INTERNATIONAL REAL ESTATE REVIEW
2005 Vol. 8 No. 1: pp. 110 - 127

Is There A Housing Bubble in Irvine, California? *A Repeat-Sales Analysis Using a New Data Set*

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Although there have been many recent studies of the housing market and the possible housing bubble, very few studies take a micro-oriented approach. We construct a repeat-sales housing price index from a new data set for Irvine, California to understand recent trends in its housing market. Our analysis for 1984 to 2003 suggests that Irvine's housing market did demonstrate traits of a bubble during certain periods of time. In fact, the bubble of the late 1980s and early 1990s appears to have been even more pronounced in Irvine. Our analysis does not, however, demonstrate conclusively that Irvine's housing market has been experiencing a bubble the past few years.

Keywords

housing bubble; real estate price indexes; repeat-sales data

Introduction

Studies that ask whether or not there is a housing bubble in the United States (US) often point to California because of its exceptional appreciation relative to other parts of the country (McCarthy and Peach, 2004). Moreover, the growth does not seem to be slowing: a recent

study released on July 25, 2005 by the California Association of Realtors (CAR) estimates that the median price of a single-family home in June 2005 in California was $542,720, which is 16% higher than in June 2004. This phenomenon is particularly apparent in Southern California and San Francisco.

Many journalists and professionals interpret this extraordinary price appreciation as evidence of a housing bubble. If there is a housing bubble and it were to burst, there would be a significant decline in household wealth since the average US homeowner in 2000 had 88% of his or her non-pension wealth invested in home equity (Englund et al., 2002).

Surprisingly, there are few studies focusing on Southern California real estate. Additionally, most studies, which either look at individual zip codes, metropolitan statistical areas (MSA), states, or the US as a whole, do not offer uniform conclusions. So, we propose an intensive study of a specific area: southern Irvine. Our analysis will include as much Irvine-level data as is available.

Irvine was chosen from Southern California because it is one of the most well known "master-planned" towns in the US. Beginning in 1970, the Irvine Company began planning many small patches of ordered homes within 43 square miles and has since expanded. Neighborhoods of fairly homogenous homes are commonplace in Irvine. The Irvine City Council annually evaluates the city's Strategic Business Plan and General Plan, maintaining a solid infrastructure in terms of zoning. This uniformity across the town allows our study to control for quality more confidently than previous studies.

This study relies on previous specifications of an asset bubble to study a specific market, approximating a constant-quality stock of homes. By limiting the geographical range to relatively affluent and homogenous neighborhoods that all lie on the same hill in southern Irvine, the study can provide a better estimate of price fluctuations in the local housing market. We construct a housing price index that utilizes a new data set generated from public records of repeat-sales in Orange County. To conclude, we will assess whether the city of Irvine has been experiencing an asset bubble in home prices.

Defining and Testing for "Housing Bubbles"

Although each previous study offers a slightly different interpretation

of what constitutes an asset bubble, Stiglitz (1990) offers two general specifications. The first definition is the most commonly used specification in the bubble literature:

> *If the reason that the price is high today is only because investors believe that the selling price will be high tomorrow – when "fundamental" factors do not seem to justify such a price – then a bubble exists. (p. 13)*

The majority of studies and their respective definitions of a "housing bubble" involve fundamental value.

A common test, then, of the existence of a bubble is estimating the asset's price deviation from its fundamental value. For homes, one such test is to determine if a home's price is above the present value of its future cash flows. In general, the purchase price of a home should equal the net present value of future rent that the owner could collect. Smith et al. (2004) apply this definition to rent and price data for matched-pair houses in Southern California.

Our study aims to incorporate several tests of deviation from fundamental value. Some studies, such as Baker (2002), Case and Shiller (2003), and McCarthy and Peach (2004), use primarily macro-level data to evaluate the existence of housing bubbles and deviations from fundamentals. Two common tests are the ratio of median home price to median household income and the comparison of a rent value from the consumer price index (CPI) against the cost of owning a home. Others like Abraham and Hendershott (1996), Case and Mayer (1996), and Smith et al. (2004), work to incorporate more regional-specific attributes. Bubbles can be local or regional phenomena, but national factors such as the prevailing mortgage rate or personal income may also play a role in determining fundamentals. We can analyze recent trends in the Irvine housing market using both the macro-oriented and micro-oriented tests.

