STANDARD & POOR'S

S&P/CASE-SHILLER HOME PRICE INDICES

INDEX METHODOLOGY

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Introduction

The S&P/Case-Shiller 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 are calculated monthly and cover 20 major metropolitan areas (Metropolitan Statistical Areas or MSAs), which are also aggregated to form two composites – one comprising 10 of the metro areas, the other comprising all 20.

The S&P/Case-Shiller U.S. National Home Price Index ("the U.S. national index") tracks the value of single-family housing within the United States. The index is a composite of single-family home price indices for the nine U.S. Census divisions and is calculated quarterly.

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 monthly S&P/Case-Shiller 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 quarterly S&P/Case-Shiller U.S. National Home Price Index aggregates nine quarterly U.S. Census division repeat sales indices using a base period and estimates of the aggregate value of single-family housing stock for those periods.

Please refer to the U.S. National Index Methodology section for details.

The S&P/Case-Shiller 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

Inclusions and Exclusions

The S&P/Case-Shiller indices are designed to measure, as accurately as possible, changes in the total value of all existing single-family housing stock. The methodology samples all available and relevant transaction data to create matched sale pairs for pre-existing homes.

The S&P/Case-Shiller indices do not sample sale prices associated with new construction, condominiums, co-ops/apartments, multi-family dwellings, or other properties that cannot be identified as single-family.

The factors that determine the demand, supply, and value of housing are not the same across different property types. Consequently, the price dynamics of different property types within the same market often vary, especially during periods of increased market volatility. In addition, the relative sales volumes of different property types fluctuate, so indices that are segmented by property type will more accurately track housing values.

Index Construction

Approaches

The S&P/Case-Shiller 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 20 defined MSAs and three price tiers – low, middle and high (see Tables 1 and 1a 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 consist 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.

All available arms-length transactions for single-family homes are candidates for sale pairs. When they can be identified, transactions with prices that do not reflect market value are excluded from sale pairs. This includes: 1) non-arms-length transactions (e.g., property transfers between family members); 2) transactions where the property type designation is changed (e.g., properties originally recorded as single-family homes are subsequently recorded as condominiums); and 3) 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 and 20 Metro Area Indices are then combined, using a market-weighted average, to create the Composite of 10 and the Composite of 20.

Moreover, each sales pair in each metro area is also allocated to one of three price tiers – low, middle and high – depending on the position of the first price of the pair among all prices occurring during the period of the first sale. Separate data sets of low-price-tier houses, medium-price-tier houses and high-price tier repeat sales pairs are assembled for each metro area. The same repeat sale procedures used to produce the Metro Area Indices are applied to these data sets. The resulting indices are the Low-Tier, Medium-Tier and High-Tier Indices.

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 original 10 S&P/Case-Shiller Home Price Indices. These 10 metro areas are used to derive the Composite of 10.

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-Santa Ana, CA Metropolitan Statistical Area	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 representation of component markets within any S&P/Case-Shiller Home Price Index may vary over time depending upon sales activity and the availability of sales data.

Note: the S&P/CS® New York City Home Price 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/ CS® Chicago Home Price Index is not an MSA.

Table 1a: Metro Areas for the additional 10 S&P/Case-Shiller Home Price Indices. These 10 metro areas, with the 10 in Table 1 above, are used to derive the Composite of 20.

