Unraveling Housing Price Inflation

Extreme housing price run-ups were a highly localized phenomenon.

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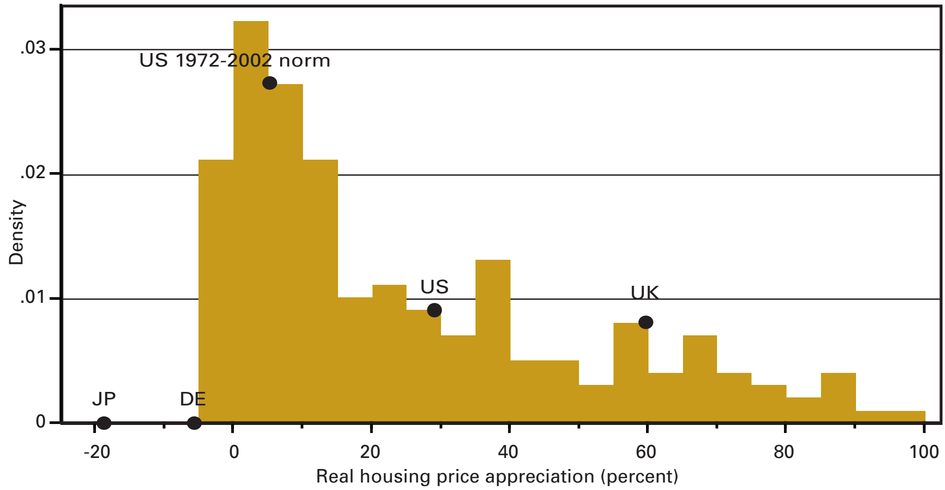
FROM 2002 TO 2006, real housing prices reportedly soared around the world. However, little attention has been given to the fact that in many countries, and some parts of the United States, there was no notable increase. Prominent examples include Japan and Germany, along with U.S. Metropolitan Statistical Areas (MSAs) such as Houston, Dallas, and Detroit. Figure 1 displays the distribution of four-year (total) real home price appreciation rates for the 200 largest U.S. MSAs (which account for roughly 75 percent of the U.S. population) for the period 2002 to 2006. As reference points we also note the real appreciation rates for the U.S. market as a whole, United Kingdom (2001 to 2005), Japan, and Germany, as

Figure 1: The 200 largest U.S. MSAs' real housing price appreciation rates from 2002 to 2006



well as the average four-year real appreciation rate for the U.S. market from 1972 to 2002. It is noteworthy that approximately a tenth of these MSAs experienced negative appreciation rates, as did Japan and Germany (then the world's second and third largest economies). A third of MSAs had four-year real appreciation rates of 0 percent to 10 percent, while only one quarter percent had appreciation rates in excess of 40 percent. Hence, a home price increase was clearly not a global or U.S. state of affairs. Rather, there were numerous localized excesses.

SUPPLY AND DEMAND

Can these disparate price changes be explained by supply-demand fundamentals? To answer this question, we adjust for improved housing quality, since housing quality in the United States (and other developed nations) has continuously improved. Although the Office of Federal Housing Enterprise Oversight (OFHEO) housing price index is constructed on the transaction prices for the same houses at different times, it is not a true constant-quality price index, as renovations and extensions occur, while the lowest-quality homes disappear over time. The American Housing Survey (AHS) contains extensive information on structural characteristics, unit size, occupant characteristics, mortgage financing, and neighborhood conditions of housing stock in the United States. Using estimated hedonic price equations for 1985 to 2005, we created a constant-quality housing unit utilizing the median housing quality attributes in 2005.

A reduced form real housing price regression was estimated from the first quarter of 1970 to the fourth quarter of 2002, reflecting the historical impacts of changes in supply and demand variables, including: the annual user cost of housing (reflects annual interest costs, maintenance, property taxes, and expected appreciation); household formation; employment; real income and real wealth; the unemployment rate; household age composition and family size; the short-term interest rate; and movements in local construction costs. Table I summarizes the variables used in this analysis.

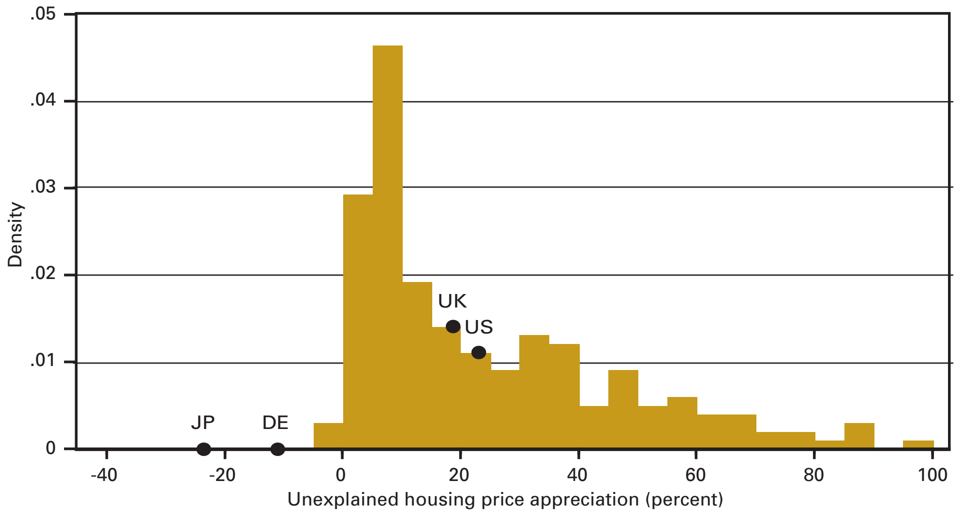
We forecast expected real housing price appreciation based upon the local regression for the first quarter of 2003 to the fourth quarter of 2006. This method is applied to the aggregate United States, individually to each of the 200 largest U.S. MSAs, the United Kingdom, Japan, and Germany. By comparing these expected appreciation rates with the actual appreciation rates, we calculate an "unexplained appreciation rate." We also calculate the implied expected annual home price appreciation rate, which is consistent with the actual housing price appreciation patterns.

