with constructing composite asset price indexes"

3. Anthony Pennington-Cross, "Aggregation bias and the repeat sales price index"

Robert J Shiller

The papers in this session impress on me how far we have come in the construction of real estate price indexes, but also about the distance we still have to go.

First, let me say that the progress in the construction of home price indexes, as revealed by the papers in this session, is stunning. When I first got involved in the construction of home price indexes in 1987, there were really no really good indexes available for any country, as far as Karl Case, my colleague, and I could determine. In the United States, there was the median sales price computed by the National Association of Realtors for major US cities, but at that time at least the median was often quite erratic through time. There was the Constant Quality Index produced by the Commerce Department, but it was a price for new homes only, and of course new homes tend not to be built in neighbourhoods with declining prices, and so this was an essentially biased estimate. In 1987, with only such data available, people hardly knew what the course of real estate prices were. There is always going to be uncertainty about the future, but in those days there was about as much uncertainty about the past: historical home prices were just not known accurately.

Now, looking at both the Stephan Arthur results and the Ahnert-Page results we can see a detailed account of what is happening to residential property prices. The Bank for International Settlements has done us all a great service by assembling its multi-country data set of asset price indexes for 13 countries. Until they had done this, the world had not seen the detailed international price data for residential properties, and the magnitude and covariability of these price movements were an eye-opener. The BIS data were of such news quality that the popular news magazine *The Economist* has gone to the sources that the BIS tapped and is giving much press to these indexes.

Stephan Arthur's computation of an aggregate asset price index (AAPI), and a plot of this total with its breakdown (in Graph 2) for 16 countries, gives us yet another powerful indicator of the wealth of nations, and new insights into the changes through time. The rather different behaviour across these components in the time paths reveals how much the stability of aggregate wealth in each country is the result of diversification across the three main asset classes, equity, residential real estate, and commercial real estate. The time paths of any one of the components differs a lot across countries, but the time path of the aggregate is fairly similar across all countries. (I only wish he had also included fixed incomes on these charts, which would have rounded out the remaining major asset class.)

The Ahnert-Page paper gives a good indication of the data and methods that underlie the European Central Bank (ECB) euro area residential property price indicator. They also show the remaining weaknesses in these indexes. Annex 1 reveals that for three of the 12 countries no quality adjustment at all is made, and for another five the quality adjustment is only based on square metres.

Regional weighting, for which Ahnert and Page (as well as Pennington-Cross) present a good theoretical case, is either not attempted at all or not defined in half of the countries. One might well surmise that regional weighting can make a great difference, if it is really done right. The Ricardian model of a city shows prices increasing like a rising pyramid on a plane, with prices zero in

the undeveloped lands around the city, with the base of the pyramid expanding through time, and with the highest amount of sales occurring at the perimeter of the base of the pyramid, where prices stay near zero. While the Ricardian model is an extreme case, it does suggest that without regional weighting, a price index may show no increase even as the pyramid grows larger and larger.

It is fortunate that the results of Pennington-Cross suggest that such weighting was not so important in his examples. But, it is still possible that a more detailed study would show bigger effects. A spatial map of price levels would likely show irregular contours with some sharp peaks in urban areas.

Another problem for constructors of price indexes which ought ideally to be addressed is the resistance of sales prices to declines (downward rigidity). David Genesove and Christopher Mayer have shown, with some detailed data from the United States, that homeowners are reluctant to sell at a loss, apparently for psychological reasons related to the pain of regret. In down markets, the volume of sales drops dramatically, and so the sales in all regions can become unrepresentative of the actual prices that might be arrived at in actual markets.

There is also a fundamental distinction between new construction and existing homes. New construction goes on mostly in areas where land is not scarce, and only when price rises above construction cost. In those areas, there are forces to keep home prices in line with construction costs. Sales are biased towards new homes, tending to misrepresent the change in prices overall.

In the United States, Karl Case and I found a sharp distinction between states whose prices track the price of construction and states whose prices show wild departures from the price of construction. We concluded that states whose cities have an abundance of buildable land show very little price volatility, and the real estate market in those cities never becomes speculative. In contrast, states whose cities have little buildable land, and particularly in the glamorous cities within those states, a speculative sensitivity tends to infect the thinking of homebuyers, causing sometimes erratic moves in home prices. We see a hint of this in the Ahnert-Page data, that show the glamour city of Paris with much more volatile prices than France overall.

I was struck that, according to Ahnert and Page, none of the European data producers used the repeat-sales method. This seems most unfortunate, since the repeat-sales method would eliminate a number of problems, including the problem of excessive weight being given to new construction. Ahnert and Page dismiss this method because they say it demands a large amount of data. But, in fact, in our modern electronic age the volume of accessible data is growing by leaps and bounds, and the repeat-sale method ought to be considered for the future in Europe.

