Description of Price Indexes for New Multifamily Housing Under Construction

Introduction

The multifamily under construction indexes are a group of price indexes designed for use in deriving a constant dollar series from the current dollar series of privately-owned multifamily value put in place. The indexes are formed with data for privately-owned multifamily housing projects in which the majority of units are for rent. All indexes apply to the construction cost of new multifamily housing that are under construction as defined for the multifamily value put in place estimates. See Value of Construction Put in Place methodology documentation for more information.

The Multifamily Under Construction indexes are only computed at the national level.

The data used for computing these indexes are obtained from the U.S. Census Bureau's Survey of Construction (SOC) and the Multifamily Construction Progress Reporting Survey (CPRS). The Survey of Construction collects information on the physical characteristics of new multifamily buildings. This is done through monthly interviews with the builders or owners of a national sample of new residential construction. The Multifamily CPRS collects data on a subsample of new residential building projects with two units or more selected from the SOC. Once a project is selected, monthly construction progress reports are requested from the owner until the project is completed. About 1,500 projects are in the survey each month. This number includes newly selected projects, as well as projects carried over from the previous months.

Types of Indexes

Laspeyres and Paasche type price indexes are computed for multifamily housing under construction. From these a Fisher Ideal index is derived. The indexes are published as Laspeyres Constant Quality Index for Multifamily Housing Under Construction and the Fisher Price Deflator Index for New Multifamily Housing Under Construction. We do not publish the Paasche type index. The following sections describe the various types of indexes and their computation.

Price Index Design

Laspeyres Type Price Index Computation

The basic form of a Laspeyres type price index is:

$$\frac{\sum_i (p_{ti} * q_{0i})}{\sum_i (p_{0i} * q_{0i})}$$

Where the p_{0i}'s and p_{ti}'s are the prices in the base and current period, respectively, and the q_{0i}'s are the quantities in the base period. This represents the ratio of the current cost of the quantity of goods purchased in the base year to the cost in base year prices of the same quantity of goods. Notice that the denominator is the construction cost of the average base period house. To compute this index the *p's* must be derived from a regression model since we only collect a total housing price.

Experience has shown that regression estimation of the price in the following multiplicative model is superior to estimation for the above additive model:

$$\frac{e^{\sum_i (d_{ti} * q_{0i})}}{e^{\sum_i (d_{0i} * q_{0i})}}$$

Where the d_{0i}'s and d_{ti}'s are price factors and the q_{oi}'s are the quantities in the base period. It is necessary to obtain the *d's* and *q's* for various commodities to compute this index. e estimate from survey data the *q*'s (quantities) for commodities that we refer to as house characteristics. The *d's* – referred to as price factors – for the characteristics cannot be collected so we estimate them from a regression model. For this reason the sums in the above equation can be thought of as regressed values taken from a regression model. The regression models used to estimate the price factors are described in more detail below.

Paasche Type Price Index Computation

The basic form of a Paasche type price index is:

$$\frac{\sum_i (p_{ti} * q_{ti})}{\sum_i (p_{0i} * q_{ti})}$$

Where the p_{0i}'s and p_{ti}'s are the prices in the base and current period, respectively, and the q_{ti}'s are the quantities in the current period. This represents the ratio of the current cost of the quantity of goods purchased in the current period to the cost in base year prices of the same quantity of goods. It differs from a Laspeyres type index in that quantities in the Laspeyres index are base period quantities and in the Paasche index they are current period quantities. Notice that the numerator of the Paasche type index is the construction cost of the average current period house.

As with the Laspeyres index described in the previous section, the Paasche additive model shown above is replaced with a multiplicative model that is the weighted average of five strata. We estimate from survey data the quantities and price factors for commodities referred to as house characteristics.

Fisher Type Price Index Computation

A Fisher Ideal index is formed by computing the square root of the product of compatible Laspeyres and Paasche type indexes.

Regression Models

The Survey of Construction collects data on new multifamily buildings including the number of units, number of floors, number of units by bedroom type (efficiency, 1 bedroom, 2 bedroom, 3 or more bedrooms), number of units by bathroom type (1 bath, 1.5 bath, 2 bath), type of parking available, air conditioning, laundry, heating system/fuel, framing(wood, steel), fireplaces, construction method(site, modular, panelized), building square footage, and intent (for rent or for sale).

The Multifamily CPRS collects data on the construction value put in place for new multifamily projects that contain buildings selected from the SOC. This value includes the total construction cost and fees for architectural and engineering services, and miscellaneous costs. In addition to project value, the CPRS also collects data on start and completion of each project, and the number of buildings and the number of units in the project. The construction value used in the regression model is the reported total construction cost unless the project has been completed and its total value put in place (reported monthly) is greater than the reported total construction cost.

Data collected for buildings in the SOC is aggregated to the project level and combined with the data collected in the CPRS. A multifamily housing project is included in the index for a given time period if it was active (started or under construction) during that period. It remains in the index until construction is completed.

To compute an index, price factors (*d's*) must be derived for a suitable set of available characteristics. Price factors are derived from the construction cost and characteristics data by estimating a multiple linear regression model to predict total construction cost.

Available characteristics for multifamily buildings are evaluated in order to determine a suitable set to use for index calculations. Since consumer preferences change over time, any set of characteristics is useful for a limited number of years. At irregular intervals, one set of characteristics is replaced by a new set. When a new set of characteristics is introduced into the index computations, the index for prior periods may be recomputed or the index may be re-based.

Presently there is one regression model used to calculate the price indexes. The current model includes seven housing characteristics and two additional auxiliary variables, cooling degree days and weekly wage rate data by state. Weekly wage data by state from the Bureau of Labor Statistics are included in the model to represent cost and income differences among geographic areas. Cooling degree-days, which measure the frequency and extent of temperatures above 65°F, are included to account for qualities in construction found in cold versus warm climates (i.e additional insulation, stronger roofing, etc.) Cooling degree-days data is available from the National Oceanic and Atmospheric Administration's (NOAA) Climate Prediction Center. The housing characteristics are calculated as ratios per unit and based only on counts of units reporting each characteristic in the SOC. Square feet per unit is calculated based on the units reporting square footage in the SOC. The dependent variable, value per unit, is calculated from the total construction value and number of units reported in the CPRS. Logarithms of both value per unit and square feet per unit are taken before including them in the regression model. The same set of characteristics is used for both Laspeyres type indexes and the Paasche type indexes.

The table below shows the characteristics used in the regression model. These tables also show the average quantities (*q*'s) for the base quarter (2005Q1) used in the calculation of the Laspeyres type indexes. Quantities for the Passche type indexes change each time period and are not shown.

Characteristic	2005Q1 Base Weights
Log of square feet per unit	6.947
Log of VIP number of units	4.432
Bathrooms per unit	1.458
Bedrooms per unit	1.666
Proportion of units with air conditioning	0.871
Proportion of units with parking	0.342
Proportion of units in buildings with 4 or more floors	0.338
Weekly wage rate data (by State)	6.390
Cooling degree days data (by State)	1.692

A resistant regression procedure is used that diminishes the impact of unusual observations by down-weighting the data for those observations.

Since the regression does not include all of the characteristics that explain price variability and because the characteristics are interdependent, the estimated regression coefficients should not be regarded as estimates of the true price factors. The estimated regression coefficients are not shown.