

S&P/Case-Shiller[®] Metro Area Home Price Indices

Table of Contents

Introduction.....	1
Eligibility Criteria	2
Index Construction.....	3
Index Construction Process.....	9
Repeat Sales Methodology	14
Index Maintenance.....	20
Index Governance	21
Index Policy	22
Index Dissemination	23
Appendix.....	24
S&P Contact Information.....	28
Disclaimer	29

Introduction

The S&P/Case-Shiller® Metro Area Home Price Indices are designed to be a reliable and consistent benchmark of housing prices in the United States. Their purpose is to measure the average change in home prices in a particular geographic market. They cover ten major metropolitan areas (Metropolitan Statistical Areas or MSAs), which are also aggregated to form a national composite. The indices measure changes in housing market prices given a constant level of quality. Changes in the types and sizes of houses or changes in the physical characteristics of houses are specifically excluded from the calculations to avoid incorrectly affecting the index value.

Partnership

These indices are generated and published under agreements between Standard & Poor's, Fiserv and MacroMarkets LLC.

Highlights

The S&P/Case-Shiller Metro Area Home Price Indices use the “repeat sales method” of index calculation – an approach that is widely recognized as the premier methodology for indexing housing prices – which uses data on properties that have sold at least twice, in order to capture the true appreciated value of each specific sales unit.

Please refer to the Repeat Sales Methodology section for details.

The S&P/Case-Shiller Metro Area Home Price Indices originated in the 1980s by Case Shiller Weiss's research principals, Karl E. Case and Robert J. Shiller. At the time, Case and Shiller developed the repeat sales pricing technique. This methodology is recognized as the most reliable means to measure housing price movements and is used by other home price index publishers, including the Office of Federal Housing Enterprise Oversight (OFHEO).

Eligibility Criteria

To be eligible for inclusion in the indices, a house must be a single-family dwelling. Condominiums and co-ops are specifically excluded. Houses included in the indices must also have two or more recorded arms-length sale transactions. As a result, new construction is excluded.

Index Construction

Approaches

The S&P/Case-Shiller Metro Area Home Price Indices are based on observed changes in home prices. They are designed to measure increases or decreases in the market value of residential real estate in 10 defined MSAs (see Table 1 below). In contrast, the indices are, specifically, not intended to measure recovery costs after disasters, construction or repair costs, or other such related items.

The indices are calculated monthly, using a three-month moving average algorithm. Home sales pairs are accumulated in rolling three-month periods, on which the repeat sales methodology is applied. The index point for each reporting month is based on sales pairs found for that month and the preceding two months. For example, the December 2005 index point is based on repeat sales data for October, November and December of 2005. This averaging methodology is used to offset delays that can occur in the flow of sales price data from county deed recorders and to keep sample sizes large enough to create meaningful price change averages.

Index Calculations

To calculate the indices, data are collected on transactions of all residential properties during the months in question. The main variable used for index calculation is the price change between two arms-length sales of the same single-family home. Home price data are gathered after that information becomes publicly available at local recording offices across the country. Available data usually consists of the address for a particular property, the sale date, the sale price, the type of property, and in some cases, the name of the seller, the name of the purchaser, and the mortgage amount.

For each home sale transaction, a search is conducted to find information regarding any previous sale for the same home. If an earlier transaction is found, the two transactions are paired and are considered a “repeat sale.” Sales pairs are designed to yield the price change for the same house, while holding the quality and size of each house constant.

These sales pairs are further examined to eliminate outliers that might distort the calculations. Outliers include non-arms-length transactions (e.g., property transfers between family members); transactions immediately preceding or subsequent to substantial physical changes to a property; transactions where the property type designation is changed (e.g., properties originally recorded as single-family homes are subsequently recorded as condominiums); and suspected data errors where the order of magnitude in values appears unrealistic.

Each sales pair is aggregated with all other sales pairs found in a particular MSA to create the MSA-level index. The 10 Metro Area Indices are then combined, using a market-weighted average, to create the national composite.

The Weighting of Sales Pairs

The indices are designed to reflect the average change in all home prices in a particular geographic market. However, individual home prices are used in these calculations and can fluctuate for a number of reasons. In many of these cases, the change in value of the individual home does not reflect a change in the housing market of that area; it only reflects a change in that individual home. The index methodology addresses these concerns by weighting sales pairs.

Different weights are assigned to different changes in home prices based on their statistical distribution in that geographic region. The goal of this weighting process is to measure changes in the value of the residential real estate market, as opposed to atypical changes in the value of individual homes. These weighting schemes include:

Price anomalies. If there is a large change in the prices of a sales pair relative to the statistical distribution of all price changes in the area, then it is possible that the home was remodeled, rebuilt or neglected in some manner during the period from the first sale to the second sale. Or, if there were no physical changes to the property, there may have been a recording error in one of the sale prices, or an excessive price change caused by idiosyncratic, non-market factors. Since the indices seek to measure homes of constant quality, the methodology will apply smaller weights to homes that appear to have changed in quality or sales that are otherwise not representative of market price trends.

High turnover frequency. Data related to homes that sell more than once within six months are excluded from the calculation of any indices. Historical and statistical data indicate that sales made within a short interval often indicate that one of the transactions 1) is not arms-length, 2) precedes or follows the redevelopment of a property, or 3) is a fraudulent transaction.

Time interval adjustments. Sales pairs are also weighted based on the time interval between the first and second sales. If a sales pair interval is longer, then it is more likely that a house may have experienced physical changes. Sales pairs with longer intervals are, therefore, given less weight than sales pairs with shorter intervals.

Initial home value. Each sales pair is assigned a weight equal to the first sale price to ensure that the indices track the aggregate/average value of all homes in a market.