Macroeconomic evaluations of the real estate market look at indicators such as CPI, income, interest rates, and mortgage rates. The housing price index (HPI) or repeat-sales (RS) indexes are also common. In terms of scale, these studies generally evaluate the US as a whole and may look at state or regional indicators.

Baker (2002) relies on the national and state-level CPI and HPI for the majority of the study's analysis, but also incorporates a rental price index (RPI) and other statistics from the Bureau of Labor Statistics (BLS) and the Office of Federal Housing Price Enterprise Oversight

(OFHEO). Since the mid-1990s, the HPI has been diverging from the CPI. Such a deviation indicates, relative to all other goods included in the CPI, rapidly rising housing prices. In the past, such deviations have been followed by periods of the HPI declining relative to the CPI. Baker (2002) concludes that there is a housing bubble because of the HPI's divergence from the CPI and because the real cost of owning has departed from the real cost of renting, where the real cost of renting is the CPI rent index and the real cost of owning a house is the HPI from the OFHEO.

Conversely, McCarthy and Peach (2004) use an expanded set of macroeconomic measures and conclude that there is not a US housing bubble. In addition to the general economic indicators, McCarthy and Peach (2004) also use the OFHEO index of repeat-sales to create several ratios to demonstrate evidence for and against a potential housing bubble. Their conclusion is that the combination of a strong US economy in the 1990s and falling mortgage rates explains the increase in home prices. They argue that changing demand fundamentals in regions like California explain the greater degree of price fluctuation over the period of 1975 to 1999. Additionally, they conclude that the housing supply is more inelastic in places like California, which can also lead to higher prices.

Abraham and Hendershott (1996) incorporate factors that might account for more price volatility in certain areas. Their measure is the deviation between the actual metropolitan house price level and their fundamental price determined by their empirical work. The study uses a repeat-sales database from Fannie Mae/Freddie Mac with explanatory variables that include local CPIs, real income growth, after-tax interest rates growth, real construction costs growth, and employment growth. Using a time frame of 1977 to 1992, their conclusion is that a bubble only exists in coastal regions.

In addition to measuring several fundamentals, Case and Shiller (2003) conduct a survey of homeowners. Their 2003 survey is of purchasers of homes in 2002 in Los Angeles, San Francisco, Boston, and Milwaukee. The survey results provide strong evidence that the majority of homeowners are unaware of many basic economic principles, such as the implications of supply and demand: "buyers and sellers in the housing market are overwhelmingly amateurs, who have little experience with trading" (p. 335). Consequently, some aspects of a bubble do exist: strong investment motive, unrealistic expectations of future house prices, and speculation. Despite the survey results, though, the study concludes that, fundamentally speaking, houses are more

affordable in 2003 than they were in 1995.

Glaeser et al. (2005) assess the importance of housing quality, new construction, and government regulation of new construction. The study offers a model of a local zoning authority and how residents, developers, and government officials will act. According to the study, homeowners now believe new construction will significantly reduce their home value. Conversely, homeowners in the 1950s did not have strong incentives to combat new construction. They conclude that "the housing supply has been constrained by government regulation as opposed to fundamental geographic limitations" (p. 8) and that this restriction is causing a steep increase in housing prices.

Constructing a Real Estate Price Index

A precise price index is necessary for any analysis of a housing market. Some real estate analysts use the median selling price of homes, but the variation in quality of available homes may fluctuate tremendously with time; such a measure, on its own, is inadequate. One possible price index is a quality-adjusted price index, but they are cumbersome and controversial (Palmquist, 1980). Many studies have attempted hedonic price indexes, but the means of incorporating time-adjusted variables, aggregating different data sets, and deriving the price index from the regressions is equally challenging (Palmquist, 1980). A third option is a price index based on repeat-sales data. Empirical work on the construction of an RS index began with Bailey et al. (1963) and has been developed further by others, including Palmquist (1980), Clapp and Giacotto (1992), and Quigley (1995).