Figure 2 displays the distribution of unexplained real appreciation rates for

Table I: Deterioration of lending standards, 2002 to 2006

Independent variables Demand side:	Description
User cost	$UC = (1 - t_{inc}) \cdot (t_p + m + \pi) + \delta + \gamma - g$ where t_{inc} is the income tax rate, measured by the ratio of "tax and other transfers" to "total personal income" released by the Bureau of Economic Analysis (BEA); t_p is the property tax rate, which is assumed at 2 percent; m is real mortgage interest rate; π is inflation; $m+\pi$ is measured by the traditional thirty-year mortgage rate from Freddie Mac; δ is maintenance, which is assumed at 2.5 percent; γ is risk premium of homeownership, which is assumed at 4 percent; g is the expected housing price appreciation, which is measured as the average housing price appreciation rate of the past eight quarters.
Household	Total households in the area measured in logarithm.
Employment	Total employment in the area measured in logarithm.
Income	Disposable income per capita in logarithm.
Wealth	Net worth per capita in logarithm.
Unemployment rate	Unemployment rate in the area.
Age composition	Percentage of population between ages forty and sixty-four.
Family size	Percentage of households with three or more people.
Supply side:	
Short-term interest rate	Three-month LIBOR rate in logarithm.
Construction costs	Construction cost index released by the Means Company.

Figure 2: Distribution of unexplained housing price appreciation rate for the 200 largest U.S. MSAs



2002 to 2006 for the 200 largest U.S. MSAs, as well as for the aggregate of U.S., United Kingdom, Japan, and Germany. Most unexplained appreciation rates are positive; that is, most MSAs demonstrated more appreciation than was generated by housing supply-demand considerations. Only three MSAs (Killeen-Temple-Fort Hood, Texas; Clarksville, Tenn.-Ky.; and Fayetteville, N.C.) revealed negative unexplained appreciation, while 109 MSAs had unexplained appreciation of 0 percent to 20 percent over the four-year period. But only twenty-eight MSAs (which represent roughly 16 percent of the U.S. population; five of the MSAs are among the Case-Shiller 20 MSAs) had unexplained appreciation rates greater than 50 percent. That is, most MSAs were within relatively reasonable bounds of supply-demand fundamentals, with only about 14 percent seemingly "going completely crazy."

Of the four countries we studied, two large economies had very negative unexplained appreciation rates, signifying that the irrational housing price appreciation was not an international phenomenon. Instead, frenetic housing price run-up was a highly localized phenomenon with huge variance.

Similarly, the post-2006 price declines were also very local and are negatively correlated with the extent of previous run-ups: the correlation of the appreciation rates in 2002 to 2006 and those in 2007 to 2009 is -0.69. The correlation between unexplained appreciation in 2002 to 2006 and the subsequent price appreciation is -0.80.

IMPLIED APPRECIATION RATES

A comparison of the distribution of the 200 largest U.S. MSAs' actual appreciation rates and implied appreciation rates reveals that actual appreciation rates were generally notably lower than implied rates. As a reference, the implied appreciation rates for the U.S. market as a whole, United Kingdom, Japan, and Germany, and the average actual four-year appreciation rate for the U.S. market from 1972 to 2002 are also shown (Figure 3). For some California and Florida MSAs, such as Los Angeles, Riverside, Miami, and Palm Bay, the implied appreciation rates were a staggering 150 percent higher than actual, a rate that is hard to view as "rational." Table II displays selected percentiles of the differences between implied appreciation rates and actual appreciation rates. Approximately 44 percent of the MSAs had differences under 20 percent, while only 28 percent of MSAs had differences greater than 65 percent, echoing the fact that housing price patterns are highly localized, and residents of only a minority of MSAs held unrealistic expectations of housing price appreciation. Roughly 70 percent of U.S. MSAs appear to have been relatively grounded in their behavior. Twelve of the 20 MSAs in the Case-Shiller index had differences under 65 percent, while six of them had differences greater than 100 percent. Table III displays the

Figure 3: Distribution of implied housing price appreciation rate for the 200 largest U.S. MSAs