MSA	Represented Counties
Atlanta-Sandy Springs-Marietta, GA Metropolitan Statistical Area	Barrow GA, Bartow GA, Butts GA, Carroll GA, Cherokee GA, Clayton GA, Cobb GA, Coweta GA, Dawson GA, De Kalb GA, Douglas GA, Fayette GA, Forsyth GA, Fulton GA, Gwinnett GA, Haralson GA, Heard GA, Henry GA, Jasper GA, Lamar GA, Meriwether GA, Newton GA, Paulding GA, Pickens GA, Pike GA, Rockdale GA, Spalding GA, Walton GA
Charlotte-Gastonia-Concord, NC-SC Metropolitan Statistical Area	Anson NC, Cabarrus NC, Gaston NC, Mecklenburg NC, Union NC, York SC
Cleveland-Elyria-Mentor, OH Metropolitan Statistical Area	Cuyahoga OH, Geauga OH, Lake OH, Lorain OH, Medina OH
Dallas-Fort Worth-Arlington, TX Metropolitan Statistical Area	Collin TX, Dallas TX, Delta TX, Denton TX, Ellis TX, Hunt TX, Johnson TX, Kaufman TX, Parker TX, Rockwall TX, Tarrant TX, Wise TX
Detroit-Warren-Livonia, MI Metropolitan Statistical Area	Lapeer MI, Livingston MI, Macomb MI, Oakland MI, Saint Clair MI, Wayne MI
Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Statistical Area	Anoka MN, Carver MN, Chisago MN, Dakota MN, Hennepin MN, Isanti MN, Ramsey MN, Scott MN, Sherburne MN, Washington MN, Wright MN, Pierce WI, Saint Croix WI
Phoenix-Mesa-Scottsdale, AZ Metropolitan Statistical Area	Maricopa AZ, Pinal AZ
Portland-Vancouver-Beaverton, OR-WA Metropolitan Statistical Area	Clackamas OR, Columbia OR, Multnomah OR, Washington OR, Yamhill OR, Clark WA, Skamania WA
Seattle-Tacoma-Bellevue, WA Metropolitan Statistical Area	King WA, Pierce WA, Snohomish WA
Tampa-St. Petersburg-Clearwater, FL Metropolitan Statistical Area	Hernando FL, Hillsborough FL, Pasco FL, Pinellas FL

Note: The representation of component markets within any S&P/Case-Shiller Home Price Index may vary over time depending upon sales activity and the availability of sales data.

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. The county components of MSAs are subject to change as a result of revisions to metro area definitions by the White House Office of Management and Budget, data insufficiencies, or the availability of new data sources.

Composites

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

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

where $Index_{Ct}$ 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 indices are 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 a composite index:

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

Calculating Composite Index History

Calculating history for the composite indices 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, 4, 2a, 3a and 4a, below.

Table 2: Single-Family Housing Stock (units) for the original 10 indices

	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) for the original 10 indices

	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

Table 4: Aggregate Value of Single-Family Housing Stock (US$, millions) for the original 10 indices

	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

Table 2a: Single-Family Housing Stock (units, thousands) for all 20 indices

	2000
Atlanta	1,133
Boston	927
Charlotte	381
Chicago	1,567
Cleveland	631
Dallas	1,273
Denver	599
Detroit	1,343
Las Vegas	322
Los Angeles	2,450
Miami	1,116
Minneapolis	820
New York	3,772
Phoenix	861
Portland	522
San Diego	629
San Francisco	948
Seattle	788
Tampa	677
Washington, D.C.	1,249

Source: U.S. Census Bureau, Economy.Com.

Table 3a: Average Value of Single Family Housing (US$, 000's) for all 20 indices

	2000
Atlanta	182
Boston	299
Charlotte	181
Chicago	212
Cleveland	144
Dallas	163
Denver	230
Detroit	189
Las Vegas	172
Los Angeles	323
Miami	167
Minneapolis	179
New York	270
Phoenix	178
Portland	194
San Diego	328
San Francisco	465
Seattle	259
Tampa	115
Washington, D.C.	235

Source: Fiserv

Table 4a: Aggregate Value of Single-Family Housing Stock (US$, millions) for all 20 indices

	2000
Atlanta	206,267
Boston	277,160
Charlotte	68,993
Chicago	332,298
Cleveland	90,850
Dallas	207,477
Denver	137,696
Detroit	253,803
Las Vegas	55,350
Los Angeles	791,298
Miami	186,445
Minneapolis	146,718
New York	1,018,535
Phoenix	153,182
Portland	101,189
San Diego	206,158
San Francisco	440,778
Seattle	204,209
Tampa	77,826
Washington, D.C.	293,529
Divisor	5,249,761

Source: Fiserv

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:

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

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

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 Indices with Normalized Weights

When the base period values of the metro area price indices are equal, the composite indices can also be calculated using normalized weights where the *Divisor* is set equal to one[1]. 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.

