House Prices in America

Methodology Update

A Global Insight / National City Corporation Joint Venture

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House Prices in America: Valuation Methodology

Summary

- This study employs a statistical technique — pooled time series regression analysis — to evaluate single family house prices in 330 metro areas. These 330 areas collectively account for 78 of all existing single family housing units and 92 percent of all related real estate value, as of the third quarter of 2007.

- For the period from Q1/1985 to Q3/2007, price-to-income ratios are statistically explained by four factors: household population density, mortgage interest rates, relative income levels and characteristics unique to the history of each metro area.

- The model accounts for 73 percent of the variation in house price-to-income ratios over time and across the 330 metro areas. Explanatory variables are statistically significant with high levels of confidence.

Our approach to determining fair value in the housing market is statistical in orientation. This contrasts with financial asset valuation, where a vast body of theoretical and empirical literature addresses the question of "intrinsic value." Rather, our approach examines a particular historical period — Q1/1985 to Q3/2007 — and accepts that house prices, on average, adhered to some normal relationship to underlying determinants during that time.

We conduct our analysis at the metropolitan area level of geographic detail, in recognition of, and controlling for, the disparate conditions that characterize different markets. This is done with a technique call multivariate pooled time series analysis, which combines the virtues of time series analysis (estimating relationships as they change over time) and cross-section analysis (estimating relationships as they vary across different members of a group). Specifically, we examine the ratio of home prices to household incomes in 330 metropolitan areas and attempt to explain the variation in that ratio as a function of four key determinants:

- Household Population Density$_{MSA}$
- Conventional Mortgage Rate$_{US}$
- Relative Income Level$_{MSA}$
- Constant$_{MSA}$

Household population density is measured as the number of households per square mile in each metro area and serves as a proxy for the scarcity of land. The fact that Detroit, for example, has 1,246 households per square mile implies a far greater scarcity of land than in Las Vegas, where there are 82 households per square mile. Also relevant to house prices is the fact that Detroit's household population density has fallen 2 percent over the past decade, while in Las Vegas it climbed 70 percent.

The conventional mortgage rate is not specific to metropolitan areas and captures the extent to which financing costs influence home prices. For example, a conventional 30-year mortgage of $200,000 carries a monthly cost of $1,468 with mortgage interest rates of 8 percent. At 6 percent, however, a homebuyer could service a far higher $245,000 mortgage with the same monthly expense. In recognition of the fact that changing interest rates have a nonlinear impact on financing costs (due to changing interest and amortization schedules) we incorporate the mortgage interest rate on an annuitized basis.

Relative income borrows from the economic concept of the "luxury good." Generally, a luxury good is defined as one toward which consumers allocate more of their income as their real incomes rise. In this case, we recognize that the high-income (twice the national average) residents of Bridgeport, Connecticut, are likely to allocate a larger share of their income toward housing than are the lower-income (three-quarters the national average) residents of Hattiesburg, Mississippi.

Finally, we calculate a "constant" term for each metropolitan area. These control for historically observed differences in metro area price-to-income ratios that is not explained by the other three determinants. The numbers range from -5.5 to +3.5 and reflect a variety of difficult to quantify,

but nonetheless important, factors that influence prices. Factors that influence metro area constants would include pollution, climate, expected property price appreciation, cultural amenities, school systems, miscellaneous costs, (e.g. tax and utility rates) and geographic location.

For example, Honolulu and San Jose each have metro constants of approximately 1.8, meaning that house prices there should be 1.8 times income levels, abstracting from the influence of all other factors. Presumably, their pleasant climate influences these high metro area constants. Alternatively, Boston, New York and Detroit each have negative metro area constants. In these instances we believe their high concentration of multifamily residential housing units is at play. Because our study focuses only on single family houses, the reported measures of population density for these areas no doubt over-states the scarcity of land, which is corrected for by their low constant terms.