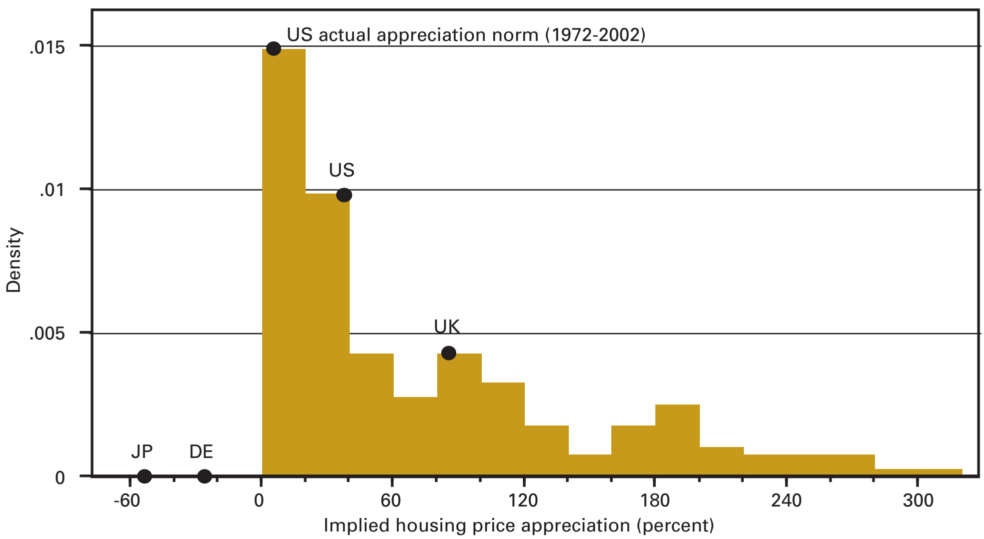


Table II: Selected percentiles of the differences between implied appreciation rates and actual appreciation rates, 2002 to 2006

10th percentile	25th percentile	median	75th percentile	90th percentile
9.6	14.2	26.3	69.5	124.5

population and difference between implied and actual appreciation rates for the Case-Shiller MSAs.

An interesting finding is that the two-year moving average of home price appreciation seems to approximate the implied appreciation used in the "craziest" outliers. The absolute differences between annual implied appreciation rates and the two-year moving averages of actual appreciation rates over 2002 to 2006 for each MSA for the 200 MSAs are exhibited in Table IV. The five- and ten-year moving averages were also analyzed, with both the mean and standard deviation for the difference between implied appreciation and two-year moving average smallest among the three cases, suggesting that the two-year moving average approximates the appreciation rate people used. Of course, it does not explain why people used this time profile to estimate perpetuity appre-

Table III: Population and the differences between implied and actual appreciation rates for Case-Shiller MSAs

Case-Shiller MSA	% of U.S. population	Difference between implied and actual appreciation rates
Georgia-Atlanta	1.5	14.9
Mass.-Boston	1.6	62.6
N.C.-Charlotte	0.5	10.9
Ill.-Chicago	3.2	58.9
Ohio-Cleveland	0.8	9.1
Texas-Dallas	1.8	7.8
Colo.-Denver	0.8	12.2
Mich.-Detroit	1.6	12.0
Nev.-Las Vegas	0.5	101.8
Calif.-Los Angeles	4.4	191.6
Fla.-Miami	1.8	164.3
Minn.-Minneapolis	1.1	48.4
N.Y.-New York	6.5	97.8
Ariz.-Phoenix	1.2	82.2
Oregon-Portland	0.7	56.1
Calif.-San Diego	1.0	139.8
Calif.-San Francisco	1.5	64.9
Wash.-Seattle	1.1	47.4
Fla.-Tampa	0.9	111.9
D.C.-Washington	1.7	122.7

Table IV: Statistics of the absolute differences between implied appreciation rates and different lengths of moving averages of actual appreciation rates, 2002 to 2006

	Mean	Standard deviation
Absolute difference between implied appreciation and two-year MA of actual appreciation	8.1	7.3
Absolute difference between implied appreciation and five-year MA of actual appreciation	8.4	8.5
Absolute difference between implied appreciation and 10-year MA of actual appreciation	10.2	10.3

Table V: Changes in new residents per new home, population, and real housing prices

MSA	Control period (1988-2002)		
	New residents per new home	Annual housing price appreciation rate (%)	Annual population growth rate (%)
Atlanta-Sandy Springs-Marietta, GA	2.5	1.3	3.1
Austin-Round Rock, TX	3.9	0.8	3.5
Baltimore-Towson, MD	1.5	1.2	0.8
Birmingham-Hoover, AL	1.7	1.2	0.8
Boston-Cambridge-Quincy, MA-NH	2.7	1.1	0.5
Charlotte-Gastonia-Concord, NC-SC	1.8	1.1	2.5
Chicago-Naperville-Joliet, IL-IN-WI	2.1	2.5	0.9
Cincinnati-Middletown, OH-KY-IN	1.4	1.5	0.8
Cleveland-Elyria-Mentor, OH	0.3	1.9	0.1
Columbus, OH	1.7	1.6	1.4
Dallas-Fort Worth-Arlington, TX	3.2	-0.8	2.4
Denver-Aurora, CO	2.7	2.9	2.2
Detroit-Warren-Livonia, MI	0.9	3.3	0.4
Houston-Sugar Land-Baytown, TX	3.5	1.1	2.1
Indianapolis-Carmel, IN	1.7	1.1	1.5
Jacksonville, FL	2.1	1.0	2.0
Kansas City, MO-KS	1.7	1.0	1.1
Las Vegas-Paradise, NV	2.3	0.7	6.2
Los Angeles-Long Beach-Santa Ana, CA	4.2	1.8	1.1
Louisville-Jefferson County, KY-IN	1.4	2.1	0.8
Memphis, TN-MS-AR	1.5	0.2	1.1
Miami-Fort Lauderdale-Pompano Beach, FL	3.9	2.3	2.1
Milwaukee-Waukesha-West Allis, WI	1.2	2.5	0.6
Minneapolis-St. Paul-Bloomington, MN-WI	2.2	2.2	1.6
Nashville-Davidson-Murfreesboro-Franklin, TN	2.3	0.9	2.0
New York-Northern New Jersey-Long Island, NY-NJ-PA	3.2	0.6	0.6
Oklahoma City, OK	2.3	-0.1	1.0
Orlando-Kissimmee, FL	2.3	0.6	3.3
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	1.3	0.8	0.4
Phoenix-Mesa-Scottsdale, AZ	2.8	0.5	3.5
Pittsburgh, PA	-1.0	1.2	-0.2
Portland-Vancouver-Beaverton, OR-WA	2.6	3.9	2.3
Richmond, VA	2.1	0.9	1.5
Riverside-San Bernardino-Ontario, CA	4.1	1.1	3.4
Sacramento--Arden-Arcade--Roseville, CA	3.0	2.6	2.5
Salt Lake City, UT	2.1	2.6	2.0
San Antonio, TX	3.6	-1.0	1.7
San Diego-Carlsbad-San Marcos, CA	3.4	2.8	1.6
San Francisco-Oakland-Fremont, CA	3.3	4.1	1.1
San Jose-Sunnyvale-Santa Clara, CA	3.2	4.5	1.1
Seattle-Tacoma-Bellevue, WA	2.2	3.6	1.9
St. Louis, MO-IL	1.0	0.9	0.4
Tampa-St. Petersburg-Clearwater, FL	2.1	1.1	1.6
Washington-Arlington-Alexandria, DC-VA-MD-WV	2.3	1.7	1.7