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

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

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

The tables below list the normalized weights for calculating index points from January 2000 onward.

Table 5: Normalized Composite Weights for the Composite of 10

	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

[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.

Table 5a: Normalized Composite Weights for the Composite of 20

	2000
Atlanta	0.03929074
Boston	0.05279478
Charlotte	0.01314212
Chicago	0.06329774
Cleveland	0.01730555
Dallas	0.03952123
Denver	0.02622900
Detroit	0.04834563
Las Vegas	0.01054334
Los Angeles	0.15073029
Miami	0.03551495
Minneapolis	0.02794756
New York	0.19401550
Phoenix	0.02917885
Portland	0.01927497
San Diego	0.03926998
San Francisco	0.08396154
Seattle	0.03889872
Tampa	0.01482467
Washington, D.C.	0.05591283

Source: Fiserv

Index Construction Process

The S&P/Case-Shiller 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 are 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 Home Price Indices are designed to reflect the average change in market prices for constant-quality homes in a geographic market and price tier, in the case of the three tier indices. The sale pairing process and the weighting used within S&P/Case-Shiller Home Price Indices’ 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 Home Price Indices' 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 record[2], 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 repossessions of properties by mortgage lenders at the beginning of foreclosure proceedings. Subsequent sales by mortgage lenders of foreclosed properties are included in repeat sale pairs, because they are arms-length transactions.

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.

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 records[4] 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

[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 (repossessions of properties before a foreclosure auction). 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.

[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.

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 Division of Repeat Sales Pairs into Price Tiers[5]

For the purpose of constructing the three tier indices, price breakpoints between low-tier and middle-tier properties and price breakpoints between middle-tier and upper-tier properties are computed using all sales for each period, so that there are the same number of sales, after accounting for exclusions, in each of the three tiers. The breakpoints are smoothed through time to eliminate seasonal and other transient variation. Each repeat-sale pair is then allocated to one of the three tiers depending on first sale price, resulting in a repeat sales pairs data set divided into thirds. The same methods used for the Metro Area Indices are applied separately to each of these three data sets to produce the Low-Tier, Medium-Tier and High-Tier Indices.

Note that the allocation into tiers is made according to first sale price. Individual properties may shift between price tiers from one sale date to the next. We use only the tier of the first sale, ignoring the tier of the second sale. This allocation was chosen so that each of the tier indices closely represents a portfolio of homes that could be constructed on each date using information actually available on that date. Thus, the tier indices are essentially replicable by forming a portfolio of houses in real time. The Low-Tier index for a metro area is an indicator of a strategy of buying homes falling in the bottom third of sale prices (while the High Tier Index as an indicator of a strategy of buying homes in the top third of sale prices) and holding them as investments for as long as the homeowner lived in the home. The trend of home price indices in each of the three tiers reflects the outcome of such an investment strategy.

A "value effect," has been noted in the tier indices: low-tier indices have typically appreciated somewhat more than high-tier indices. Part of this value effect may be analogous to the effect that motivates value-investing strategies in the stock market. Individual homes' prices have shown some tendency to mean revert, so purchasing low-priced homes may have been an overall good investment strategy. We do not know

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[5] See Karl E. Case and Robert J. Shiller, "A Decade of Boom and Bust in Prices of Single Family Homes: Boston and Los Angeles, 1983 to 1993", New England Economic Review, March/April 1994, pp. 39-51.

whether this value effect will continue into the future, and the value effect has not been stable through time even in the historic sample that we have observed.

