

House Prices in America

Methodology Update

**A Global Insight/National City Corporation
Joint Venture**

June 2006

Summary

- This study employs a statistical technique — pooled time series regression analysis — to evaluate single family house prices in 317 metro areas. These 317 areas collectively account for 84 percent of the single family housing market, as of the first quarter of 2006.
 - For the period from Q1/1985 to Q1/2006, 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 77 percent of the variation in house price-to-income ratios over time and across the 317 metro areas. Explanatory variables are statistically significant with high levels of confidence.
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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 Q1/2006 — 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 317 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 -3.1 to +3.2 and reflect a variety of difficult to quantify, but nonetheless important, factors that influence prices. Such 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 2.3, meaning that house prices there should be 2.3 times income levels, abstracting from the influence of all other factors. Presumably, their famously pleasant climate, sunshine and beaches influence 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 78 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 sixty-six actual metro area price corrections — which are defined as a decline of at least 10 percent over a period of at least 8 quarters — over the 1985 to Q1/2006 period, we found such markets, on average, to be 34 percent over-valued prior to the subsequent decline in prices. Hence, property markets over-valued by 34 percent, or more, are considered extreme.

Finally, we acknowledge that the estimates of over-, or under-valuation will vary with periodic updates, as will the percentage threshold used to identify “extremely overvalued” markets. These changes, though slight, reflect two things. First, 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.

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 the greatest degree possible. In some instances, especially for the most current periods, however, estimates are prepared by Global Insight. All data may be obtained from Global Insight by contacting Jeannine Cataldi at 610-490-2650.

The Model

Dependent Variable: Price-to-Income _{MSA}	R-squared	0.778	Mean dependent var	1.634
Method: Pooled Least Squares	Adjusted R-squared	0.775	S.D. dependent var	0.506
Date: 06/06/06 Time: 08:25	S.E. of regression	0.24	Akaike info criterion	-0.01
Sample: 1985Q1 2006Q1	Sum squared resid	1495	Schwarz criterion	0.093
Cross-sections included: 317	Log likelihood	403.6	F-statistic	285.4
Total pool (unbalanced) observations: 26326	Durbin-Watson stat	0.046	Prob(F-statistic)	0