Source: Bureau of Economic Analysis, Federal Reserve Bank of St. Louis, and OFHEO

Study period (2002-2006)			Change in new residents per new home from control period to study period (%)	Change in annual real housing price appreciation from control period to study	Change in annual population growth from control period to study
New residents per new home	Annual housing price appreciation rate (%)	Annual population growth rate (%)			
2.0	1.0	3.0	-0.4	-0.3	-0.2
2.4	0.8	3.1	-1.5	0.0	-0.4
1.8	12.2	0.6	0.2	11.0	-0.1
1.3	2.7	0.8	-0.5	1.6	0.1
0.2	4.3	0.1	-2.6	3.2	-0.5
2.0	1.1	3.0	0.2	0.0	0.5
1.0	6.1	0.5	-1.1	3.6	-0.4
1.4	0.5	0.8	0.1	-1.0	0.0
-1.3	-0.3	-0.4	-1.6	-2.2	-0.5
1.5	0.8	1.1	-0.3	-0.8	-0.3
2.3	-0.2	2.2	-0.9	0.5	-0.2
1.8	-0.1	1.4	-1.0	-3.0	-0.8
0.1	-0.8	0.0	-0.8	-4.1	-0.3
2.2	1.0	2.5	-1.3	-0.1	0.4
1.6	-0.1	1.4	-0.1	-1.2	-0.1
1.4	10.5	2.2	-0.7	9.5	0.2
1.3	1.8	1.0	-0.4	0.8	-0.1
1.8	14.8	4.0	-0.5	14.2	-2.2
1.4	17.0	0.4	-2.8	15.2	-0.7
1.4	1.0	0.8	0.0	-1.1	0.1
1.2	0.7	1.0	-0.3	0.5	-0.1
1.6	16.3	1.0	-2.4	14.0	-1.1
0.9	4.9	0.3	-0.3	2.4	-0.2
1.3	4.6	0.9	-1.0	2.4	-0.6
2.0	2.9	2.2	-0.3	2.0	0.2
0.9	9.6	0.3	-2.3	9.0	-0.4
1.6	2.5	1.2	-0.7	2.6	0.2
1.9	13.6	3.3	-0.3	13.0	0.0
1.0	8.3	0.3	-0.2	7.5	-0.1
2.5	14.1	3.7	-0.3	13.7	0.3
-1.9	1.5	-0.5	-1.0	0.3	-0.3
1.9	8.7	1.5	-0.7	4.8	-0.9
2.0	8.1	1.5	-0.1	7.3	0.1
2.8	17.7	3.4	-1.3	16.6	0.1
1.8	12.0	1.7	-1.1	9.5	-0.8
2.1	5.4	1.8	0.0	2.8	-0.2
2.3	3.0	2.1	-1.4	4.0	0.5
0.7	11.6	0.3	-2.6	8.8	-1.3
0.0	7.8	0.0	-3.3	3.7	-1.1
1.8	7.8	0.6	-1.5	3.2	-0.5
1.4	8.3	1.1	-0.8	4.7	-0.8
1.1	3.5	0.5	0.1	2.7	0.1
1.8	12.6	2.0	-0.3	11.6	0.5
1.8	13.1	1.2	-0.5	11.4	-0.5

ciation rates in the areas where prices rose so rapidly.

UNEXPLAINED APPRECIATION

As noted above, unexplained appreciation varies substantially across both countries and MSAs. But why? We explore the following features: changes in new residents per new home built; local subprime mortgage usage; and local land use regulatory factors. While we would have preferred to incorporate these variables in the supply-demand analyses, data availability for all MSAs was limited.

The number of new residents per new home built is calculated as the ratio of population growth and total housing starts in a given period for each MSA. This ratio reflects the response of construction activity to household growth. For example, if there are always two people per household, no local housing destruction, and no seasonal local demand, there should be a ratio of two people per new unit built over the long term. Greater destruction, fewer people per household, and seasonal demand generate lower ratios. Each MSA has its own norm, reflecting its typical family size, housing destruction rate, and seasonal resident demand.