On the whole, this statistical model works well. It explains 73 percent of the variation in home price-to-income ratios across places and over time. Additionally, explanatory variables are statistically significant at high levels of confidence.

Once the model has been estimated, we then use it to determine what prices "should" be, in the statistical sense. By comparing those estimated prices to actually observed prices, we then determine the extent to which markets have historically been under or overvalued.

By examining eighty-five actual metro area price corrections — defined as a decline of at least 10 percent over a period of at least 8 quarters — over the 1985 to Q3/2007 period, we found such markets, on average, to be 33 percent over-valued prior to the subsequent decline in prices. Hence, property markets over-valued by 33 percent, or more, are considered extreme.

Interpreting the Data

Users sometimes misinterpret the valuation metrics by assuming that a particular degree of overvaluation implies that house prices are destined to decline by that amount. So, for example, the observation that Reno, Nevada is overvalued by 14 percent is mistaken to imply that

THE DATA

House Prices

House prices pertain to median values for single-family dwelling units and are based on the 2000 Census of Housing. That point-in-time Census estimate is then extrapolated, based on price indices published by the Office of Federal Housing Enterprise Oversight (OFHEO). Because OFHEO has acknowledged that these price indices overstate increases when refinance activity is strong, we further adjust the data to correct for this influence.

Household Income

Household income is calculated by dividing total personal income (source: Bureau of Economic Analysis) by the number of households (source: Bureau of Census). When calculating relative income levels, these metrics for metro areas are shown as a ratio to the corresponding national figure.

Household Population Density

Household population density is determined by the number of households divided by land area, in square miles (source: Census of Population).

Interest Rate

The interest rate a 30-year fixed rate for existing properties (source: Telerate), with payments based on a standard amortization schedule.

Other

Primary source material is relied upon to the greatest degree possible. In some instances, especially for the most current periods, however, estimates are prepared by Global Insight. Data tables are available upon request: contact, Jeannine Cataldi (Global Insight) at 610-490-2650.

prices there are headed for a 14 percent drop.

This would not necessarily be correct for the following reasons. First, housing markets tend to adjust very gradually and price declines, when they occur, have historically averaged 18 quarters in duration. Because house prices determinants generally improve over that time (especially population density and incomes) we observe that price declines are about one-half the initial degree of overvaluation (see Appendix C in *House Prices in America: Valuation Update*). Second, we caution against over interpreting the metrics since the historically normal dispersion of valuations is quite wide. Specifically, our model has a standard deviation in house price valuations of +/-15 percent, meaning that any valuation between 15 percent overvalued and 15 percent undervalued should be considered statistically normal.

Finally, we acknowledge that the estimates of over, or undervaluation will vary with periodic updates, as will the percentage threshold used to identify "overvalued" markets. These changes, though slight, reflect two things. First, various "input" data are revised as more current, and accurate, information become available. For example, the house price data are revised with each quarterly update. Second, the model is re-estimated each quarter to incorporate all available information. As such, the "historic relationships" between home prices and other factors will also change somewhat. To do otherwise would necessarily impose some arbitrary judgment of what constitutes a period of normalcy in terms of house price valuations.

METHODOLOGY APPENDIX

The Model

The Model

Dependent Variable: Price-to-Income$_{MSA}$	R-squared	0.737
Method: Pooled Least Squares	Adjusted R-squared	0.734
Date: 11/30/07 Time: 13:50	S.E. of regression	0.288
Sample (adjusted): 1985Q1 2007Q3	Sum squared resid	2399
Included observations: 91 after adjustments	Log likelihood	-4895
Cross-sections included: 330	Durbin-Watson stat	0.15
Total pool (unbalanced) observations: 29361		