Metro Areas

Table 1: Metro Areas for the S&P/Case-Shiller Metro Area Home Price Indices

MSA	Represented Counties
Boston-Cambridge-Quincy, MA-NH Metropolitan Statistical Area	Essex MA, Middlesex MA, Norfolk MA, Plymouth MA, Suffolk MA, Rockingham NH, Strafford NH
Chicago-Naperville-Joliet, IL Metropolitan Division	Cook IL, DeKalb IL, Du Page IL, Grundy IL, Kane IL, Kendal IL, McHenry IL, Will IL
Denver-Aurora, CO Metropolitan Statistical Area	Adams CO, Arapahoe CO, Broomfield CO, Clear Creek CO, Denver CO, Douglas CO, Elbert CO, Gilpin CO, Jefferson CO, Park CO
Las Vegas-Paradise, NV Metropolitan Statistical Area	Clark NV
Los Angeles-Long Beach-Glendale, CA Metropolitan Division	Los Angeles CA, Orange CA
Miami-Fort Lauderdale-Miami Beach, FL Metropolitan Statistical Area	Broward FL, Miami-Dade FL, Palm Beach FL
New York City Area	Fairfield CT, New Haven CT, Bergen NJ, Essex NJ, Hudson NJ, Hunterdon NJ, Mercer NJ, Middlesex NJ, Monmouth NJ, Morris NJ, Ocean NJ, Passaic NJ, Somerset NJ, Sussex NJ, Union NJ, Warren NJ, Bronx NY, Dutchess NY, Kings NY, Nassau NY, New York NY, Orange NY, Putnam NY, Queens NY, Richmond NY, Rockland NY, Suffolk NY, Westchester NY, Pike PA
San Diego-Carlsbad-San Marcos, CA Metropolitan Statistical Area	San Diego CA
San Francisco-Oakland-Fremont, CA Metropolitan Statistical Area	Alameda CA, Contra Costa CA, Marin CA, San Francisco CA, San Mateo CA
Washington-Arlington-Alexandria, DC-VA-MD-WV Metropolitan Statistical Area	District of Columbia DC, Calvert MD, Charles MD, Frederick MD, Montgomery MD, Prince Georges MD, Alexandria City VA, Arlington VA, Clarke VA, Fairfax VA, Fairfax City VA, Falls Church City VA, Fauquier VA, Fredericksburg City VA, Loudoun VA, Manassas City VA, Manassas Park City VA, Prince William VA, Spotsylvania VA, Stafford VA, Warren VA, Jefferson WV

Note: the S&P/Case-Shiller New York City Area Index is not an MSA. It represents a customized metro area that measures single-family home values in select New York, New Jersey and Connecticut counties with significant populations that commonly commute to New York City for employment purposes. Similarly, the S&P/Case-Shiller Chicago-Naperville-Joliet, IL Metropolitan Division Index is not an MSA.

While the indices are intended to represent all single-family residential homes within a given MSA, data for particular properties or component areas may not be available. Performance of individual properties or counties is not necessarily consistent with the MSA as a whole. County components are subject to change as a result of revisions by the U.S. Census Bureau or data insufficiencies.

National Composite

The composite home price index is constructed to track the total value of single-family housing within its constituent metro areas:

$$Index_{C_t} = \left(\sum_i (Index_{it} / Index_{i0}) \times V_{i0} \right) / Divisor$$

where $Index_{C_t}$ is the level of the composite index in period t,

$Index_{it}$ is the level of the home price index for metro area i in period t, and

V_{i0} is the aggregate value of housing stock in metro area i in a specific base period 0, where the base period is updated as detailed below.

The *Divisor* is chosen to convert the measure of aggregate housing value (the numerator of the ratio shown above) into an index number with the same base value as the metro area indices.

The composite home price index is analogous to a cap-weighted equity index, where the aggregate value of housing stock represents the total capitalization of all of the metro areas included in the composite. The numerator of the previous formula is an estimate of the aggregate value of housing stock for all metro areas in the composite index:

$$V_{C_t} = \sum_i (Index_{it} / Index_{i0}) \times V_{i0}$$

Calculating Composite Index History

Calculating history for the composite index requires setting the base periods for weights and the aggregate values of single-family housing stock for those periods. Since the decennial U.S. Census currently provides the only reliable counts of single-family housing units for metro areas, the years 1990 and 2000 were chosen as the base periods. The housing stock measures used to calculate the aggregate value of single-family housing (for both 1990 and 2000) are the U.S. Census counts for the metro areas. The base period values of single-family housing stock, average single-family housing prices, and the aggregate value of housing stock are provided in tables 2, 3, and 4 below.

Table 2: Single-Family Housing Stock (units)

	1990	2000
Boston	834,851	926,956
Chicago	1,347,250	1,567,442
Denver	480,023	598,679
Las Vegas	155,741	321,801
Los Angeles	2,284,576	2,449,838
Miami	892,931	1,116,437
New York	3,390,191	3,772,351
San Diego	554,821	628,531
San Francisco	867,454	947,910
Washington, D.C.	1,036,528	1,249,060

Source: U.S. Census Bureau

Table 3: Average Value of Single-Family Housing (US\$, thousands)

	1990	2000
Boston	192	299
Chicago	138	212
Denver	97	230
Las Vegas	107	172
Los Angeles	284	323
Miami	136	167
New York	205	270
San Diego	221	328
San Francisco	290	465
Washington, D.C.	204	235

Source: Fiserv CSW

Table 4: Aggregate Value of Single-Family Housing Stock (US\$, millions)

	1990	2000
Boston	160,291	277,160
Chicago	185,921	332,298
Denver	46,562	137,696
Las Vegas	16,664	55,350
Los Angeles	648,820	791,298
Miami	121,439	186,445
New York	694,989	1,018,535
San Diego	122,615	206,158
San Francisco	251,562	440,778
Washington, D.C.	211,452	293,529
Divisor	2,989,671	3,739,247

Source: Fiserv CSW

The aggregate value of single-family housing stock in each metro area was found by multiplying the U.S. Census counts of units (S_{i0}) by estimates of average single-family housing prices (P_{i0}), calculated by Fiserv CSW:

$$V_{i(1990)} = S_{i(1990)} \times P_{i(1990)}$$

$$V_{i(2000)} = S_{i(2000)} \times P_{i(2000)}$$

The aggregate value measures for the 1990 base period were used to calculate composite index points for the period from January 1987 to December 1999, while the 2000 base period measures were used to calculate points for the period from January 2000 to the present. The *Divisor* for each of these periods was set so that the composite index equals 100.0 in January 2000.

Calculating the Composite Index with Normalized Weights

When the base period values of the metro area price indices are equal, the composite index can also be calculated using normalized weights where the *Divisor* is set equal to one¹. The normalized weights are each metro area's share of the total aggregate value of housing stock in all of the areas covered by the composite index.

$$w_{i(2000)} = V_{i(2000)} / \sum_i V_{i(2000)}$$

The composite index can then be calculated by summing the product of each metro area's normalized weight and current index level.

$$V_{Ct} = \sum_i w_{i(2000)} \times Index_{it}$$

Table 5, below, lists the normalized weights for calculating index points from January 2000 onward.

Table 5: Normalized Composite Weights

	2000
Boston	0.07412188
Chicago	0.08886762
Denver	0.03682453
Las Vegas	0.01480245
Los Angeles	0.21161961
Miami	0.04986164
New York	0.27239040
San Diego	0.05513356
San Francisco	0.11787881
Washington, D.C.	0.07849949

Source: Fiserv CSW

¹ The use of normalized weights only applies to the period including and after January 2000. The January 1987 to December 1999 base period indices are not equal across all metro areas.

Index Construction Process

The S&P/Case-Shiller® Metro Area Home Price Indices are based on observed changes in individual home prices. The main variable used for index calculation is the price change between two arms-length sales of the same single-family home. Home price data is gathered after that information becomes publicly available at local deed recording offices across the country. For each home sale transaction, a search is conducted to find information regarding any previous sale for the same house. If an earlier transaction is found, the two transactions are paired and are considered a “sale pair”. Sale pairs are designed to yield the price change for the same house, while holding the quality and size of each house constant.