Variable	Coef.	t-Stat.	Variable	Coef.	t-Stat.	Variable	Coef.	t-Stat.	Variable	Coef.	t-Stat.	Variable	Coef.	t-Stat.
HH Density _{MSA}	1.934	20.1	Charleston, SC	1.307	29.4	Hickory, NC	1.177	26.9	Monroe, LA	1.115	26.7	Saginaw, MI	1.001	22.2
Interest Rate	-3.624	-24.8	Charlottesville, VA	1.714	35.9	Holland, MI	1.124	21.8	Monroe, MI	1.229	25.3	San Jose, CA	2.247	32.3
Relative Income _{MSA}	0.425	10.7	Charleston, WV	1.077	24.9	Honolulu, HI	2.329	31.8	Montgomery, AL	1.154	25.3	Salem, OR	1.652	37.2
Abilene, TX	0.886	20.5	Cincinnati, OH-KY-IN	1.039	20.3	Houma, LA	1.102	26.2	Mount Vernon, WA	2.068	45.5	Salinas, CA	2.465	44.0
Akron, OH	0.830	15.0	Cleveland, OH	0.567	8.8	Houston, TX	0.548	9.9	Muskegon, MI	1.038	23.6	Salt Lake City, UT	1.628	33.3
Albuquerque, NM	1.764	39.8	Columbus, IN	1.110	23.2	Huntsville, AL	1.215	25.8	Myrtle Beach, SC	1.597	38.1	San Luis Obispo, CA	3.231	70.9
Alexandria, LA	0.988	23.1	College Station-Bryan, TX	1.699	44.6	Idaho Falls, ID	1.319	29.1	Napa, CA	2.310	41.6	Sandusky, OH	1.117	22.9
Albany, GA	1.188	28.5	Colorado Springs, CO	1.680	35.5	Indianapolis, IN	1.113	21.9	Naples, FL	1.356	23.9	San Angelo, TX	1.015	23.5
Allentown, PA-NJ	1.369	26.5	Columbus, GA-AL	1.195	27.2	Iowa City, IA	1.549	34.2	Nashville, TN	1.352	28.0	San Antonio, TX	0.964	20.7
Albany, NY	1.393	28.4	Columbia, MO	1.401	31.7	Ithaca, NY	1.546	34.3	New Haven, CT	0.878	12.0	Sarasota, FL	1.052	20.3
Amarillo, TX	1.058	24.5	Columbus, OH	1.200	24.0	Jackson, MI	1.112	24.6	New Orleans, LA	1.022	21.3	Santa Rosa, CA	2.599	48.7
Anchorage, AK	1.458	25.8	Corpus Christi, TX	0.951	21.3	Jackson, MS	1.153	25.9	Niles-Benton Harbor, MI	1.134	25.2	Savannah, GA	1.088	23.5
Anderson, IN	0.987	22.1	Corvallis, OR	1.982	42.7	Janesville, WI	1.151	25.2	Norwich-New London, CT	1.521	28.2	Scranton, PA	1.173	26.0
Ann Arbor, MI	1.234	22.0	Columbia, SC	1.156	25.3	Jefferson City, MO	1.242	28.1	Edison, NJ	0.898	12.5	Seattle, WA	1.573	27.2
Anderson, SC	1.180	27.3	Dallas, TX	0.723	12.6	Joplin, MO	1.194	28.6	Nassau-Suffolk, NY	0.098	1.0	Tacoma, WA	1.662	34.4
Appleton, WI	1.169	24.2	Fort Worth, TX	0.848	16.7	Jacksonville, FL	1.060	21.8	Newark, NJ-PA	1.202	17.3	Oakland, CA	1.439	18.1
Asheville, NC	1.501	35.3	Dalton, GA	1.097	24.9	Kalamazoo, MI	1.137	24.3	New York-White Plains, NY-NJ	-2.455	-9.8	San Francisco, CA	1.763	19.3
Atlantic City, NJ	1.182	21.8	Davenport-Moline, IA-IL	0.983	21.7	Kankakee, IL	1.297	28.5	Ocala, FL	1.356	33.2	Sheboygan, WI	1.133	23.7
Athens, GA	1.714	41.6	Dayton, OH	1.006	20.0	Kansas City, MO-KS	1.079	21.9	Ocean City, NJ	1.586	31.2	Sherman, TX	1.139	27.3
Atlanta, GA	1.186	22.2	Decatur, AL	1.173	26.9	Kennewick, WA	1.493	32.8	Odessa, TX	0.759	18.3	Shreveport, LA	1.079	24.8
Augusta, GA-SC	1.216	27.5	Detroit, MI	-1.369	-10.3	Killeen, TX	1.110	24.8	Ogden, UT	1.488	31.0	Sioux Falls, SD	1.125	23.7