Bailey et al. (1963) was the first to depart from a multiplicative chain index of sales in each period in favor of a regression method. For each sale, they compute R, a ratio of the sale price of a house in period t to the previous sale price in the period $t–1$. The model essentially averages all R that have transactions in each of the same two periods, allowing the regression to estimate coefficients for each time period relative to all other time periods. The model is capable of reflecting changes to properties in the form of renovations and additions, but it can only handle depreciation at a constant rate.

Palmquist (1980) proposes a solution to this problem of unrealistic constant depreciation inherent to quality-adjusted studies by proposing the combined use of hedonic models and RS regressions. This allows the length of time between sales to affect depreciation, which is a more

plausible assumption (Palmquist, 1979).

However, Clapp and Giacotto (1992) develop a theoretical basis for ignoring the effects of depreciation for which Palmquist (1979) laid the groundwork. They posit that depreciation, as well as changing neighborhood dynamics, should be reflected in the price index and not be measured or held constant. Losses to an asset's value over time should be reflected in exchanges between buyers and sellers exactly in the same way that stock indexes do not control for the aging of the capital stock (p. 303).

Clapp and Giacotto (1992) point out two more negative aspects of the RS method in their survey of different residential property indexes. First, they claim that the RS method "reduces the sample size by as much as 97%!" (p. 302). Our own data, however, tells us that we will have usable data for 25% of houses (209 out of 831 homes). Second, they propose that an RS index may have a "lemons" bias: houses that are transacted more than others are probably inferior goods that the owners do not want to hold. Our data consist of developments filled with homes built by the same company in the same year, and often times with very similar floor plans. Arguing that all of them have been maintained equally over time would require inspecting each home, but dismissing the "lemons" concern is more conceivable here than in previous studies. The theory that some houses are sold more frequently because they are inferior is too simple an explanation; there are many factors that go into sales and purchases of homes.

Quigley (1995) develops yet another hybrid model that combines assessed value and RS methodologies. Specifically, the model is based on an explicit error structure and makes use of a random walk, a method similar to those of other studies (Case and Shiller, 1987; Abraham and Schauman, 1991). The Quigley (1995) argument against the use of RS alone is familiar: "repeat sales indexes are likely to be quite biased" (p. 5). The logic for this claim is that "in particular, lower-priced and homogenous 'starter' homes are more frequently traded than higher priced luxury accommodations." We dispute that this theory applies to all regions and argue that Irvine, as one of the largest master-planned cities in the US, does not present obstacles to using an RS model.

The Repeat-Sales Index Model

We use the model outlined in Clapp and Giaccotto (1992) for

estimating a real estate repeat-sales (RS) price index. The first and second sale prices are defined as:

$$p_1 = ca_1 + c_1 Q1_1 + ... + c_T QT_1 + e_1 - cz_1 \quad (1)$$

$$p_2 = ca_2 + c_1 Q1_2 + ... + c_T QT_2 + e_2 - cz_2 \quad (2)$$

Both values of p are the natural log of the transaction price P. The values of a are the natural log of the assessed value of the home and c is the assessment equity parameter, which allows for departures from assessment uniformity. QT_i is a time dummy variable with values of 1 if the house sold in period t and 0 otherwise and the regression coefficients c_1, c_2, ..., c_T represent the logarithm of the cumulative price index. In our case, each time period is a calendar year. The subscripts 1 and 2 index the first and second sale of each house. Our random error for estimating the index is e and has 0 mean. The other disturbance term, z, is for assessment errors. The properties of natural logs state that $\ln(P_2 / P_1) = p_2 - p_1$, so the final estimating equation for the price index becomes:

$$p_2 - p_1 = c_1(Q1_2 - Q1_1) + ... + c_T(QT_2 - QT_1) + e_2 - e_1 \quad (3)$$

Here, the model assumes no changes in property characteristics between the two sales, so $a_1 = a_2$ and $z_1 = z_2$ and those terms drop out of Eq. (3). In other words, variations in quality between the two sales are seen as part of the general change that will be indicated by changes in the price index (Palmquist, 1979).

Repeat-Sales Data

The data were gathered during the spring of 2005 from the Assessor and Clerk-Recorder Departments of Orange County where Irvine has its property records. Using these sources, we were able to construct a unique data set of repeat home sales from housing developments in Irvine.

Data from the Office of the Assessor includes current property value and legal ownership of property. All such information on all taxable property is publicly available. The database also notes major additions or improvements to the property. This information makes it simple to account for, with respect to the RS model, significant changes in quality.