The S&P/Case-Shiller® Metro Area Home Price Indices are designed to reflect the average change in market prices for constant-quality homes in a geographic market. The sale pairing process and the weighting used within S&P/Case-Shiller® repeat sales index model ensure that the indices track market trends in home prices by ignoring or down-weighting observed price changes for individual homes that are not market driven and/or occur because of idiosyncratic physical changes to a property or a neighborhood. Sale prices from non-arms-length transactions, where the recorded price is usually below market value, are excluded in the pairing process or are down-weighted in the repeat sales model. Pairs of sales with very short time intervals between transactions are eliminated because observed price changes for these pairs are much less likely to be representative of market trends. Idiosyncratic changes to properties and/or neighborhoods are more likely to have occurred between sales with longer transaction intervals, so these pairs are down-weighted in the repeat sales index model if they are not eliminated during the sale pairing process.

Pairing Sales and Controlling Data Quality

The automated sale pairing process is designed to collect arms-length, repeat sales transactions for existing, single-family homes. This process collects as many qualifying sale prices as possible, ensuring that large, statistically representative samples of observed price changes are used in the S&P/Case-Shiller repeat sales model. In an arms-length transaction, both the buyer and seller act in their best economic interest when agreeing upon a price. When they can be identified from a deed record², non-arms-length transactions are excluded from the pairing process. The most typical types of non-arms-length transactions are property transfers between family members and transfers of properties from mortgage borrowers to lenders during foreclosure proceedings. Although identified foreclosure transfers are excluded during the pairing process, subsequent sales by mortgage lenders of foreclosed properties are candidates to be included in repeat sale pairs.

The pairing process is also designed to exclude sales of properties that may have been subject to substantial physical changes immediately preceding or following the transaction. Furthermore, since a property must have two recorded transactions before it can be included as a repeat sale pair, newly constructed homes are excluded from the index calculation process until they have been sold at least twice. Deed records do not usually describe the physical characteristics of properties (other than the size and alignment of land parcels). However, other items listed on the deed record can be used to identify properties that may have been subject to substantial physical changes.³ Deeds that have been marked as transfers of land with no improvements (i.e., no structures) are excluded. Transactions where the seller may be a real estate developer (based on the seller's name) are also excluded, since it is likely that this is the sale of a newly constructed home built on a previously vacant or occupied lot or a rebuilt existing home.

² A deed record may directly indicate that a transaction is not arms-length. In other cases, it is possible to identify non-arms-length transactions by comparing the surnames of the buyer and seller (transfers between family members) or by checking if the "buyer" is a mortgage lender (foreclosure transfer). Local deed recorders and property data vendors differ in how often and consistently they collect and record information that can be used to identify non-arms-length transactions.

³ Local deed recorders and property data vendors differ in how often and consistently they collect and record information that can be used to identify properties that have experienced substantial physical changes.

Finally, sales that occur less than 6 months after a previous sale are excluded, primarily because single real estate transactions often have duplicate or multiple deed records⁴ due to the procedures used by local deed recorders and property data vendors. It is also more likely that in cases with a very short intervals between sales that: (1) one of the transactions is non-arms-length (e.g., a transfer between family members before selling a property), (2) the property has undergone substantial physical changes (e.g., a developer has purchased and quickly sold a rebuilt property), or (3) one of the transactions is a fraudulent transaction (a “property flip”).

Although the number of excluded transactions will vary from market to market, depending on how much detailed information is available in recorded deeds, usually less than 5% of non-duplicate transaction records are identified as non-arms-length and are removed as possible pairing candidates. Similarly, typically less than 5% of non-duplicate transaction records are preceded by another transaction within the last 6 months. The percentage of properties identified as either new construction or rebuilt existing homes depends on local market conditions, since construction activity is cyclical and related to the strength of the market’s economy, the overall age and condition of the existing housing stock, and the balance between housing supply and demand. Depending on these factors and the completeness of deed information, the percentage of sales identified and eliminated from the pairing process because there may have been substantial physical changes to the property usually ranges from 0% to 15%.

The Weighting of Sale Pairs

Although non-arms-length transactions and sales of physically altered properties are discarded during the pairing process, it is not possible to identify all of these sales based on the information available from deed records. Furthermore, the price changes observed for individual homes may be the result of non-market, idiosyncratic factors specific to a property (which cannot be identified from the deed information) or a property’s neighborhood. For example, a buyer was in a special hurry to buy and paid too much, boosting the value of nearby properties relative to the market, or an individual property may have not been well maintained, reducing its value relative to the market. Finally, errors in recorded sale prices may cause a particular sale pair to mismeasure the actual price change of an individual property.

⁴ The same transaction date may be listed on duplicate deed records. Duplicate records for a single transaction may contain transaction dates that are weeks apart, depending on the recording processes used at local deed offices and the collection procedures used by property data vendors. Requiring transaction dates to be at least 6 months apart prevents these duplicate records from being used as sale pairs.

To account for sale pairs that include anomalous prices or that measure idiosyncratic price changes, the repeat sales index model employs a robust weighting procedure. This automated, statistical procedure mitigates the influence of sale pairs with extreme price changes. Each sale pair is assigned a weight of one (no down-weighting) or a weight less than one but greater than zero, based on a comparison between the price change for that pair and the average price change for the entire market. The degree to which sale pairs with extreme price changes are down-weighted depends on the magnitude of the absolute difference between the sale pair price change and the market price change. No sale pair is eliminated by the robust weighting procedure (i.e., no pair is assigned a zero weight), and only sale pairs with extreme price changes are down-weighted. Although the number of sale pairs that are down-weighted depends on the statistical distribution of price changes across all of the sale pairs, in large metro area markets, typically 85% to 90% of pairs are assigned a weight of one (no down-weighting), 5% to 8% are assigned a weight between one and one-half, and 5% to 8% are assigned a weight between one-half and zero.