Other things being equal, an area with larger families will have a higher ratio than an area with smaller families. California, with an average family size of 3.4 people, was among the states with the largest families and displayed a higher ratio of new residents per housing start than Wyoming, with an average family size of three. It is also expected that an MSA with an older housing stock and a high rate of obsolescence/demolition requires more new starts to shelter its households, thus resulting in a lower ratio. As a result, older cities such as Philadelphia and Pittsburgh have lower ratios than MSAs such as Houston. In the same vein, if housing is required for seasonal residency demand ("snow birds"), then the ratio will be lower than for otherwise comparable areas. This explains why Florida MSAs generally have relatively lower ratios.

Table V presents the ratio for the forty-four major MSAs (among the fifty largest MSAs) for which we have full data for the past two decades. We treat 1988 to 2002 as our control period, reflecting long-term local "norms," while 2002 to 2006 is the study period. Some MSAs have a very low index of new residents per new home over the long term. For example, Cleveland-Elyria-Mentor averaged 0.25 new residents per housing start from 1988 to 2002, and Pittsburgh had a loss of one new resident per housing start during the same period. Such cases are largely due to little (or no) population growth (or seasonal demand), while the existing housing stock was destroyed, requiring that new units be built despite little (or no) population growth. Our interest lies in the change in the local norms that occurred between the control and study periods for each MSA.

Figure 4 illustrates the distribution of the change (between the control and study periods) in new residents per housing start for the 79 MSAs we analyze (representing 58 percent of the U.S. population), both unweighted and weighted by the number of households in the MSA. Most MSAs experienced a decline in the number of residents associated with a housing start in the 2002 to 2006 period, with a drop of roughly two new residents per housing start. A comparison between these two plots indicates that a decrease in new residents per housing start was more likely in larger MSAs.

Table VI displays the distribution of seventy-nine MSAs in different combinations of annual unexplained housing price appreciation from 2002 to 2006, and the change in new residents per housing start from the period 1998 to 2002 to the period 2002 to 2006. Most MSAs experienced declines in new residents per housing start. Moreover, there is a correlation between larger unexplained appreciation and greater decline in new residents per housing start. For declines of new residents per housing start of under 0.5 people, most MSAs had unexplained housing price appreciation of less than 2 percent. However, for declines of new residents per housing start between 0.5 and one person,

Figure 4: Density of changes in new residents per housing start, 1988 to 2002 and 2002 to 2006

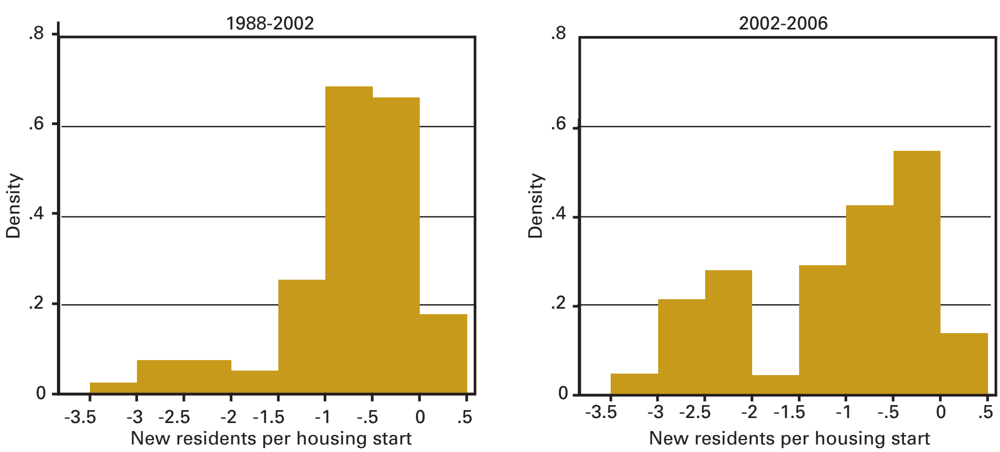


Table VI: Distribution of 79 MSAs in combination of annual unexplained housing price appreciation (2002-2006) and change in new residents per housing start (1988-2002 to 2002-2006)

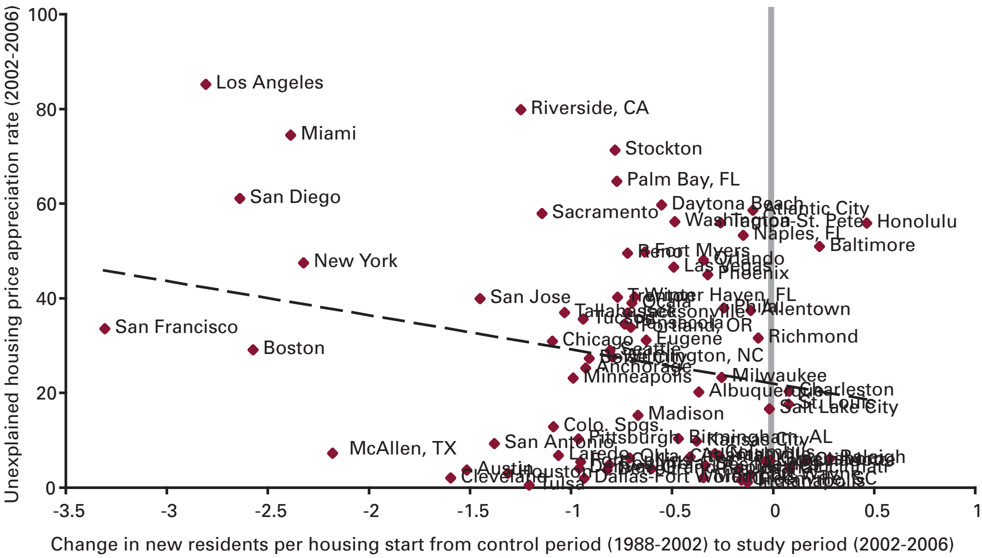
		Change in new residents per housing start			
		LT -1	-1 to -0.5	-0.5 to 0	GTE 0
Unexplained housing price appreciation (%)	LT 2	8	9	14	4
	2 to 10	9	19	10	3
	GTE 10	8	6	9	3