The Clerk-Recorder Department was used to find additional sales for

each home. Unlike the Assessor database, where it is possible to search by property address, the Clerk-Recorder databases are organized by name and document number. Each property referenced in our database was manually searched by name and document number to look for possible repeat sales over our selected time period, 1984 to 2003. Once an appropriate document is located, the title transfer tax on the sale is available, as is the exact date of purchase. The tax is $1.10 for every $1,000 in the sale price, making a sale price easy to calculate. These forms are the source of p_1 and p_2 for Eq. (3). However, transfer taxes are not assessed on inter-family or inter-spousal transfers, so many exchanges did not contain a market value and were therefore unusable. Given the incentive for family members to transfer homes amongst each other at below market value for tax reasons, such homes would add bias to our sample.

Results

Repeat-sales data

The results of our data collection are summarized in Table 1. The period spans 1984 to 2003, with all years after 1985 containing at least 13 sales. In fact, 13 out of the 20 years have at least 20 sales, for a total of 230 repeat-sales pairs. Table 2 demonstrates that all twelve months are well represented in both the first and second sales of homes. Additionally, the distribution of the sales is not surprising: more of the sales fall in the late spring, summer, and early autumn months. CAR data for monthly transactions indicates that the month with the most sales, dating back to at least 1991, has always been between March and September. Again, our data collection yielded usable homes 25% of the time (209 out of 831).

Although there are 230 repeat-sales pairs in the index calculations, Table 3 shows that 35 of them represent homes that were sold more than twice during the time period. The use of the same home in more than one pair reduces the efficiency of our index estimators by adding non-zero terms to the off-diagonal elements of the variance-covariance matrix.

Table 4 summarizes the annual RS index for Irvine and the results are encouraging, with 17 out of 20 estimators significant at the 5% level or better. The index indicates a sharp increase in home prices between 1988 and 1991, with the short-term peak occurring in 1990. The index also indicates that home prices have been rising steadily since 1995.

Table 1: Summary of sales

Year	Sales	Mean ($)	Median ($)	Std. Dev. ($)	Min ($)	Max ($)
1984	11	266,574	230,727	70,676	193,500	375,000
1985	8	234,176	222,500	62,585	171,000	355,000
1986	25	321,607	308,500	86,442	188,000	455,000
1987	38	313,681	298,500	81,635	192,909	492,000
1988	22	460,932	444,000	153,025	182,000	785,000
1989	23	563,719	565,000	179,082	325,000	940,500
1990	19	538,299	500,000	193,258	230,000	1,117,000
1991	32	484,233	458,750	157,529	325,000	1,100,000
1992	18	524,306	517,500	172,788	270,000	900,000
1993	15	578,767	532,500	272,736	305,000	1,325,000
1994	23	516,196	470,000	206,229	312,000	1,020,000
1995	13	389,923	362,500	107,959	264,000	585,000
1996	22	518,159	451,000	174,273	320,000	948,000
1997	25	489,500	452,500	191,600	287,500	940,000
1998	32	530,541	501,000	166,826	285,000	940,000
1999	27	591,020	590,000	201,956	330,000	1,195,000
2000	31	601,868	540,000	201,385	371,000	1,165,000
2001	30	693,136	590,000	277,592	387,500	1,389,000
2002	17	674,735	620,000	220,583	485,000	1,416,500
2003	22	849,296	790,000	236,989	540,000	1,590,000
First sale	230	433,711	387,250	185,562	171,000	1,389,000
Second sale	230	599,447	550,000	231,367	264,000	1,590,000

Sources: Assessor's Office and Clerk-Recorder Department of the City of Irvine; authors' calculations.

Table 2: Summary of sale month

Month	First	Second
January	15	8
February	14	12
March	20	20
April	20	26
May	25	20
June	25	30
July	22	33
August	33	27
September	13	22
October	12	14
November	16	10
December	15	8

Sources: Assessor's Office and Clerk-Recorder Department of the City of Irvine.