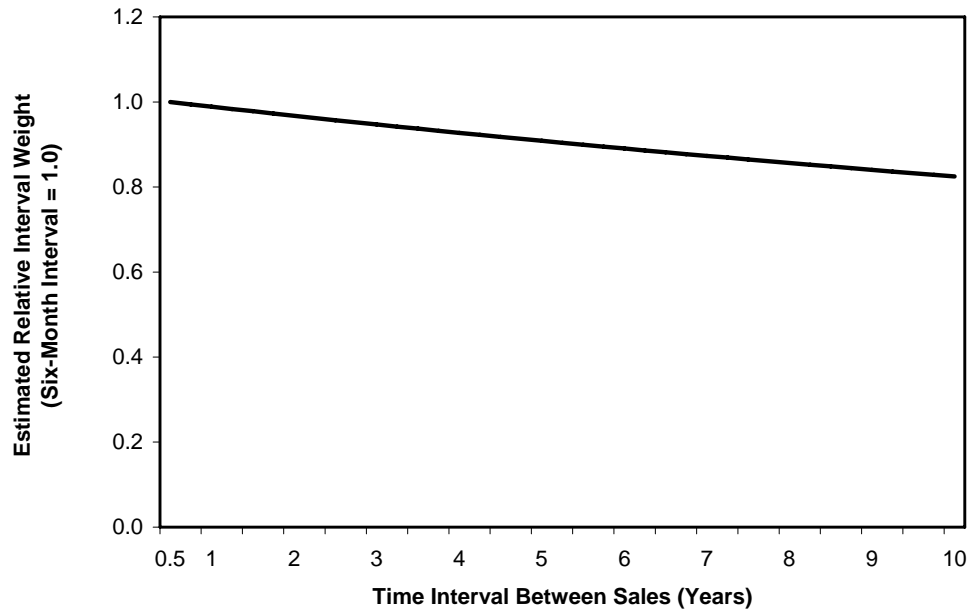
The S&P/Case-Shiller repeat sales model also includes an interval weighting procedure that accounts for the increased variation in the price changes measured by sale pairs with longer time intervals between transactions. Over longer time intervals, the price changes for individual homes are more likely to be caused by non-market factors (e.g., physical changes, idiosyncratic neighborhood effects). Consequently, sale pairs with longer intervals between transactions are less likely to accurately represent average price changes for the entire market.

The interval weights are determined by a statistical model within the repeat sales index model that measures the rate at which the variance between index changes and observed sale pair price changes increases as the time interval between transactions increases (time-between-sales variance). It is also assumed that the two sale prices that make up a sale pair are imprecise, because of mispricing decisions made by homebuyers and sellers at the time of a transaction. Mispricing variance occurs because buyers and sellers have imperfect information about the value of a property. Housing is a completely heterogeneous product whose value is determined by hundreds of factors specific to individual homes (e.g., unique physical attributes; location relative to jobs, schools, shopping; neighborhood amenities). The difficulty in assigning value to each of these attributes, especially when buyers and sellers may not have complete information about each factor, means that there is significant variation in sale prices, even for homes that appear to be very similar.

The interval weights in the repeat sales model are inversely proportional to total interval variance, which is the sum of the time-between-sale variance and the mispricing variance. A statistical model within the repeat sales model is used to estimate the magnitudes of the two components of total interval variance. The interval weights introduce no bias into the index estimates, but increase the accuracy of the estimated index points.⁵

⁵ More technically, the interval weights correct for heteroskedastic (non-uniform) error variance in the sale pair data. These corrections for heteroskedasticity reduce the error of the estimated index points, but do not bias the index upwards or downwards. See Case, K.E. and R.J. Shiller (1987) "Prices of Single-Family Homes Since 1970: New Indices for Four Cities" *New England Economic Review*, pp. 45-56 for a discussion of the heteroskedastic error correction model used in the Case-Shiller repeat sales index model.

The following graph shows estimated interval weights for a large, representative metro area market (relative to the weight for a sale pair with a six month interval between transactions):



For large metro area markets, the interval weights for sale pairs with ten-year intervals will be 20% to 45% smaller than for sale pairs with a six-month interval.

Repeat Sales Methodology

Introduction

The S&P/Case-Shiller home price indices are calculated using a Robust Interval and Value-Weighted Arithmetic Repeat Sales algorithm (Robust IVWARS). Before describing the details of the algorithm, an example of a Value-Weighted Arithmetic repeat sales index is described below. In the next section, the value-weighted arithmetic model is augmented with interval weights, which account for errors that arise in repeat sale pairs due to the length of time between transactions. The final section describes pre-base period, simultaneous index estimation and post-base period, chain-weighted index estimation.

Value-Weighted Arithmetic Repeat Sales Indices⁶

Value-weighted arithmetic repeat sales indices are estimated by first defining a matrix X of independent variables which has N rows and $T-1$ columns, where N is the number of sale pairs and T is the number of index periods. The elements of the X matrix are either prices or zeroes (element n,t of the matrix will contain a price if one sale of pair n took place in period t , otherwise it will be zero). Next, an N -row vector of dependent variables, Y , is defined, with the price level entered in rows where a sale was recorded during the base period for the index and zeros appear in all other rows. If we define a vector of regression coefficients, β , which has $T-1$ rows, then an arithmetic index can be calculated by estimating the coefficients of the basic regression model: $Y = X\beta + U$, where U is a vector of error terms. The levels of the value-weighted arithmetic index are the reciprocals of the estimated regression coefficients, $\hat{\beta}$.

⁶ The example in this section is taken from Shiller, R.J. (1993) *Macro Markets*, Clarendon Press, Oxford, pp. 146-149.

A simple example illustrates the structure of the regression model used to estimate value-weighted arithmetic index points. Suppose that we have sale pair information for 5 properties (a sale pair is two recorded sales for the same property) for transactions that occurred in 3 time periods ($t = 0, 1, 2$). Let P_{nt} be the sale price for pair n recorded during period t . Then, for this example, suppose we have the following matrix of independent variables and vector of dependent variables:

$$X = \begin{bmatrix} P_{11} & 0 \\ P_{21} & 0 \\ 0 & P_{32} \\ 0 & P_{42} \\ -P_{51} & P_{52} \end{bmatrix}, \quad Y = \begin{bmatrix} P_{10} \\ P_{20} \\ P_{30} \\ P_{40} \\ 0 \end{bmatrix}$$

In this example, $t=0$ is specified to be the base period, so the first sale pair ($n=1$) describes a property that was sold during the base period and the first period after the base period ($t=1$). Similarly, the fifth sale pair ($n=5$) describes a property that was sold in both the first and second index periods.

Because home prices are measured with errors, the matrix of independent variables is stochastic, and likely to be correlated with the vector of error terms, U . Therefore, in order to estimate consistent estimates of the model coefficients, β , we use an instrumental variables estimator, $\hat{\beta} = (Z'X)^{-1}Z'Y$, where Z is a matrix with N rows and $T-1$ columns that indicates when the sales for each property occurred. The Z matrix is constructed by replacing the positive or negative price levels in X with 1 or -1 , respectively. For our example, the matrix of instrumental variables looks like this:

$$Z = \begin{bmatrix} 1 & 0 \\ 1 & 0 \\ 0 & 1 \\ 0 & 1 \\ -1 & 1 \end{bmatrix}$$

The OLS normal equations for this example (using the instrumental variables estimator) are:

$$\hat{\beta}_1^{-1} = Index_1 = \frac{P_{11} + P_{21} + P_{51}}{P_{10} + P_{20} + \hat{\beta}_2 P_{52}}$$

$$\hat{\beta}_2^{-1} = Index_2 = \frac{P_{32} + P_{42} + P_{52}}{P_{30} + P_{40} + \hat{\beta}_1 P_{51}}$$

Notice that the index level for the first period is equal to the aggregate change in the value of all properties that were sold in period 1 ($\hat{\beta}_2 P_{52}$ is the second period price of property 5 discounted back to the base period). Similarly, the index level for the second period is equal to the aggregate change in the value (from the base period) of all properties sold in period 2 ($\hat{\beta}_1 P_{51}$ is the first period price of property 5 discounted back to the base period).⁷ Also notice that the estimated value of each index point is conditional on the estimated value of the other index point. In this model formulation, the index points are estimated simultaneously. That is, the value of each estimated index point is conditional of the values of all other index point estimates.