The original repeat-sales index idea is due to Baily et al (1963). The idea is to base price index construction exclusively on the change in price of individual homes. To construct a repeat-sales price index along lines outlined by Baily et al, one regresses change in log price between sale dates on time dummies, -1 for first sale period and $+1$ for second sale period except for the base period for which there is no dummy. Here, period refers to the unit of time, whether year, quarter or month. The estimated coefficients of time dummies become the log price index, and the log price index is zero in the base period by construction. For example, with four sales pairs, the first two of which were bought in period zero and sold in period one, the third in period zero and period two, and the fourth in period one and period two, we set up the regression model $Y = X\beta + \varepsilon$ where:

$$X = \begin{bmatrix} 1 & 0 \\ 1 & 0 \\ 0 & 1 \\ -1 & 1 \end{bmatrix}, \quad Y = \begin{bmatrix} p_{11} - p_{10} \\ p_{21} - p_{20} \\ p_{32} - p_{30} \\ p_{42} - p_{41} \end{bmatrix}$$

and where P_{ht} is log price of house h at period t, $t = 0, 1, 2$, and the coefficient corresponding to the first column of X is the log price index for $t = 1$ and the coefficient corresponding to the second column of X is the log price index for $t = 2$. This is essentially the method that Karl Case and I developed further, and that my firm Case Shiller Weiss, Inc, pioneered, and that is now used by Fannie Mae, Freddie Mac, and the Office of Federal Home Equity Oversight in the United States.

The repeat-sales method is very attractive because it solves the missing hedonic variables problem (so long as homes' characteristics are unchanging), and homes whose characteristics have changed in a major way can sometimes be excluded (as by accessing data on building permits).

The Ahnert and Page paper describes repeat-sales regression and hedonic regression as fundamentally different methods. But, in fact, they are both regression methods, and all regression methods are fundamentally related. It is just a matter of what one controls for in the regression. In fact, there is a natural hybrid between repeat-sales method and the hedonic method, as I described in my 1993 book *Macro Markets* and in a 1993 article. I defined there the hedonic repeat-sales method, which is an extension of the repeat-sales regression method. To create a price index using hedonic repeated measures method, one must regress the change in log price of house between sales on dummies for individual house and also on interactions of hedonic variables with dummies for individual house.

To continue the above example, suppose that we have for each of the four homes the hedonic variable s_{ht}, the square feet of floor space of home h at time t, which can change if new construction expands the house. We then set up the regression:

$$X = \begin{bmatrix} 1 & 0 & s_{11} & 0 \\ 1 & 0 & s_{21} & 0 \\ 0 & 1 & 0 & s_{32} \\ -1 & 1 & -s_{41} & s_{42} \end{bmatrix}, \quad Y = \begin{bmatrix} p_{11} - p_{10} \\ p_{21} - p_{20} \\ p_{32} - p_{30} \\ p_{42} - p_{41} \end{bmatrix}$$

This regression model takes account of all factors that are constant for a single house as well as allowing for square feet of floor space that changes through time for the house. From the estimated coefficients we can define a log price index for a standard house, for period one equal to the coefficient of the first column plus the coefficient of the third column times s, and for period two equal to the coefficient of the second column plus the coefficient of the fourth column times s, where s is the square feet of floor space for the standard house.

The perfection of our price indexes is very important because the home price indexes play many roles, going far beyond the role of detecting financial instability, as was emphasised in an earlier session in this conference. The desiderata for good indexes that reveal financial instability is that the indexes should capture national trends well, that the indexes should have associated with them some measure of earnings or rents so that a price-earnings ratio can be computed, and that indexes might be broken out between speculative glamour cities (where price bubbles tend to occur) and other areas. But, there are other purposes for price indexes and these other purposes suggest other desiderata.

An important application of real estate price indexes has been for automatic valuation models (AVMs) for homes. These models update past selling prices of individual homes with a real estate price index for its locale as a way of estimating the value of the homes. There is now great demand for AVMs, as the mortgage industry is going increasingly electronic and online, and so quick electronic access to home values is increasingly important. There is now a substantial industry which produces AVMs for sale to mortgage originators, home equity lenders, and others who have an interest in valuation of individual homes.

The desiderata for price indexes for use in AVMs are that the indexes should be finely disaggregated by region and by property type, as indeed price trends can differ significantly from one part of a city to another, and from one class of housing to another. Moreover, we do not want to purge the indexes from the effects of quality change in the homes, since the indexes are meant to compute the price of the houses with all the quality changes. On the other hand, we would ideally like to correct the indexes for the problem of downward rigidity of asking prices, and failure to sell homes whose prices have really declined.

Another very important use for real estate price indexes is in the settlement of financial contracts that allow the management of risks associated with real estate. The first such contract was a UK property futures market set up by the London Futures and Options Exchange (London Fox) in 1991. Although that market failed, successors are now succeeding. Also in London, City Index and IG Index set up index-based UK property futures markets in 2002. In 2003 Goldman Sachs launched certain real estate warrants in London that settle in terms of the Halifax residential property indexes. In the United States, there are several firms with plans to launch index-based futures markets in real estate: Hedgestreet.com, Realliquidity.com and Advanced e-Financial Technologies. A firm that I helped found, Macro Securities LLC, has been working with the American Stock Exchange to produce securities whose dividends depend on indexes, such as real estate price indexes. As these markets develop it will become increasingly possible to hedge real estate risks.

Designing indexes for use in contract settlement suggests different desiderata. When applied to contract settlement, it is important that the indexes be provided with great frequency and little time lag, and with great assurance that the index will be produced on time. The index should ideally not be revised after it is first announced, lest contracts be settled on erroneous values. The index construction method must be simple and replicable, and at the same time robust to criticism, so that market participants can have faith in the values. Since we will not have markets for every neighbourhood or property type, aggregate indexes are most important. Invulnerability to manipulation or early release of data to insiders have to be avoided.

I think that the progress that is being made in real estate price index construction as revealed by the papers in this session is an important beginning. But, with all the uses that will be made in the future for such indexes, and with all the improved electronic data transmission facilities, we have a lot more work cut out for us in the future.

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