Austin, TX	1.347	28.1	Decatur, IL	0.841	18.5	Kingston, NY	1.747	38.1	Oklahoma City, OK	1.049	23.5	South Bend, IN-MI	0.972	20.8
Bakersfield, CA	1.568	34.7	Deltona-Daytona Beach, FL	1.410	32.2	Knoxville, TN	1.211	26.6	Olympia, WA	1.672	35.6	Spartanburg, SC	1.117	25.0
Baltimore, MD	0.921	14.7	Denver, CO	1.360	25.4	Kokomo, IN	1.005	21.8	Omaha, NE-IA	1.004	20.4	Springfield, IL	1.119	24.1
Barnstable, MA	1.787	32.5	Des Moines, IA	1.044	21.3	La Crosse, WI-MN	1.217	27.4	Orlando, FL	1.250	26.0	Springfield, MA	0.859	11.9
Baton Rouge, LA	1.163	25.9	Warren, MI	0.738	11.9	Lafayette, LA	1.105	24.7	Oshkosh, WI	1.031	21.4	Springfield, MO	1.463	35.1
Battle Creek, MI	0.991	22.3	Dover, DE	1.597	35.4	Lafayette, IN	1.523	35.2	Owensboro, KY	1.162	27.3	Springfield, OH	1.027	22.3
Bay City, MI	0.957	21.3	Dubuque, IA	1.140	24.8	Lakeland, FL	1.100	25.5	Oxnard-Ventura, CA	2.231	37.8	Spokane, WA	1.635	37.3
Beaumont, TX	0.828	18.9	Duluth, MN-WI	1.163	27.6	Los Angeles, CA	1.042	11.4	Palm Bay-Melbourne, FL	1.266	26.7	St. Cloud, MN	1.382	30.5
Bellingham, WA	2.315	54.1	Durham, NC	1.526	31.9	Lancaster, PA	1.240	24.1	Panama City, FL	1.339	31.3	St. George, UT	2.293	55.3
Bend, OR	1.898	42.8	Eau Claire, WI	1.256	29.4	Lansing, MI	1.191	25.5	Pensacola, FL	1.289	29.6	St. Joseph, MO-KS	1.145	27.4
Billings, MT	1.446	33.1	Elkhart, IN	0.972	20.0	Santa Ana-Anaheim, CA	0.225	1.8	Peoria, IL	1.010	22.0	St. Louis, MO-IL	0.952	18.9
Binghamton, NY	1.202	27.1	El Paso, TX	0.916	19.7	Las Cruces, NM	1.469	36.7	Camden, NJ	0.950	15.9	Stockton, CA	1.925	39.8
Birmingham, AL	1.087	23.5	Erie, PA	1.003	21.9	Las Vegas, NV	1.772	36.7	Phoenix, AZ	1.451	30.5	Syracuse, NY	1.116	23.7
Bismarck ND	1.294	29.4	Eugene, OR	1.966	46.6	Lawrence, KS	1.736	40.9	Philadelphia, PA	0.122	1.5	Tallahassee, FL	1.456	34.0
Blacksburg, VA	1.671	42.1	Evansville, IN-KY	1.045	23.4	Lebanon, PA	1.261	26.6	Wilmington, DE-MD-NJ	1.109	19.6	Tampa-St. Petersburg, FL	0.672	11.6
Bloomington-Normal, IL	1.312	27.8	Fairbanks, AK	1.548	30.9	Lexington, KY	1.228	25.8	Pittsfield, MA	1.731	36.8	Toledo, OH	0.929	19.0
Bloomington, IN	1.589	38.8	Fargo, ND-MN	1.354	30.4	Lima, OH	1.023	22.7	Pittsburgh, PA	0.764	15.2	Topeka, KS	1.158	26.2
Boston-Quincy, MA	-2.687	-11.3	Farmington, NM	1.315	32.0	Lincoln, NE	1.255	27.4	Portland, ME	1.622	34.1	Trenton, NJ	0.336	4.2
Cambridge-Framingham, MA	-3.104	-11.9	Fayetteville, AR-MO	1.433	34.2	Little Rock, AR	1.109	24.7	Portland, OR-WA	1.662	33.6	Tucson, AZ	1.693	40.4
Essex County, MA	1.156	15.5	Flagstaff, AZ	1.884	42.8	Logan, UT-ID	1.824	42.1	Port St. Lucie-Fort Pierce, FL	1.352	28.4	Tulsa, OK	0.997	21.6
Boise City, ID	1.467	31.7	Flint, MI	0.642	12.2	Longview, TX	1.002	23.3	Poughkeepsie-Newburgh, NY	1.637	30.6	Tyler, TX	1.036	22.7
Rockingham-Strafford, NH	1.438	26.7	Florence, SC	1.012	23.7	Louisville, KY-IN	1.076	22.8	Prescott, AZ	2.331	59.3	Utica, NY	1.301	30.4