This example also illustrates that the price indices are value-weighted. Each index point is found by calculating the aggregate change in the value of properties sold during that point's time period. So, each sale pair is weighted by the value of its first sale price. Value weighting ensures that the S&P/Case-Shiller indices track the aggregate value of a residential real estate market. Value-weighted repeat sales indices are analogous to capitalization-weighted stock market indices. In both cases, if you hold a representative portfolio (of houses or stocks), both types of indices will track the aggregate value of that portfolio.

Interval and Value-Weighted Arithmetic Repeat Sales Indices⁸

The value-weighted arithmetic repeat sales model described above assumes that the error terms for each sale pair are identically distributed. However, in practice, this is unlikely to be the case, because the time intervals between the sales in each pair will be different. Over longer time intervals, the price changes for an individual home are more likely to be caused by factors other than market forces. For example, a home may be remodeled, rooms added, or it may be completely rebuilt. Some properties are allowed to deteriorate, or, in extreme cases, are abandoned. In these situations, price changes are driven mostly by modifications to the physical characteristics of the property, rather than changes in market value.

Consequently, sale pairs with longer time intervals will tend to have larger pricing errors than pairs with shorter time intervals (i.e., the value-weighted arithmetic repeat sales regression model has heteroskedastic errors). We can control for heteroskedastic errors, thereby increasing the precision of the index estimates, by applying weights to each of the sale prices before estimating the index points. Returning to the example from the previous section, we apply a weight, w_n , to pair n:

$$\hat{\beta}_1^{-1} = Index_1 = \frac{w_1 P_{11} + w_2 P_{21} + w_5 P_{51}}{w_1 P_{10} + w_2 P_{20} + w_5 \hat{\beta}_2 P_{52}}$$

⁷ Note: Fiserv CSW normalizes all indices so that their base period value equals 100. So, in the preceding example, $Index_0 = 100$ and the gross changes in aggregate value from the base period ($Index_1$ and $Index_2$) are multiplied by 100.

⁸ This extension of the example to include weights to control for heteroskedastic errors is given in Shiller, R.J. (1993) *Macro Markets*, Clarendon Press, Oxford, p. 149. The description of the sources of pricing errors appears in Case, K.E. and R.J. Shiller (1987) "Prices of Single-Family Homes Since 1970: New Indices for Four Cities" *New England Economic Review*, pp. 45-56.

$$\hat{\beta}_2^{-1} = Index_2 = \frac{w_3 P_{32} + w_4 P_{42} + w_5 P_{52}}{w_3 P_{30} + w_4 P_{40} + w_5 \hat{\beta}_1 P_{51}}$$

The weight applies to the sale pair, so for each property, the same weight is applied to both prices in the pair.

To explicitly account for the interval-dependent heteroskedasticity of the errors in the sale pairs, assume that the error vector has the following structure:

$$U_n = e_{nt(2)} - e_{nt(1)}$$

where $e_{nt(1)}$ is the error in the first sale price of pair n and $e_{nt(2)}$ is the error in the second sale price. Furthermore, assume that the error in any sale price comes from two sources: 1) mispricing at the time of sale (mispricing error) and 2) the drift over time of the price of an individual home away from the market trend (interval error). Mispricing error occurs because homebuyers and sellers have imperfect information about the value of a property, so sale prices will not be precise estimates of property values at the time of sale. Interval error occurs for the reasons outlined above -- over longer time intervals, the price changes for an individual home are more likely to be caused by factors other than market forces (e.g., physical changes to a property). So, define the error for any single price as:

$$e_{nt} = h_{nt} + m_n$$

where h_{nt} is the interval error for pair n and m_n is the mispricing error.

Mispricing errors are likely to be independent, both across properties and time intervals, and can be represented by an identically distributed white-noise term: $m \sim Normal(0, \sigma_m^2)$ where σ_m^2 is the variance of the mispricing errors. The interval errors are assumed to follow a Gaussian random walk, so $\Delta h \sim Normal(0, \sigma_h^2)$ and the variance of the interval error increases linearly with the length of the interval between sales. Consequently, the variance of the combined mispricing and interval errors for any sale pair may be written as: $2\sigma_m^2 + I_n \sigma_h^2$ where I_n is the time interval between sales for pair n .

If the errors of the value-weighted arithmetic repeat sales model have this heteroskedastic variance structure, then more precise index estimates can be produced by estimating a weighted regression model, $\beta = (Z' \Omega^{-1} X)^{-1} Z' \Omega^{-1} Y$, where Ω is a diagonal matrix containing the combined mispricing and interval error variance for each sale pair. Since Ω is unknown, the interval and value-weighted arithmetic repeat sales model is estimated using a three-stage procedure. First, the coefficients of the value-weighted arithmetic repeat sales model are estimated. Second, the residuals from this model are used to estimate Ω . Finally, the interval and value-weighted arithmetic repeat sales index is estimated by plugging $\hat{\Omega}$ into the weighted regression estimator.

Returning to our example, the terms of the error variance matrix act as the weights that control for the presence of mispricing and heteroskedastic interval errors:

$$\omega_n^{-1} = w_n$$

where ω_n^{-1} is the reciprocal of the n^{th} diagonal term in the error variance matrix, Ω .⁹

Pre-Base and Post-Base Index Estimation¹⁰

The base period of the tradable S&P/Case-Shiller home price indices is January 2000, where the index point is set equal to 100.0. All index points prior to the base period are estimated simultaneously using the weighted regression model described above. The estimation is simultaneous because all of the estimated index points (or $\hat{\beta}_i^{-1}$) are conditional on the estimates of all other index points.

After the base period, the index points are estimated using a chain-weighting procedure in which an index point is conditional on all previous index points, but independent of all subsequent index points. The purpose of the post-base, chain-weighting procedure is to limit revisions to recently estimated index points while maintaining accurate estimates of market trends.

⁹ Fiserv CSW augments the interval and value-weights with a robust weighting procedure. This procedure mitigates the influence of sale pairs with extreme price changes (which are more likely to result from physical changes to properties or data errors, rather than market forces). Sale pairs with very large price changes (positive or negative, relative to the market trend) are down-weighted to prevent them from adding error to the index estimates.