Variable	Coef.	Variable	Coef.	Variable	Coef.	Variable	Coef.	Variable	Coef.
HH Density$_{MSA}$	2.73	Chico, CA	1.27	Hickory, NC	-0.02	Monroe, LA	-0.05	San Diego, CA	-1.12
Interest Rate	-4.97	Cincinnati, OH-KY-IN	-0.27	Holland, MI	-0.18	Monroe, MI	-0.01	San Francisco, CA	-0.03
Relative Income$_{MSA}$	0.74	Cleveland, OH	-0.95	Honolulu, HI	0.86	Montgomery, AL	-0.06	San Jose, CA	0.84
Abilene, TX	-0.29	College Station-Bryan, TX	0.54	Houma, LA	-0.07	Mount Vernon, WA	0.95	San Luis Obispo, CA	2.19
Akron, OH	-0.56	Colorado Springs, CO	0.47	Houston, TX	-0.86	Muskegon, MI	-0.18	Sandusky, OH	-0.15
Albany, GA	0.03	Columbia, MO	0.19	Huntington, WV-KY-OH	-0.04	Myrtle Beach, SC	0.46	Santa Ana-Anaheim, CA	-1.86
Albany, NY	0.14	Columbia, SC	-0.05	Huntsville, AL	-0.02	Napa, CA	1.13	Santa Barbara, CA	1.72
Albuquerque, NM	0.64	Columbus, GA-AL	-0.01	Idaho Falls, ID	0.17	Naples, FL	0.09	Santa Cruz, CA	1.66
Alexandria, LA	-0.18	Columbus, IN	-0.12	Indianapolis, IN	-0.18	Nashville, TN	0.10	Santa Fe, NM	1.02
Allentown, PA-NJ	0.08	Columbus, OH	-0.09	Iowa City, IA	0.35	Nassau-Suffolk, NY	-1.82	Santa Rosa, CA	1.43
Amarillo, TX	-0.11	Corpus Christi, TX	-0.27	Ithaca, NY	0.34	New Haven, CT	-0.76	Sarasota, FL	-0.24
Ames, IA	0.25	Corvallis, OR	0.80	Jackson, MI	-0.09	New Orleans, LA	-0.23	Savannah, GA	-0.13
Anchorage, AK	0.24	Dallas, TX	-0.72	Jackson, MS	-0.03	New York-White Plains, NY-NJ	-5.69	Scranton, PA	-0.03
Anderson, IN	-0.23	Dalton, GA	-0.10	Jacksonville, FL	-0.18	Newark, NJ-PA	-0.36	Seattle, WA	0.23
Anderson, SC	-0.02	Davenport-Moline, IA-IL	-0.21	Janesville, WI	-0.02	Niles-Benton Harbor, MI	-0.07	Sheboygan, WI	-0.08
Ann Arbor, MI	-0.12	Dayton, OH	-0.30	Jefferson City, MO	0.06	Norwich-New London, CT	0.17	Sherman, TX	-0.04
Appleton, WI	-0.05	Decatur, AL	-0.01	Joplin, MO	0.03	Oakland, CA	-0.17	Shreveport, LA	-0.11
Asheville, NC	0.35	Decatur, IL	-0.37	Kalamazoo, MI	-0.09	Ocala, FL	0.24	Sioux Falls, SD	-0.09
Athens, GA	0.52	Deltona-Daytona Beach, FL	0.24	Kankakee, IL	0.12	Ocean City, NJ	0.35	South Bend, IN-MI	-0.26
Atlanta, GA	-0.18	Denver, CO	0.04	Kansas City, MO-KS	-0.18	Odessa, TX	-0.40	Spartanburg, SC	-0.12
Atlantic City, NJ	-0.07	Des Moines, IA	-0.19	Kennewick, WA	0.35	Ogden, UT	0.26	Spokane, WA	0.48
Auburn, AL	0.41	Detroit, MI	-3.52	Killeen, TX	-0.12	Oklahoma City, OK	-0.17	Springfield, IL	-0.09