MSAs had unexplained housing price appreciation of between 2 percent to 10 percent. Specific examples are telling. For example, the annual unexplained appreciation in Los Angeles was 16.9 percent, while new residents per new home dropped a stunning 2.8 people. In Miami, 15 percent of housing price appreciation was unexplained, and there were 2.4 fewer new residents per new home in 2002 to 2006 than in the control period. On the other hand, just 0.3 percent of housing price appreciation was unexplained in Indianapolis, and there was no notable change in new residents per new home.

It is important to take older housing and elderly households into account when considering the change in new residents per housing start. Some houses that are very old or built in an undesirable location in view of current demand may be removed and replaced by new houses. Their existence decreases the measure of new residents per housing start. Elderly households differ from others in that they are usually of small size, and thus lead to more housing starts per population change. In addition, the proportion of elderly households may be related to seasonal (snow bird) housing demand.

From the changes in new residents per new home built and the housing price appreciation rate, we observe that most MSAs saw fewer new residents per housing start, but a higher annual appreciation rate in real housing prices in 2002 to 2006 than in 1988 to 2002. Figure 5 shows the relationship between the change in new residents per new home and the unexplained appreciation rate. There is a -0.24 correlation between the change in new residents per housing start and the unexplained housing price appreciation. The fitted simple regression is shown in Figure 5. For a few MSAs such as Cleveland, Detroit, and Pittsburgh, fewer new residents per new home is the result of a loss of population or slowed population growth. For most MSAs, the declining ratio of new residents per new home indicates that construction is catching up with housing needs and that there is more supply. However, the coexistence of increasing real housing price and declining new residents per new home suggests substantial

Figure 5: Changes in new residents per housing start and unexplained housing price appreciation rate in major U.S. MSAs



Source: Bureau of Economic Analysis, Federal Reserve Bank of St. Louis and OFHEO

over-building during the study period—particularly in the "craziest" MSAs, as homes were built for people who were not yet there.

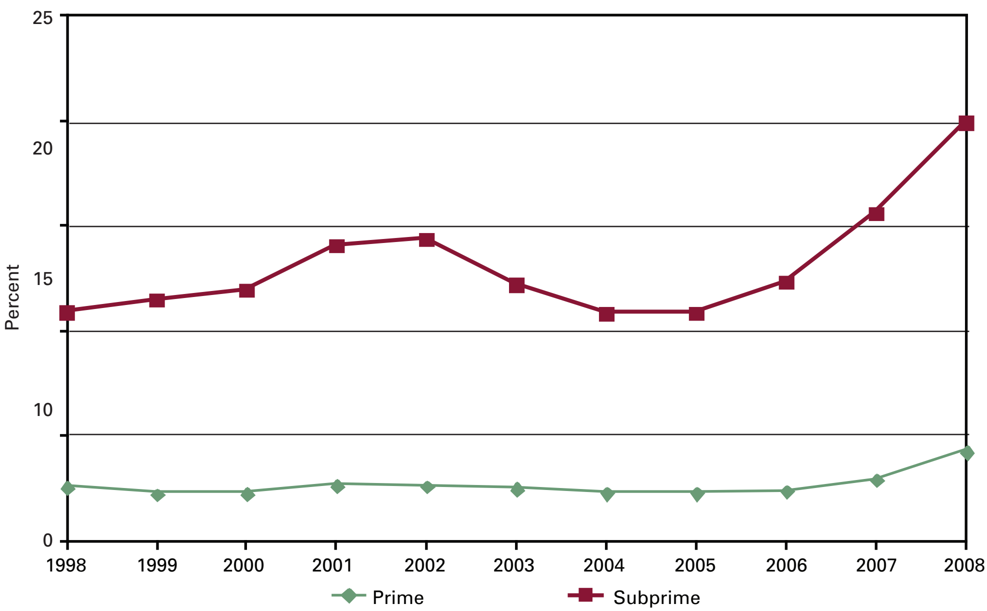
SUBPRIME MORTGAGES

It turns out that mortgage loan delinquencies and unexplained appreciation are correlated. The correlation between unexplained housing price appreciation and delinquency rates for the 200 largest MSAs is 0.2 (the delinquency rate is defined as the percent of mortgage loans that are delinquent more than 30 days). Given that each MSA has its own delinquency rate norm, we investigate the changes in delinquency rates from 2001 to 2006 to 2007 in the 200 largest MSAs. The national average delinquency rate was 2.3 percent during 2001 to 2006, growing to 3.3 percent in 2007, a change of 45 percent. However, only about one third of the 200 largest MSAs experienced growth in delinquency rates greater than the national average. A remarkable observation is that the twenty MSAs with the greatest growth in delinquency rates are in Florida and California. In 2007, the delinquency rates in Salinas, California and Naples-Marco Island, Florida were nearly three times those in 2001 to 2006. We also conducted a correlation analysis between housing price changes in 2007 to 2009 and changes in delinquency rates between 2001 to 2006 and 2007, finding that the correlation is -0.83.