¹⁰ See Shiller, R.J. (1993) *Macro Markets*, Clarendon Press, Oxford, pp. 195-199 for a discussion of chain-weighted repeat sales indices.

Returning to our example, the post-base, chain-weighting procedure can be illustrated by modifying the matrices of independent and dependent variables. Suppose that the index point for first period, $\hat{\beta}_1^{-1}$, has already been estimated. This means the matrices used for estimating the robust interval and value-weighted arithmetic repeat sales model can be re-written as:

$$X = \begin{bmatrix} 0 \\ 0 \\ P_{32} \\ P_{42} \\ P_{52} \end{bmatrix}, \quad Y = \begin{bmatrix} \hat{\beta}_0 P_{10} \\ \hat{\beta}_0 P_{20} \\ \hat{\beta}_0 P_{30} \\ \hat{\beta}_0 P_{40} \\ \hat{\beta}_1 P_{51} \end{bmatrix}, \quad Z = \begin{bmatrix} 0 \\ 0 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$

Since the first index point has already been estimated, the columns in X and Z that correspond to the first index period can be dropped. The normal equation for the second period index point, $\hat{\beta}_2^{-1}$, using the weighted regression model is:

$$\hat{\beta}_2^{-1} = Index_2 = \frac{w_3 P_{32} + w_4 P_{42} + w_5 P_{52}}{w_3 \hat{\beta}_0 P_{30} + w_4 \hat{\beta}_0 P_{40} + w_5 \hat{\beta}_1 P_{51}}$$

Again, as for the simultaneous index estimation procedure, the index level for the second period is equal to the aggregate change in the value (from the base period) of all properties sold in period 2 ($\hat{\beta}_1 P_{51}$ is the first period price of property 5 discounted back to the base period, and $\hat{\beta}_0 = 1.0$ by definition), but with a robust interval-weight attached to each sale pair. The example of post-base index estimation can be generalized as:

$$Index_t = \frac{\sum_{n \in t} w_n P_{n\tau(2,n)}}{\sum_{n \in t} w_n P_{n\tau(1,n)} / Index_{\tau(1,n)}}$$

where $\tau(2,n)$ is the period of the second sale, $\tau(1,n)$ is the period of the first sale, and $n \in t$ indicates the set of pairs with second sales in period t .

To compute three-month moving average indices, the n th sale pair is used in the above formulas as if it were three sale pairs with the same weight w_n , n_1 with dates $\tau(1,n)$ and $\tau(2,n)$, n_2 with dates $\tau(1,n) + 1$ and $\tau(2,n) + 1$, and n_3 with dates $\tau(1,n) + 2$ and $\tau(2,n) + 2$.

Index Maintenance

Updating the Composite Index

Going forward, the 2000 base period measures of the value of aggregate housing stock will be used for calculating monthly updates of the composite home price index, until new Census counts of single-family housing units (or another accurate and widely-accepted source for this data) become available.

Updating the Base Weights

The base weights used in the calculation of the composite index will be updated when new metro area counts of single-family housing units become available.¹¹ The divisor will be reset to ensure that the level of the composite index does not change due to changes in the underlying base weights. The base period of the composite index (i.e., the period where the index equals 100.0) will remain the same as the base period of the individual metro area home price indices.

Revisions

Each month, with the calculation of the latest index data point, revised data may be computed for the prior 24 months. Index data points are subject to revision as new sales transaction data becomes available. Although most sale transactions are recorded and collected expeditiously, some sale prices for the period covered by the index may have not yet been recorded at the time of the calculation.¹² When this information becomes available, the corresponding index data points are revised to maximize the accuracy of the indices. Revisions are limited to the last 24-months of data.

Base Date

The Indices have a base value of 100 on January 2000.

¹¹ The U.S. Census counts of single-family housing units by metro area are typically available 2 to 3 years after the completion of the decennial Census survey.

¹² Generally, more than 85% of the sales data for the latest index period are available when the indices are calculated. However, the completeness of the sales data for each update period and metro area will differ depending on real estate market conditions and the efficiency of the public recording and collection of sales deed records.

Index Governance

Index Committee

The S&P/Case-Shiller Metro Area Home Price Indices are maintained and governed by the S&P/Case-Shiller Index Committee. The Index Committee members are drawn from Standard & Poor's, Fiserv CSW and leading industry experts; Standard & Poor's designates the Index Committee Chairman.

The Index Committee has complete discretion to determine how the indices are calculated. In addition, the Index Committee may revise index policy covering rules for selecting houses to be considered for the index and extraordinary events, such as natural disasters, that may result in special consideration in the index in any given month.

Standard & Poor's considers information about changes to the S&P/Case-Shiller indices and related matters to be potentially market moving and material. Therefore, all Index Committee discussions are confidential.

Index Policy

Announcements

Announcements of index levels are made at 2:15 p.m. ET, on the last Tuesday of each month. Press releases are posted at www.indices.standardandpoors.com, and are released to major news services.

There is no specific announcement time for the S&P/Case-Shiller Metro Area Home Price Indices except for the monthly release of index levels, as indicated above.

Holiday Schedule

The indices are published on the last Tuesday of each month. In the event this falls on a holiday, the data will be published at the same time on the next business day.

Restatement Policy

Each month, in addition to contract settlement indices for the latest reported month, Standard & Poor's will publish restated data for each Metro Area and the Composite indices.

Restated data will be made available for the prior 24-months of reported data. Home price data are often staggered, due to the reporting flow of sales price data from individual county deed recorders. Data are restated to take advantage of additional information on sales pairs found each month. Consequently, new data received in the current month may result in a new sales pair previously unreported during the last 24 months, creating a new pair and providing additional data, resulting in a restatement. Experience shows that these restatements tend to be moderate and almost non-existent in periods older than two years.

Index Dissemination

The S&P/Case-Shiller Metro Area Home Price Indices will be published monthly, on the last Tuesday of each month at 2:15 p.m. ET.