Augusta, GA-SC	0.02	Dover, DE	0.43	Kingsport-Bristol, TN-VA	0.16	Olympia, WA	0.49	Springfield, MA	-0.76
Austin, TX	0.06	Dubuque, IA	-0.05	Kingston, NY	0.57	Omaha, NE-IA	-0.25	Springfield, MO	0.30
Bakersfield, CA	0.50	Duluth, MN-WI	0.06	Knoxville, TN	-0.01	Orlando, FL	0.02	Springfield, OH	-0.21
Baltimore, MD	-0.53	Durham, NC	0.28	Kokomo, IN	-0.20	Oshkosh, WI	-0.22	St Cloud, MN	0.22
Bangor, ME	0.29	Eau Claire, WI	0.15	La Crosse, WI-MN	0.07	Owensboro, KY	0.00	St George, UT	1.24
Barnstable, MA	0.41	Edison, NJ	-0.70	Lafayette, IN	0.33	Oxnard-Ventura, CA	0.97	St Joseph, MO-KS	-0.01
Baton Rouge, LA	-0.03	El Paso, TX	-0.39	Lafayette, LA	-0.12	Palm Bay-Melbourne, FL	0.05	St Louis, MO-IL	-0.33
Battle Creek, MI	-0.20	Elkhart, IN	-0.29	Lake Charles, LA	-0.08	Panama City, FL	0.19	State College, PA	0.37
Bay City, MI	-0.25	Erie, PA	-0.21	Lake-Kenosha, IL-WI	-1.01	Parkersburg, WV-OH	0.02	Stockton, CA	0.80
Beaumont, TX	-0.37	Essex County, MA	-0.52	Lakeland, FL	-0.06	Pensacola, FL	0.13	Syracuse, NY	-0.12
Bellingham, WA	1.25	Eugene, OR	0.91	Lancaster, PA	-0.05	Peoria, IL	-0.19	Tacoma, WA	0.45
Bend, OR	0.84	Evansville, IN-KY	-0.14	Lansing, MI	-0.04	Philadelphia, PA	-1.61	Tallahassee, FL	0.33
Bethesda, MD	-0.60	Fairbanks, AK	0.35	Las Cruces, NM	0.39	Phoenix, AZ	0.30	Tampa-St Petersburg, FL	-0.72
Billings, MT	0.31	Fargo, ND-MN	0.23	Las Vegas, NV	0.60	Pittsburgh, PA	-0.54	Toledo, OH	-0.34
Binghamton, NY	0.01	Farmington, NM	0.23	Lawrence, KS	0.51	Pittsfield, MA	0.46	Topeka, KS	-0.01
Birmingham, AL	-0.13	Fayetteville, AR-MO	0.30	Lebanon, PA	0.01	Port St Lucie-Fort Pierce, FL	0.15	Trenton, NJ	-1.38
Bismarck ND	0.20	Fayetteville, NC	-0.24	Lewiston, ME	0.27	Portland, ME	0.40	Tucson, AZ	0.62
Blacksburg, VA	0.55	Flagstaff, AZ	0.84	Lexington, KY	-0.01	Portland, OR-WA	0.50	Tulsa, OK	-0.22
Bloomington, IN	0.43	Flint, MI	-0.70	Lima, OH	-0.17	Poughkeepsie-Newburgh, NY	0.36	Tyler, TX	-0.20
Bloomington-Normal, IL	0.11	Florence, SC	-0.16	Lincoln, NE	0.04	Prescott, AZ	1.36	Utica, NY	0.13
Boise City, ID	0.34	Fond du Lac, WI	-0.02	Little Rock, AR	-0.09	Providence-New Bedford, RI-MA	-0.10	Vallejo, CA	0.72
Boston-Quincy, MA	-5.85	Fort Collins, CO	0.81	Logan, UT-ID	0.69	Provo, UT	0.89	Vero Beach, FL	-0.34
Boulder, CO	0.45	Fort Lauderdale, FL	-1.03	Longview, TX	-0.18	Pueblo, CO	0.45	Vineland, NJ	-0.03
