Bias and Precision of Estimates of Housing Investment Risk Based on Repeat-Sales Indices: A Simulation Analysis

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Abstract

A simulation analysis is reported which examines the bias and precision of estimates of housing investment risk based on small sample indices of housing returns. The trade-off between smoothing bias (due to temporal aggregation in the index) and noise bias (induced by random estimation error) is examined in the housing return total volatility, beta, and autocorrelation statistics of the index returns. The study compares the performance of three different specifications of the repeat-sales index, under assumptions of either an informationally efficient or inefficient housing market, and at two levels of estimation data availability. Findings suggest that regression-based repeated-measures indices may be useful at a more micro-level (e.g., at the neighborhood level or for specific housing types) than has hitherto been employed.

Key Words: housing investment, repeat-sales indices, risk and return

This article reports the findings of a simulation analysis of the bias and precision of estimates of investment risk based on small sample indices of housing market returns. The study focuses on the return-index sample second moments of interest to investors, including the return own-variance or “total volatility,” the covariance with an exogenous innovations series or “beta,” and the first-order autocorrelation in the returns. The former two statistics are measures of investment risk, while the autocorrelation relates to the predictability of the investment returns and the informational efficiency of the housing market. This study has several specific objectives:

1. Simultaneous consideration of two sources of second-moment bias, “smoothing” (caused by temporal aggregation in the index construction) as well as “noise” (caused by random estimation error). The article focuses on the trade-off between these two sources of second-moment bias in several different specifications of the repeat-sales regression-based index, based on small samples of houses.

2. Consideration of small sample sizes both in terms of a small number of individual houses or valuation observations on which the index is based and a small number of historical time periods available in the data. This is motivated by the practical desire to push the development of empirically based subindices of housing market returns to more micro-levels of disaggregation (e.g., indices by neighborhood and type of house).
3. Consideration of the precision as well as the bias of the index second moments as estimators of the true sample second moments realized in a given historical period. Precision of the second-moment estimates is important in judging the reliability and confidence bounds of investment-risk estimates.

4. Examination of the above-described questions under both efficient and inefficient housing market assumptions. As we are unsure to what degree housing markets are informationally efficient, it is of interest to examine how informational efficiency in the underlying housing market affects the nature of the error in our measurement of investment risk in the observable index.

The technique used to examine these questions is that of simulation analysis. While simulation analysis is in some respects not as general as a more purely analytical approach, it has the advantage of "transparency"—helping to clarify the nature of the statistical issues being examined. Furthermore, the parameter values examined in this simulation have been chosen to reflect realistic values, so it is hoped that the quantitative findings contained herein will be of some practical value to those engaged in the empirical study of housing investment risk.

1. Background

In recent years, the development of indices of housing returns has spawned growing interest in applying quantitative methods of investment analysis to housing assets. Transactions-based indices that control for differences across time in the quality of the transacting houses, such as the regression-based repeated-measures indices pioneered by Bailey–Muth–Nourse (1963) and Case–Shiller (1989), are gaining increased use for analyzing housing equity and mortgage investment risk. Shiller (1993a) has proposed using such housing indices as the basis of publicly traded futures contracts that would enable direct hedging of housing investment risk.

In analyzing investment risk, and in developing hedging strategies, the second moments of the returns across time are crucially important statistics that can be derived historically from such indices. Of course, there are problems with using the returns time-series second moments observed directly from housing indices. Investment analysts have become increasingly sensitive to the effects which the infrequent trading of unique individual houses has on the second moments observed in such indices.

As a result of the infrequent trading problem, there are two important and distinct sources of bias and error in estimated or reported housing return indices which do not occur in indices of more liquid securities and which can seriously affect the returns sample second moments observed in the index. The first type of error is commonly referred to as “smoothing.” Smoothing is caused fundamentally by temporal aggregation of house prices, and results in second moments (own-variance and covariance) that are biased toward zero. It also injects positive bias into the first-order autocorrelation of the returns series, and results in the index value changes lagging in time behind the true underlying housing market value changes. Smoothing will generally not greatly affect the contemporaneous correlations observed