The high-tier indices will tend to lie closer to the aggregate indices than do the low-tier indices. This is as we would expect, since the aggregate indices are value-weighted and hence the high-tier repeat sales figure more prominently in the aggregate indices.

The Weighting of Sale Pairs

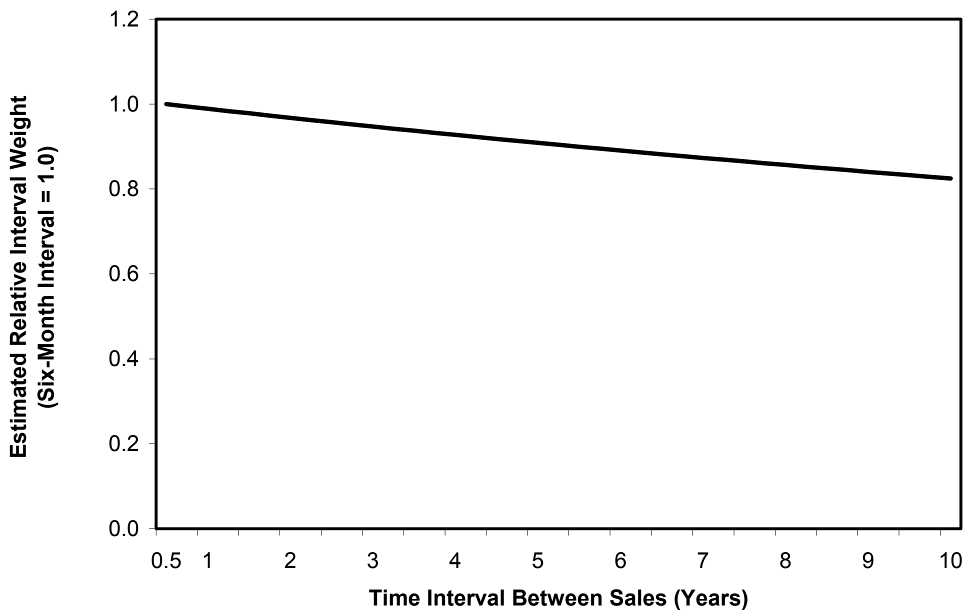
Although non-arms-length transactions and sales of physically altered properties are discarded during the pairing process, it is not possible to identify all of these sales based on the information available from deed records. Furthermore, the price changes observed for individual homes may be the result 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.

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 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 Home Price Indices' 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.[6]
The graph on the following page 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.

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[6] 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.

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 Indices[7]

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 calculating 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 <u>reciprocals</u> of the estimated regression coefficients, $\hat{\beta}$.

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*.

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

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, $\beta = (Z'X)^{-1}Z'Y$, 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).[8] 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 Home Price 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 Indices [9]

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.

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[8] 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.

[9] 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.

Returning to the example from the previous section, we apply a weight, w_n , to pair n:

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

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

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 Guassian 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.[10]

Pre-Base and Post-Base Index Estimation[11]

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 $\hat{\beta}_t^{-1}$) 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.

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.

[10] Fiserv 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.

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

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, β_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:

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

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 $\tau(2,n) + 2$.

U.S. National Index Methodology

Introduction

The S&P/Case-Shiller U.S. National Home Price Index ('the U.S. national index') tracks the value of single-family housing within the United States. The index is a composite of single-family home price indices for the nine U.S. Census divisions:

$$Index_{US\,t} = \left(\sum_i \left(Index_{it} / Index_{i\,(b)} \right) \times V_{i\,(b)} \right) \Big/ Divisor_{(b)}$$

where $Index_{US\,t}$ is the level of the U.S. national index in period *t*, $Index_{it}$ is the level of the home price index for Census division *i* in period *t*, $Index_{i(b)}$ is the level of the home price index for Census division *i* in a specified base period *(b),* and $V_{i(b)}$ is the aggregate value of single-family housing units in division *i* in the base period *(b)*. The $Divisor_{(b)}$ is chosen to ensure that the level of the composite index does not change because of changes in the base weights ($V_{i(b)}$). The $Divisor_{(b)}$ will be reset whenever the weights are changed to ensure that the level of the composite index does not suffer a discontinuity at the date of a change.