Bowling Green, KY	0.20	Fort Smith, AR-OK	0.03	Longview, WA	0.79	Punta Gorda, FL	0.55	Virginia Beach-Norfolk, VA-NC	-0.10
Bremerton, WA	0.20	Fort Walton Beach, FL	0.16	Los Angeles, CA	-0.63	Racine, WI	-0.38	Visalia, CA	0.60
Bridgeport, CT	-1.23	Fort Wayne, IN	-0.25	Louisville, KY-IN	-0.16	Raleigh-Cary, NC	0.08	Waco, TX	-0.16
Brunswick, GA	0.01	Fort Worth, TX	-0.51	Lubbock, TX	-0.18	Reading, PA	-0.06	Warner Robins, GA	-0.14
Buffalo, NY	-0.59	Fresno, CA	0.55	Lynchburg, VA	0.29	Redding, CA	1.04	Warren, MI	-0.73
Burlington, NC	0.04	Gainesville, FL	0.28	Macon, GA	-0.03	Reno, NV	0.57	Washington, DC-VA-MD-WV	-0.28
Burlington, VT	0.40	Gainesville, GA	0.07	Madera, CA	1.12	Richmond, VA	0.05	Waterloo, IA	-0.15
Cambridge-Framingham, MA	-6.50	Gary, IN	-0.10	Madison, WI	0.27	Riverside-San Bernardino, CA	0.66	Wausau, WI	0.08
Camden, NJ	-0.50	Grand Junction, CO	0.64	Manchester-Nashua, NH	-0.08	Roanoke, VA	0.24	Wenatchee, WA	1.01
Canton, OH	-0.17	Grand Rapids, MI	-0.13	Mansfield, OH	-0.03	Rochester, MN	-0.05	West Palm Beach, FL	-0.69
Cape Coral-Fort Meyers, FL	-0.09	Greeley, CO	0.78	McAllen, TX	-0.33	Rochester, NY	-0.27	Wichita Falls, TX	-0.34
Carson City, NV	0.26	Green Bay, WI	0.11	Medford, OR	0.98	Rockford, IL	-0.20	Wichita, KS	-0.24
Casper, WY	-0.24	Greensboro-High Point, NC	-0.04	Memphis, TN-MS-AR	-0.28	Rockingham-Strafford, NH	0.11	Wilmington, DE-MD-NJ	-0.25
Cedar Rapids, IA	-0.06	Greenville, NC	0.05	Merced, CA	0.83	Rocky Mount, NC	0.02	Wilmington, NC	0.62
Champaign, IL	0.14	Greenville, SC	-0.03	Miami, FL	-0.51	Rome, GA	-0.08	Winston-Salem, NC	-0.08
Charleston, SC	0.13	Gulfport-Biloxi, MS	0.06	Michigan City, IN	0.06	Sacramento, CA	0.82	Worcester, MA	0.15
Charleston, WV	-0.10	Hagerstown, MD-WV	0.51	Midland, TX	-0.64	Saginaw, MI	-0.21	Yakima, WA	0.36
Charlotte, NC-SC	-0.19	Hanford, CA	0.51	Milwaukee, WI	-0.77	Salem, OR	0.53	York, PA	-0.02
Charlottesville, VA	0.54	Harrisburg, PA	-0.07	Minneapolis-St Paul, MN-WI	-0.36	Salinas, CA	1.34	Youngstown, OH-PA	-0.27
Chattanooga, TN-GA	-0.07	Harrisonburg, VA	0.55	Missoula, MT	0.94	Salt Lake City, UT	0.45	Yuba City, CA	0.86
Cheyenne, WY	0.21	Hartford, CT	-0.35	Mobile, AL	-0.05	San Angelo, TX	-0.15		
Chicago, IL	-1.21	Hattiesburg, MS	0.13	Modesto, CA	0.78	San Antonio, TX	-0.29		