Table 3: Summary of second pairs

Year	Sales	Second Pairs
1984	11	0
1985	8	0
1986	25	0
1987	38	0
1988	22	0
1989	23	0
1990	19	0
1991	32	1
1992	18	0
1993	15	1
1994	23	1
1995	13	0
1996	22	1
1997	25	2
1998	32	4
1999	27	2
2000	31	7
2001	30	3
2002	17	6
2003	22	7
Total	453	35

Sources: Assessor's Office and Clerk-Recorder Department of the City of Irvine.

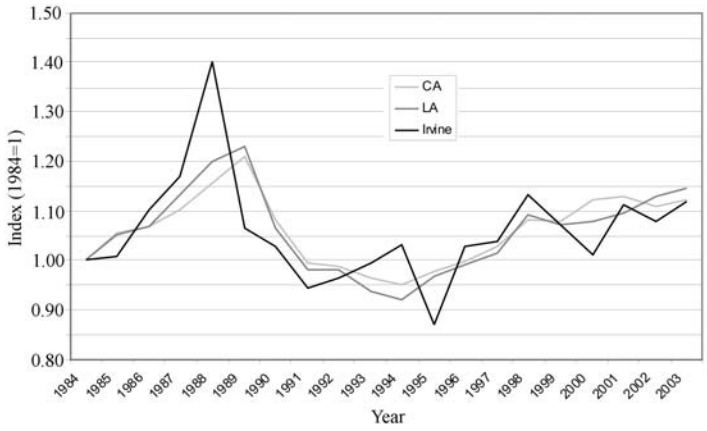
Table 4: Irvine annual repeat-sales index (1984=base)

Year	Index	Year	Index
1984	100.00**	1994	187.75**
1985	100.79**	1995	163.33
1986	111.27**	1996	167.62
1987	130.31	1997	173.98*
1988	182.72*	1998	197.45**
1989	194.95**	1999	211.70**
1990	200.36**	2000	214.58**
1991	189.42**	2001	238.52**
1992	182.84**	2002	257.33**
1993	181.90*	2003	287.72**
Observations: 230		*significant at 5% level	
R-squared: 0.68		**significant at 1% level	

Sources: Assessor's Office and Clerk-Recorder Department of the City of Irvine; authors' calculations using RS index outlined by Clapp and Giaccotto (1992).

Figure 1, which rescales the index to 1 in 1984, compares our index with OFHEO indexes for Los Angeles (LA) MSA and California (CA). While many previous studies allude to several different RS indexes, our study uses the OFHEO HPI for comparisons. The Freddie Mac CMHPI is commonly used, but these two indexes, regardless of region, follow nearly identical trends. Figure 1 has two noteworthy features: the Irvine index peaks sharply in the late 1980s and the overall trend of the Irvine index follows that of the other two. Given the small size of our sample, the volatility of the Irvine index that may appear to indicate significant divergences from the other indexes is in fact not compelling. For approximately 1986 to 1988, though, Irvine home prices appear to increase more from year to year than in the other regions. The lack of a similar acceleration of home price increases in recent years speaks against the existence of a housing bubble.

Figure 1: Annual Irvine repeat-sales index and OFHEO HPI



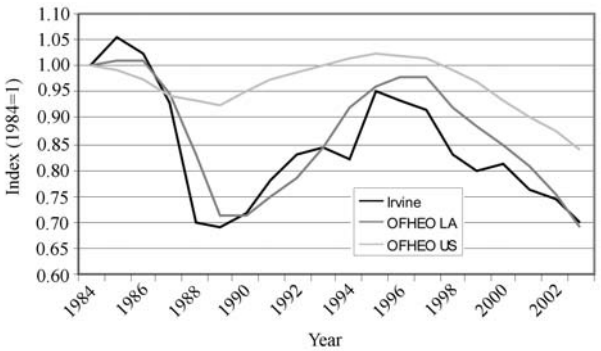
Sources: Office of Federal Housing Enterprise Oversight (OFHEO) for California (CA) and Los Angeles (LA); Assessor's Office and Clerk-Recorder Department of the City of Irvine; authors' calculations.