Calculating U.S. National Index History

Calculating historical estimates of the U.S. national index requires the choice of base periods and estimates of the aggregate value of single-family housing stock for those periods. The decennial U.S. Census currently provides reliable estimates of the aggregate value of single-family housing units for the Census divisions. The last two decennial Census years, 1990 and 2000, were chosen as the base periods. The U.S. Census aggregate value estimates by division are listed in Table 6.

The aggregate value estimates for the 1990 base period were used to calculate composite index data for the period from 1987:Q1 to 1999:Q4, while the 2000 base period estimates were used to calculate data from 2000:Q1 until the present. The *Divisor* for both of these periods is set so that the composite index equals 100.0 in 2000:Q1.

Table 6: Aggregate Value of Single-Family Housing Stock (US$)

	1990	2000
East North Central	765,418,398,000	1,528,000,592,500
East South Central	224,148,387,500	448,817,717,500
Middle Atlantic	975,073,121,500	1,322,860,220,000
Mountain	248,195,528,000	659,289,495,000
New England	467,867,938,500	618,272,542,500
Pacific	1,397,627,457,000	2,140,886,697,500
South Atlantic	924,261,612,000	1,691,801,012,500
West North Central	294,495,739,500	578,345,765,000
West South Central	384,583,746,000	700,764,790,000
Divisor	7,517,991,542,910	9,689,038,832,500

Source: U.S. Census Bureau

Census Division and State Coverage

	Housing Value, Millions $ (2000 Census)	% of U.S.	% of Div	% of State covered by the S&P/CS US National Index	Housing Value covered (Millions $)
Division 1: New England					
Connecticut	$180,725	1.9%	29.2%	100.0%	
Maine	$39,918	0.4%	6.5%	0.0%	
Massachusetts	$295,819	3.1%	47.8%	100.0%	
New Hampshire	$45,831	0.5%	7.4%	100.0%	
Rhode Island	$34,860	0.4%	5.6%	100.0%	
Vermont	$21,120	0.2%	3.4%	100.0%	
Total	$618,273	6.4%	100.0%	93.5%	$578,355
Division 2: Middle Atlantic					
New Jersey	$383,348	4.0%	29.0%	100.0%	
New York	$548,439	5.7%	41.5%	72.3%	
Pennsylvania	$391,073	4.0%	29.6%	58.0%	
Total	$1,322,860	13.7%	100.0%	76.1%	$1,006,733
Division 3: East North Central					
Illinois	$433,585	4.5%	28.4%	75.2%	
Indiana	$182,588	1.9%	11.9%	0.0%	
Michigan	$367,747	3.8%	24.1%	85.0%	
Ohio	$367,316	3.8%	24.0%	89.4%	
Wisconsin	$176,765	1.8%	11.6%	0.0%	
Total	$1,528,001	15.8%	100.0%	63.3%	$966,991
Division 4: West North Central					
Iowa	$80,498	0.8%	13.9%	22.4%	
Kansas	$70,958	0.7%	12.3%	54.7%	
Minnesota	$187,880	1.9%	32.5%	70.0%	
Missouri	$163,965	1.7%	28.4%	56.7%	
Nebraska	$45,783	0.5%	7.9%	54.8%	
North Dakota	$12,566	0.1%	2.2%	0.0%	
South Dakota	$16,696	0.2%	2.9%	0.0%	
Total	$578,346	6.0%	100.0%	53.0%	$306,426
Division 5: South Atlantic					
Delaware	$29,389	0.3%	1.7%	67.8%	
Florida	$482,662	5.0%	28.5%	97.1%	
Georgia	$256,492	2.6%	15.2%	52.5%	
Maryland	$230,018	2.4%	13.6%	100.0%	
North Carolina	$249,699	2.6%	14.8%	32.3%	
South Carolina	$110,564	1.1%	6.5%	0.0%	
Virginia	$271,481	2.8%	16.0%	41.2%	
West Virginia	$41,183	0.4%	2.4%	0.0%	
District of Columbia	$20,314	0.2%	1.2%	100.0%	
Total	$1,691,801	17.5%	100.0%	63.0%	$1,066,372