Tickers

Underlying Cash Index	Bloomberg
Boston	BOX
Chicago	CHX
Denver	DNX
Las Vegas	LVX
Los Angeles	LXX
Miami	MIX
New York	NYX
San Diego	SNX
San Francisco	SFX
Washington, D.C.	WDX
Composite	CSX

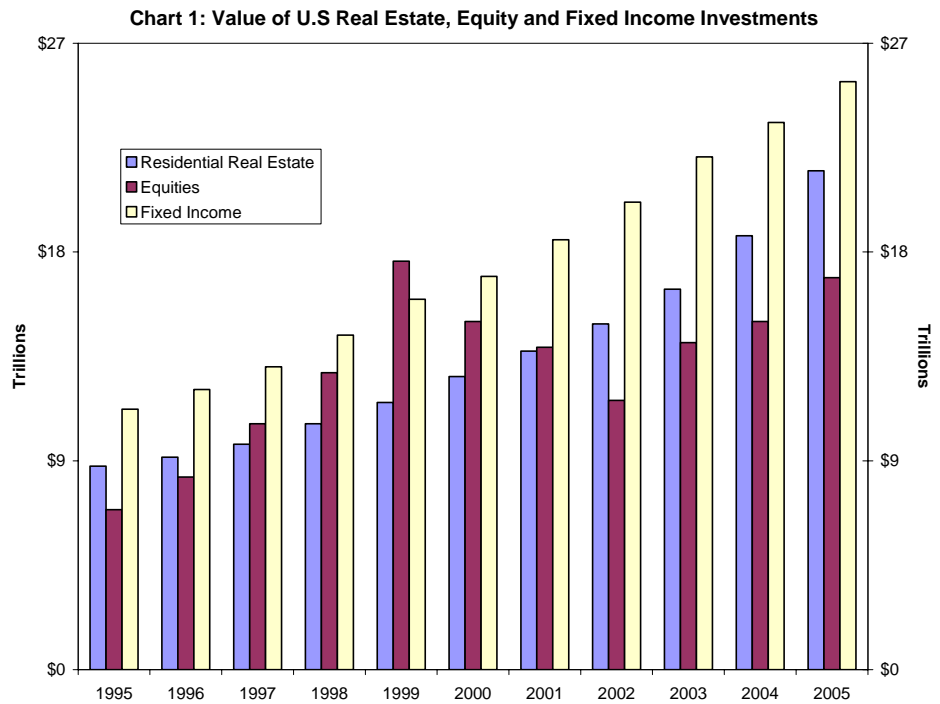
Futures and Options	Bloomberg	Reuters
Boston	COA	BOS
Chicago	CVA	CHI
Denver	CXA	DEN
Las Vegas	CYA	LAS
Los Angeles	DLA	LAX`
Miami	DQA	MIA
New York	DXA	NYM
San Diego	DZA	SDG
San Francisco	EFA	SFR
Washington, D.C.	EJA	WDC
Composite	CGA	CUS

Web site

Historical index data are published on Standard & Poor's Web site, www.indices.standardandpoors.com.

Appendix

Interest in the housing market has escalated recently due to the boom in housing activity over the past few years. Residential real estate investments have historically been comparable in value and size to other major asset classes.

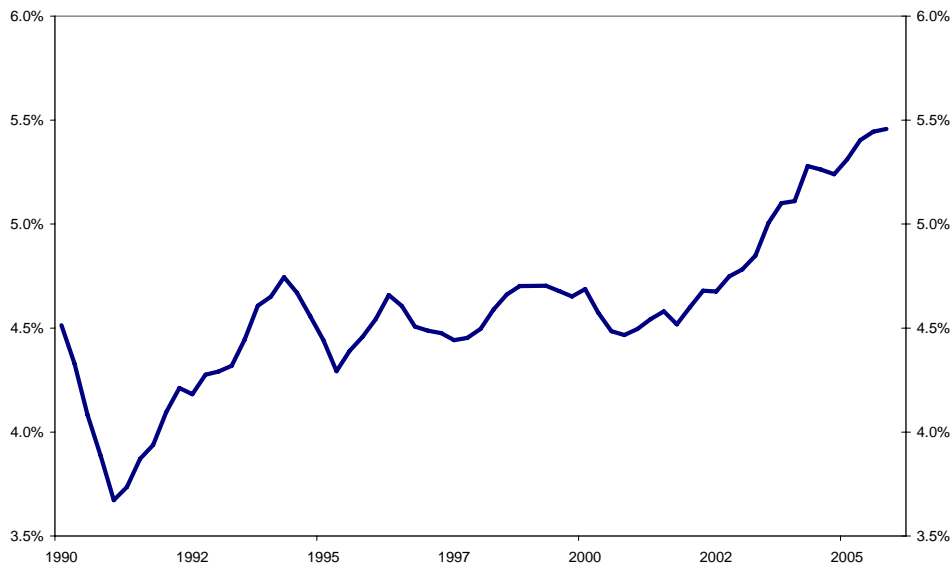


Real Estate: Residential holdings for households and nonprofit institutions. Source: Federal Reserve.
 Equities: Value of domestic listed companies (excluding closed-end funds) on the NYSE and NASDAQ. Source: NYSE
 Fixed Income: Outstanding level of public and private bond market debt, Sources: U.S. Department of Treasury; Bond Market Association.

Chart 1 illustrates that by the end of 2005 residential real estate investments totaled \$21.5 trillion, compared to fixed income investments at \$25.3 trillion, and surpassing the \$16.9 trillion in equities. Indeed real estate investments have seen steady growth since 1995.

With the real estate boom, residential construction has also flourished in recent years. From the 1990's sharp decline real residential construction spending leveled off for about a decade before surging in 2001. It can be seen from Chart 2 that residential construction represented 5.5% of real GDP in 2005, up from 4.5% in 2001.

Chart 2: Real Residential Construction as Percent of Real GDP



Source: Bureau of Economic Analysis.

With the surge in activity has come a surge in home prices across the U.S. Table 1 depicts the S&P/Case-Shiller® Metro Area Home Price Indices, and shows the increase in single-family home prices over the past five years.

Table 1: S&P/Case-Shiller Metro Area Home Price Indices

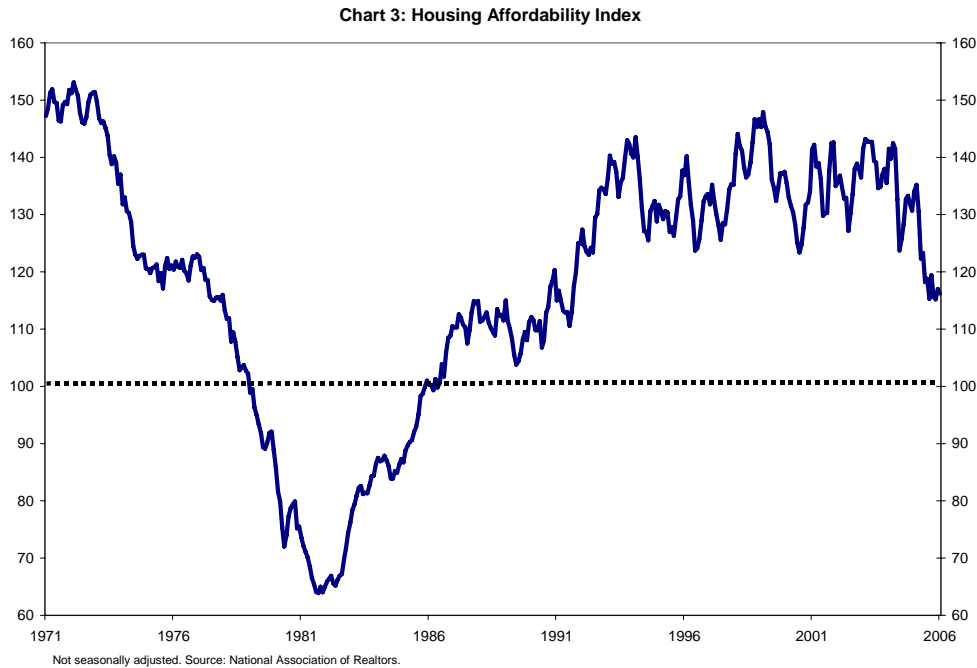
Region	2005 Index Level	2004 Index Level	Change Over Past Five Years
Boston	179.43	173.50	54%
Chicago	163.16	148.85	51%
Denver	137.50	132.40	20%
Las Vegas	229.42	207.62	118%
Los Angeles	264.77	217.34	140%
Miami	265.18	201.37	144%
New York City Area	211.39	185.13	89%
San Diego	248.55	233.08	114%
San Francisco	215.17	185.72	67%
Washington, DC	247.40	206.06	121%
Composite	221.58	191.42	95%