Why did delinquency rates change so dramatically in recent years in some MSAs? It is believed that the expansion of subprime mortgage loans encouraged subsequent delinquency. No pure criterion for defining subprime mortgages exists; that is, subprime is anything that is not prime. However, it is widely accepted that these loans have high default risk. Figure 6 displays the delinquency rates of prime mortgages and nominally subprime mortgages. While both categories experienced higher delinquency rates in 2007 and 2008, subprime mortgages had a remarkably high delinquency rate of 20 percent in 2008. Historically, the difference in delinquency rates between these two categories was notable, reaching a record high of 15 percentage points in 2008. Subprime mortgages have been blamed by many for the turmoil in the financial markets, and even for the collapse of the U.S. economy.

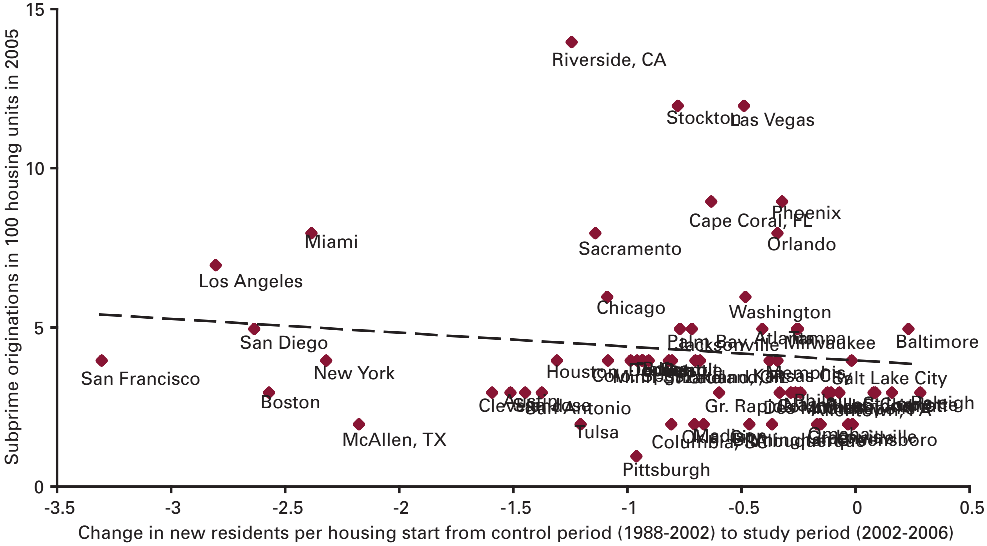
The article by Linneman and Cho in this issue of *WRER* concludes that the real federal fund rate was negative from 2002 to 2005, encouraging investors to take

Figure 6: Delinquency rates of different categories of mortgages



Source: U.S. Department of Housing and Urban Development
*Total past due

Figure 7: Subprime mortgage usage and change in new residents per housing start in U.S. MSAs



Source: Federal Reserve Bank of St. Louis, BEA, and Mayer and Pence (2008)

more long-term risk. As a result, many speculators used subprime mortgages during that period, exaggerating the delinquency and default problems when housing prices started falling. Mayer and Pence illustrate the regional dispersion of subprime originations in 2005, finding a relationship between housing price appreciation, the volume of subprime loans, and new construction for areas including California, Las Vegas, and Miami. They also note that there are some exceptions, such as many northeastern MSAs, where housing prices rocketed with only moderate use of subprime originations.

Subprime mortgages and over-construction are closely related, with a large volume of subprime mortgages occurring in MSAs with over-construction (as measured by the decline of the ratio of new residents per housing start from its norm). Figure 7 shows the relationship between subprime originations in 2005 and the change in new residents per housing start between the control and study periods for sixty-three U.S. MSAs. Interestingly, there was a correlation of -0.13 between subprime mortgages and the change in new residents per housing start. This means that more subprime mortgages were originated where new residents per start fell between 1988 to 2002 and 2002 to 2006—that is, where over-building prevailed. The ratio fell when homes were being built for people not yet there (by historic standards), and subprime usage was high, much of which was funding investor-buyers and flippers.

Subprime mortgage usage and unexplained price appreciation are also closely related, with a correlation of 0.76 between subprime originations in 2005 and unexplained real housing price appreciation in 2002 to 2006. Figure 8 displays the relationship.