Census Division and State Coverage (cont'd)

	Housing Value, Millions $ (2000 Census)	% of U.S.	% of Div	% of State covered by the S&P/CS US National Index	Housing Value covered (Millions $)
Division 6: East South Central					
Alabama	$117,198	1.2%	26.1%	0.0%	
Kentucky	$103,268	1.1%	23.0%	10.3%	
Mississippi	$58,604	0.6%	13.1%	0.0%	
Tennessee	$169,748	1.8%	37.8%	94.9%	
Total	$448,818	4.6%	100.0%	38.3%	$171,712
Division 7: West South Central					
Arkansas	$58,095	0.6%	8.3%	35.8%	
Louisiana	$102,319	1.1%	14.6%	35.0%	
Oklahoma	$73,596	0.8%	10.5%	42.2%	
Texas	$466,755	4.8%	66.6%	54.3%	
Total	$700,765	7.2%	100.0%	48.7%	$341,094
Division 8: Mountain					
Arizona	$167,639	1.7%	25.4%	95.1%	
Colorado	$207,392	2.1%	31.5%	73.5%	
Idaho	$40,864	0.4%	6.2%	0.0%	
Montana	$28,516	0.3%	4.3%	0.0%	
Nevada	$66,231	0.7%	10.0%	86.8%	
New Mexico	$51,387	0.5%	7.8%	59.3%	
Utah	$81,601	0.8%	12.4%	78.5%	
Wyoming	$15,659	0.2%	2.4%	0.0%	
Total	$659,289	6.8%	100.0%	70.4%	$463,847
Division 9: Pacific					
Alaska	$18,868	0.2%	0.9%	0.0%	
California	$1,660,985	17.1%	77.6%	98.2%	
Hawaii	$57,434	0.6%	2.7%	100.0%	
Oregon	$137,518	1.4%	6.4%	77.7%	
Washington	$266,082	2.7%	12.4%	62.1%	
Total	$2,140,887	22.1%	100.0%	91.6%	$1,961,135
UNITED STATES	**$9,689,039**				**$6,862,664**
Percent coverage in the S&P/CS U.S. National Index					**70.8%**

Note: The representation of component markets within any S&P/Case-Shiller Home Price Index may vary over time depending upon sales activity and the availability of sales data.

Calculating the U.S. National Index with Normalized Weights

When the base period values of the divisional price indices are equal, the composite index can also be calculated using normalized weights where the *Divisor* is set equal to one[12]. The normalized weights are each division's share of the total aggregate value of housing stock for all nine divisions:

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

The U.S. national index can then be calculated by summing the product of each division's normalized weight and current index level.

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

The normalized weights for calculating index points from 2000:Q1 until the present are listed in Table 7.

Table 7: Normalized Composite Weights (Source: Fiserv)

	2000
East North Central	0.15770404
East South Central	0.04632221
Middle Atlantic	0.13653163
Mountain	0.06804488
New England	0.06381155
Pacific	0.22095966
South Atlantic	0.17460979
West North Central	0.05969073
West South Central	0.07232552

Updating the U.S. National Index

Until new Census estimates of the aggregate value of single-family housing units (or another, accurate and widely-accepted source for this data) become available, the 2000 base period estimates of aggregate value will be used for calculating updates to the U.S. national home price index.