Boulder, CO	1.816	33.6	Fond du Lac, WI	1.165	24.8	Longview, WA	1.863	44.1	Provo, UT	1.990	45.1	Vallejo, CA	1.927	36.7
Bowling Green, KY	1.378	32.3	Fresno, CA	1.631	35.4	Lubbock, TX	1.010	23.5	Providence-New Bedford, RI-MA	1.329	22.1	Vero Beach, FL	0.934	17.9
Bremerton, WA	1.484	28.7	Fort Collins, CO	1.990	43.4	Lynchburg, VA	1.462	33.7	Pueblo, CO	1.549	38.5	Vineland, NJ	1.176	24.6
Bridgeport, CT	0.659	7.3	Fort Smith, AR-OK	1.161	28.8	Macon, GA	1.160	26.3	Punta Gorda, FL	1.688	39.9	Virginia Beach-Norfolk, VA-NC	1.215	23.5
Brunswick, CA	1.171	27.1	Fort Wayne, IN	0.992	20.7	Madera, CA	2.099	48.2	Racine, WI	0.918	17.5	Visalia, CA	1.655	37.6
Buffalo, NY	0.795	14.6	Fort Walton Beach, FL	1.330	28.7	Madison, WI	1.467	29.9	Raleigh-Cary, NC	1.389	26.9	Bethesda, MD	0.951	12.9
Burlington, NC	1.278	28.3	Gainesville, FL	1.423	33.4	Manchester-Nashua, NH	1.279	23.2	Reading, PA	1.203	23.9	Waco, TX	1.048	24.5
Burlington, VT	1.607	33.2	Gainesville, GA	1.338	28.5	Mansfield, OH	1.154	26.2	Redding, CA	2.075	48.4	Warner Robins, GA	1.118	24.5
Canton, OH	1.079	22.9	Green Bay, WI	1.299	27.9	McAllen, TX	0.857	21.2	Reno, NV	1.764	34.1	Waterloo, IA	1.006	23.2
Cape Coral-Fort Meyers, FL	1.201	24.2	Greeley, CO	1.924	44.7	Medford, OR	2.008	47.5	Richmond, VA	1.277	25.7	Wausau, WI	1.243	27.3
Carson City, NV	1.527	29.3	Greensboro-High Point, NC	1.212	25.8	Memphis, TN-MS-AR	0.973	20.2	Riverside-San Bernardino, CA	1.801	36.6	Washington, DC-VA-MD-WV	1.227	18.9
Casper, WY	0.932	19.4	Grand Junction, CO	1.725	41.7	Merced, CA	1.823	41.0	Roanoke, VA	1.425	31.9	Wenatchee, WA	2.080	48.2
Cedar Rapids, IA	1.131	24.3	Greenville, NC	1.226	28.7	Michigan City, IN	1.234	27.8	Rockford, IL	1.049	21.7	Wichita, KS	0.981	20.9
Champaign, IL	1.318	30.2	Grand Rapids, MI	1.114	23.0	Midland, TX	0.666	12.5	Rochester, MN	1.175	23.9	Wichita Falls, TX	0.855	19.1
Charlotte, NC-SC	1.125	22.0	Greenville, SC	1.187	26.3	Fort Lauderdale, FL	0.499	7.2	Rocky Mount, NC	1.200	28.1	Wilmington, NC	1.736	41.6
Chattanooga, TN-GA	1.131	25.3	Gulfport-Biloxi, MS	1.211	28.4	Milwaukee, WI	0.701	11.1	Rochester, NY	1.032	20.4	Winston-Salem, NC	1.170	24.4
Chicago, IL	0.461	5.9	Hanford, CA	1.605	35.4	Miami, FL	0.886	14.7	Santa Barbara, CA	2.891	53.0	Worcester, MA	1.508	28.5
Cheyenne, WY	1.367	30.0	Harrisonburg, VA	1.709	39.1	Minneapolis-St. Paul, MN-WI	0.995	17.6	Sacramento, CA	2.016	39.9	Yakima, WA	1.495	33.9
Gary, IN	1.138	23.9	Harrisburg, PA	1.180	23.9	West Palm Beach, FL	0.737	12.1	Santa Cruz, CA	2.943	51.1	York, PA	1.237	25.0
Chico, CA	2.300	56.5	Hartford, CT	1.141	18.4	Mobile, AL	1.140	26.6	San Diego, CA	0.725	7.2	Youngstown, OH-PA	0.968	21.2
Lake-Kenosha, IL-WI	0.583	8.0	Hattiesburg, MS	1.261	31.4	Modesto, CA	1.889	40.4	Santa Fe, NM	2.142	45.5	Yuba City, CA	1.935	43.8