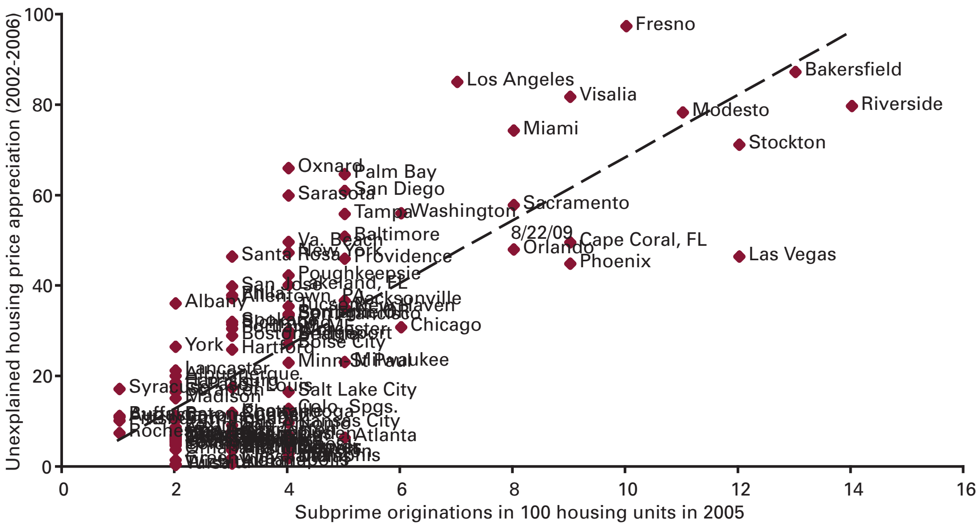
LOCAL REGULATORY FACTORS

Local regulatory constraints play an important role in shaping housing markets. City planning and other regulations are responsible for inelastic housing supply in many MSAs. Glaeser and Gyourko have persuasively argued that in addition to a strong demand in high-priced areas, government regulations—not a scarcity of land—have played a major role in the increase of housing prices.

Land use/development regulations differ substantially across communities. The Wharton Residential Land Use Regulatory Index (WRLURI) is a cross-MSA index reflecting land use restrictiveness in 2005.

We investigate the contributions to unexplained housing appreciation to these factors via regression analysis, where the dependent variable is the unexplained appreciation from 2002 to 2006, and the

Figure 8: Subprime mortgage usage and unexplained housing price appreciation in U.S. MSAs



Source: OFHEO, BLS, Authors' calculations, and Mayer and Pence (2008) independent variables are: subprime origination per 100 housing units in 2005, the change in new residents per housing start between 1988 to 2002 and 2002 to 2006, and the degree of local regulation constraint as measured by the WRLURI. We also include variables indicating shares of older houses (built before 1940) and elderly households (older than 80 years), and the average population growth rate in the past two decades as control variables for MSA norms. A location with more retirees will have a low ratio of new residents per housing start, while a location with very old buildings or a low rate of population growth would also have a low ratio of new residents per housing start. Older households are primarily retirees, hence with smaller household sizes. We use the proportion of elderly as a proxy to control the effect of seasonal demand and household size.

We estimated the model both with and without the regulatory constraint variable. Both models reveal that the change in new residents per housing start was negatively associated with the unexplained appreciation, while greater subprime originations were associated with larger unexplained appreciation (Table VII). When the WRLURI is included, the coefficient on change in new residents per housing start from 1988 to 2002 to 2002 to 2006 is much smaller and less statistically significant. The estimated impact of subprime mortgage originations, on the other hand, is very similar in both models, with a 100 basis point increased usage of subprime

Table VII: Statistics of the absolute differences between implied appreciation rates and different lengths of moving averages of actual appreciation rates, 2002 to 2006

Dependent Variable: Part in housing appreciation rate (2002-2006) that cannot be explained by the S&D model		
Independent Variables		
Change in new residents per housing start from 1988-2002 to 2002-2006	-0.5782 (0.7576)	-1.3977 b (0.6778)
Subprime origination per 100 housing units	1.3659 a (0.3199)	1.4866 a (0.3330)
WRLURI	2.6335 c (1.3046)	
Share of older houses (built before 1940) in total housing units	-0.1074 (0.1013)	-0.0161 (0.0960)
Share of elderly people (older than 80 years) in total population	2.1492 b (0.9282)	2.3984 b (0.9749)
Average population growth rate in the past two decades	-1.1526 (1.2567)	-0.2552 (1.2456)
R-Squared	0.69	0.64

Standard error in parentheses.
a: Statistically significant at the 1% level;
b: Statistically significant at the 5% level;
c: Statistically significant at the 10% level.

mortgages associated with a 140 basis point increase in the unexplained appreciation rate. Hence a community with a 20 percentage point higher subprime usage rate generally had a 28 percentage point higher unexplained appreciation rate. The WRLURI reveals a strong positive effect of additional land-use restrictiveness on unexplained appreciation. That is, more stringent regulatory constraints shift the housing supply inward, raising home prices. The coefficient on the share of elderly people is positive and with statistical significance in both models, meaning a larger share of elderly households is associated with higher seasonal demand and more unexplained appreciation. The share of older houses has a small and statistically insignificant impact.

The results reinforce the roles of new residents per housing start, subprime mortgages, and regulatory constraints in the unprecedented appreciation in real housing price from 2002 to 2006. Both over-construction and heavy subprime mortgage usage (especially for flipper units in high seasonal demand areas) relate strongly to the "crazy" price increase. Homebuyers and investors, especially flippers, formed unrealistically high expectations of housing price appreciation, fueling housing demand. Also, the appearance of flippers in highly regulated markets using easily available subprime loans fueled excessive price increases, as well as subsequent price declines and mortgage delinquency.

CONCLUSIONS

This paper studies the real housing price patterns in the 200 largest U.S. MSAs and the aggregate U.S. market. We find that extreme housing price run-up was a highly localized phenomenon, with huge variance. But there is no "global" or even "U.S." housing price pattern.

To understand the diversity of the unexplained appreciation across locations, we investigate three other aspects of the housing market: new residents per housing start, subprime mortgages, and regulatory constraints. All of these aspects had substantial effects on the markets that experienced unprecedented increase in housing prices from 2002 to 2006. Housing demand was fueled by unrealistic expectations of the price change and housing-related policy, and was further boosted by easy access to funds facilitated by subprime mortgages. Construction swelled in response to this, although buyers had not yet arrived in the area. Regulatory constraints supplemented the effects of the previous two factors by limiting housing supply, causing prices to soar in the most regulated housing markets.