Updating the Base Weights

When new Census estimates of the aggregate value of single-family housing units by division become available, the base weights used in the calculation of the U.S. national index will be updated and a new base period (b) will be chosen. The divisor will be reset to reflect the change in the base weights. Revised normalized weights will be calculated

[12] The use of normalized weights only applies to the period including and after 2000:Q1 until a new base period is defined. The 1987:Q1 to 1999:Q4 base period index values are not equal across all divisions.

for the new base period[13]. The composite index will be normalized so that the period where the index equals 100.0 will remain consistent with the individual divisional home price indices.

[13] The normalized weights for the 2000 base period will no longer be valid when a new base period is chosen.

Index Maintenance

Updating the Composite Indices

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 indices, 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 indices will be updated when new metro area counts of single-family housing units become available.[14] The divisor will be reset to ensure that the level of the composite indices do not change due to changes in the underlying base weights. The base period of the composite indices (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

For the monthly index series, with the calculation of the latest index data point, each month, revised data may be computed for the prior 24 months. For the quarterly index, with the calculation of the latest index data point, each quarter, revised data may be computed for the prior 8 quarters. 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.[15] 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 for the monthly index series. Revisions are limited to the last 8-quarters of data for the quarterly index.

Base Date

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

[14] 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.
[15] 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 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 Home Price 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 09:00 AM Eastern Time, 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 Home Price Indices except for the monthly release of index levels, as indicated above.

Holiday Schedule

The monthly indices are published on the last Tuesday of each month. The quarterly index is published on the last Tuesday of February, May, August and November. 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 or 8-quarters 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 Home Price Indices will be published monthly, on the last Tuesday of each month at 09:00 AM Eastern Time.

Tickers

Underlying Cash Index	**Bloomberg**	**Reuters**
Boston	SPCSBOS	.SPCSBOS
Chicago	SPCSCHI	.SPCSCHI
Denver	SPCSDEN	.SPCSDEN
Las Vegas	SPCSLV	.SPCSLV
Los Angeles	SPCSLA	.SPCSLA
Miami	SPCSMIA	.SPCSMIA
New York	SPCSNY	.SPCSNY
San Diego	SPCSSD	.SPCSSD
San Francisco	SPCSSF	.SPCSSF
Washington, D.C.	SPCSWDC	.SPCSWDC
Composite of 10	SPCS10	.SPCS10
Atlanta	SPCSATL	.SPCSATL
Charlotte	SPCSCHAR	.SPCSCHAR
Cleveland	SPCSCLE	.SPCSCLE
Dallas	SPCSDAL	.SPCSDAL
Detroit	SPCSDET	.SPCSDET
Minneapolis	SPCSMIN	.SPCSMIN
Phoenix	SPCSPHX	.SPCSPHX
Portland	SPCSPORT	.SPCSPORT
Seattle	SPCSSEA	.SPCSSEA
Tampa	SPCSTMP	.SPCSTMP
Composite of 20	SPCS20	.SPCS20
U.S. National	SPCSUSA	.SPCSUSA

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 of 10	CGA	CUS

Web site

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

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
Mariah Alsati-Morad – Manager, Index Strategy
mariah_alsati-morad@standardandpoors.com +1.212.438.2308

Media Relations

David Guarino – Communications
dave_guarino@standardandpoors.com +1.212.438.1471

Index Operations & Business Development

North America
New York
David Kao +1.212.438.3354
Toronto
Jasmit Bhandal +1.416.507.3203
Europe
Paris
Christopher O'Brien +33.1.40.75.77.91
London
Susan Fagg +44.20.7176.8388
Asia
Tokyo
Seiichiro Uchi +813.4550.8568
Beijing
Andrew Webb +86.10.6569.2919
Sydney
Guy Maguire +61.2.9255.9822

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