*Question 21:* What are the explanatory factors OFHEO should consider in modeling loss severity?

*Question 22:* Should OFHEO model the individual cost and revenue components of severity or should OFHEO model only overall severity?

*Question 23:* What is an appropriate house price index for real estate owned (REO) properties? In estimating foreclosure sales prices, should OFHEO use a house price index based on all properties or a house price index based only on REO properties?

### E. House Price Indexes

The Act requires that OFHEO use house price indexes to determine changes in the values of properties securing mortgages owned or guaranteed by the Enterprises and the corresponding changes in LTVs. Changes in property values are—

determined on an annual basis by region, in accordance with the Constant Quality Home Price Index published by the Secretary of Commerce (or any index of similar quality, authority, and public availability that is regularly used by the Federal Government).<sup>27</sup>

Since the second quarter of 1994, the Enterprises have published the quarterly **Conforming Mortgage House Price Index** (CMHPI) for the nine Census divisions. This represents a significant improvement over the annual four Census region Commerce Constant Quality Index (CCQI). The CMHPI is based on a weighted repeat sales (WRS) approach in which multiple transactions, *i.e.*, mortgage originations, for individual properties are matched by street address to obtain changes in sales prices or appraisal values. Observed property values and transactions dates are then combined in a multivariate statistical model to estimate an index of housing values.28

OFHEO believes that a WRS index based on Enterprise data offers a number of advantages for estimating the changing LTVs of the Enterprises mortgage assets. Perhaps foremost among these is the direct correspondence between index data and the housing segment serviced by the Enterprises. This factor, along with others, should make the index more accurate for establishing the current market values of properties securing mortgages held or guaranteed by the Enterprises. In addition, a WRS index based on Enterprise data will allow OFHEO to estimate changes in housing

<sup>28</sup> See W. Stephens, Y. Li, V. Lekkas, J. Abraham, C. Calhoun, and T. Kimner, "Agency Repeat Transactions," revised August 1994, forthcoming in Journal of Housing Research (available from OFHEO). values at lower levels of geographic and temporal aggregation, and with greater statistical precision, than the CCQI allows. In order to meet the requirements of the Act regarding the use of an alternative house price index, OFHEO will produce and publish a similar house price index or indexes using data on the historical mortgage transactions of the Enterprises.

Issues that have a bearing on the application of house price indexes to the risk-based capital test include the appropriate level of geographic aggregation, sample selection and appraisal bias, and the effect of index revisions as new data becomes available.<sup>29</sup>

## Geographical Aggregation

Aggregation across housing markets with imperfectly correlated house price changes will result in biased estimates of the average levels of appreciation in individual markets. This bias can be characterized in terms of the smoothing of market-wide indexes, with a corresponding increase in the apparent volatility of individual house prices around the market index. Excessive disaggregation, however, may reduce the frequency at which indexes can be meaningfully computed and subject them to large revisions.

*Question 24:* What principles should OFHEO use in selecting the optimal level of geographic aggregation for the stress test?

# Bias

As discussed below, potential sources of statistical bias include sample selection bias and appraisal bias.

### Sample Selection Bias

Even within the total database of Enterprise mortgages, non-random sampling of individual properties with repeat transactions could result in an index that is biased for the larger population of Enterprise properties. For example, the conforming loan limit and year-to-year changes in the limit could result in sample selection bias in the estimated parameters of a repeat transactions index. A closely related form of sample selection bias can occur when the waiting time between repeat transactions is correlated with the change in house prices. For example, if more rapidly appreciating properties turn over within shorter time intervals, they will appear in the repeat sample more quickly. In this case, appreciation rates for repeat transactions near the end of the sample period will not be representative. Thus, sample selection bias would be greater near the end of the index.

## Appraisal Bias

Approximately 85 percent of the repeat transactions used by the Enterprises to estimate WRS house price indexes involve a refinance transaction.<sup>30</sup> Appraisals provide useful information on house values in the absence of sales transactions. However, the use of appraisals in real estate valuation is thought to impart bias by smoothing the fluctuations in housing values. Appraisals are derived through comparisons with properties that have either been sold or listed for sale within the past several months and may fail to indicate more recent changes in housing values.

*Question 25:* Should house price indexes estimated using Enterprise data include adjustments for identifiable sources of statistical bias?

*Question 26:* What additional sources of statistical bias exist and what are possible corrective actions that may be taken to address them?

*Question 27:* What methods of accounting and correcting for sample selection bias should be used?

*Question 28:* Should a statistical adjustment to the WRS house price index be made to address the impact of appraisal bias?

#### Revision Volatility

As data on new transactions are obtained each quarter, new repeat transactions can be combined with transactions that occurred in the past. Thus, the quarterly index estimation process involves the revision of the entire index in light of new information.

<sup>&</sup>lt;sup>27</sup> Section 1361(d)(1) (12 U.S.C. 4611(d)(1)).

<sup>29</sup> Methodological issues related to the estimation of repeat transaction house price indexes are discussed in the following papers: M.J. Bailey, R.F. Muth, and H.O. Nourse, "A Regression Method of Real Estate Price Index Construction," Journal of the American Statistical Association, 58:933-942. December 1963; K.E. Case and R.J. Shiller, "Prices of Single-Family Homes since 1970: New Indexes for Four Cities," New England Economic Review, 45-56, September/October 1987; K.E. Case and R.J. Shiller, "The Efficiency of the Market for Single Family Homes," American Economic Review 79:125–137, 1989; J.M. Abraham, J.M. and W.S. Schauman, "New Evidence on Home Prices from Freddie Mac Repeat Sales," Journal of the American Real Estate and Urban Economics Association, 19:333-352, 1991; C.A. Calhoun, "Estimating Changes in Housing Values from Repeat Transactions," Federal National Association International meetings (available from OFHEO); and C.A. Calhoun, P. Chinloy, and I.F. Megbolugbe, "Temporal Aggregation and House Price Index Construction," Federal National Mortgage Association, forthcoming in Journal of Housing Research (available from OFHEO); and B. Case, H.O. Pollakowski, and S.M. Wachter, "On Choosing Among House Price Index Methodologies," Journal of the American Real Estate and Urban Economics Association, 19(3):286-307, 1991.

<sup>&</sup>lt;sup>30</sup> See Stephens, et al., supra.