Source: Standard & Poor's

Index levels as of December of each year.

Miami and Los Angeles led the increase in home prices at 144% and 140%, respectively, New York City Area comes closest to the composite at 89%, and Denver demonstrated the slowest increase at 20%.

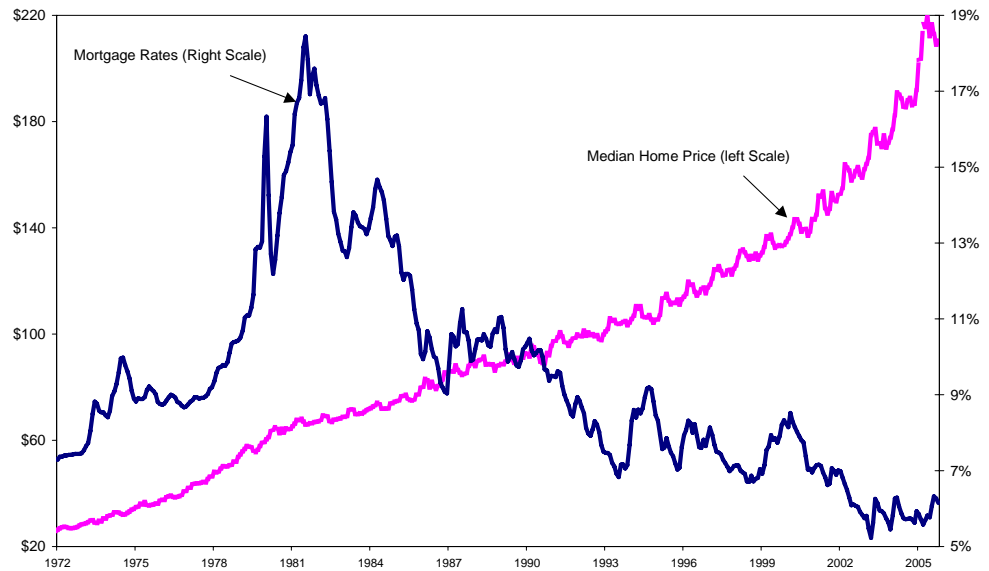
Housing affordability is related to mortgage rates, income growth and home prices. The increase in home prices is directly correlated to an increase in the ability of U.S. families to afford houses. Chart 3 portrays the U.S. housing affordability index. A value of 100 means that a family earning the national median income has just the right amount of money needed to qualify for a mortgage on a median-priced single-family home; higher than 100 means they have more than enough and lower than 100 means they cannot afford the house.



It can be seen from Chart 3 that housing affordability has been comfortably above 100 since 1986. It began to decline in early 2005, falling below 120 for the first time since 1991, likely due to a combination of high home prices and increasing interest rates.

Chart 4 depicts the median price of existing homes against mortgage rates. It can be seen that median home prices have been steadily increasing since 1972, so affordability is likely a result of declining mortgage rates and income growth. However, the relative decline in affordability in the past year seems correlated with the sharp increase in home prices in 2005 more so than with an increase in mortgage rates, since they still hover close to record lows. Between February 2005 and January 2006 existing median home prices increased 12.7% from \$186,800 to \$210,500, while mortgage rates rose from 5.6% to 6.1%.

Chart 4: Existing Single-Family Home Prices vs. Mortgage Rates



Home prices in thousands of dollars, not seasonally adjusted. Average conventional 30-year commitment rates, fixed -rate mortgage.
Source: National Association of Realtors, Federal Home Loan Mortgage Corporation.

The surge in housing activity is also obvious when you look at the construction of new homes. Chart 6 is the level of single-family housing starts in the U.S. Housing starts surged in the last 15 years and remains near record highs.

Chart 5: Housing Starts



Housing starts, private including farm – one unit, seasonally adjusted, in thousands of units.
Source: U.S. Department of Commerce, Bureau of the Census Construction Report.

S&P Contact Information

Index Management

David M. Blitzer, Ph.D. – Managing Director & Chairman of the Index Committee
 david_blitzer@standardandpoors.com 1 212 438 3907

Media Relations

David Guarino – Communications
 dave_guarino@standardandpoors.com 1 212 438 1471

Sales and Marketing

North America

New York

Wendy Chan 1 212 438 4080
 Maureen O’Shea 1 212 438 2046

Toronto

Jasmit Bhandal 1 416 507 4116
 Tony North 1 416 507 4106

Europe

Paris

Christopher O’Brien 33 (0) 1 40 75 77 91

London

Susan Fagg 44 (0) 20 7176 8388

Asia

Hong Kong

Jean Park 852 2841 1032

Beijing

Andrew Webb 8610 6535 2919

Tokyo

Seiichiro Uchi 81 3 4550 8568

Sydney

Jason Hill 61 2 9255 9872

Disclaimer

The report is published by Standard & Poor's, 55 Water Street, New York, NY 10041. Copyright © 2006. Standard & Poor's is a division of The McGraw-Hill Companies, Inc. All rights reserved. Standard & Poor's does not undertake to advise you of changes in the information contained in this report.

These materials have been prepared solely for informational purposes based upon information generally available to the public from sources believed to be reliable. Standard & Poor's makes no representation with respect to the accuracy or completeness of these materials, the content of which may change without notice. Standard & Poor's disclaims any and all liability relating to these materials and makes no express or implied representations or warranties concerning the accuracy or completeness of the report.

No portion of this publication may be reproduced in any format or by any means including electronically or mechanically, by photocopying, recording or by any information storage or retrieval system, or by any other form or manner whatsoever, without the prior written consent of Standard & Poor's.

Analytic services and products provided by Standard & Poor's are the result of separate activities designed to preserve the independence and objectivity of each analytic process. Standard & Poor's has established policies and procedures to maintain the confidentiality of non-public information received during each analytic process.