Renting versus Buying

While both the average and median home price increased significantly in Irvine from 1984 to 2003, additional evidence is necessary to make a concrete claim regarding the existence of a housing bubble. Two additional approaches, such as those used by McCarthy and Peach (2004), are to compare rents to prices and to look at a ratio of home price to some measure of income. Figure 2 takes the owner's equivalent rent from the Los Angeles CPI and the US CPI and

compares it to our RS index and the OFHEO indexes. The CPI rental equivalence measures the change in the implicit rent, which is the amount a homeowner would pay to rent, or would earn from renting, his or her home in a competitive market. The ratio is at its lowest point in 2003, even lower than in the late 1980s and early 1990s. Los Angeles and Irvine have noticeably lower ratios than the US during virtually every year, with Los Angeles and Irvine following very similar trends. Figure 2 suggests that since 1997, the purchasing of houses in Southern California is increasingly expensive relative to renting. While this appears to be more pronounced in Southern California, all three areas share the same overall trend.

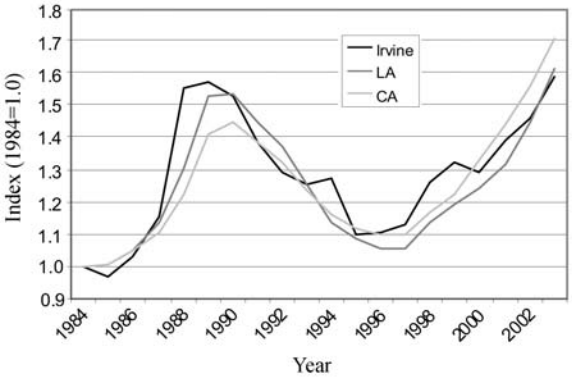
Figure 2: Owner's equivalent rent to repeat-sales index



Sources: OFHEO for Los Angeles (LA) and United States (US), Assessor's Office and Clerk-Recorder Department of the City of Irvine; The Community Development Department of the City of Irvine; Bureau of the Census; Bureau of Labor Statistics (BLS); authors' calculations.
Note: The owner's equivalent rent index comes from the Consumer Price Index (CPI) of the BLS. LA CPI is used for Irvine and LA indexes and US CPI is used for US index.

Figure 3 also demonstrates this trend. Looking at constant-quality median home prices, the calculations show that real home prices peaked once in 1989 and 1990, and have been increasing steadily since 1998. The ups and downs of Figure 3 mirror those of Figure 2. The Irvine and Los Angeles calculations use the Los Angeles CPI from the BLS, while California prices are deflated using the California CPI. So, using a deflated measure of constant-quality, housing prices in Irvine are increasing. This increase in real home prices, however, is in line with increases in Los Angeles and California.

Figure 3: Change in real home prices

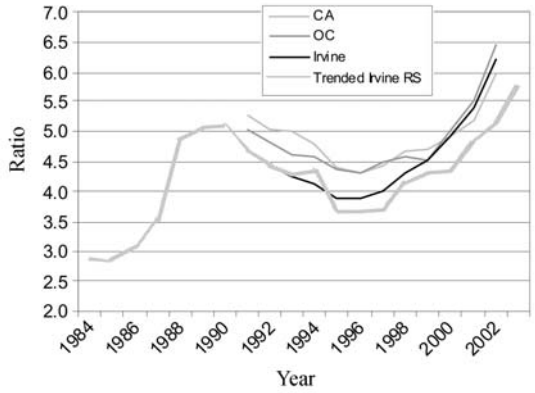


Sources: CAR; OFHEO; National Association of Realtors (NAR); Assessor's Office and Clerk-Recorder Department of the City of Irvine; The Community Development Department of the City of Irvine; Bureau of the Census; BLS; authors' calculations.
Note: The home prices used are median home prices.

Home Price versus Income

Figure 4 combines two data sets to offer a comparison of median home price to median household income. First, the CAR data that spans from 1991 to 2002 is used for California, Orange County (OC), and Irvine. The measure is median household price to median household income. The fourth line comes from our repeat-sales data. Starting with the median home price in 1984, that price is trended annually using the RS index to maintain a constant-quality comparison. The income measure is not available annually, so estimates were used to fill in missing years (see Figure 4 notes). Despite the two different data sources, the figures yield very similar results. In a pattern similar to Figures 2 and 3, the ratio peaks in the late 1980s, dips, and begins to increase in the mid-1990s. The trended RS index line actually maintains a lower ratio than the other estimates. However, holding quality constant and relative to median household income, the median home price almost doubled between 1984 and 2003.

Figure 4: Median home prices to median household income

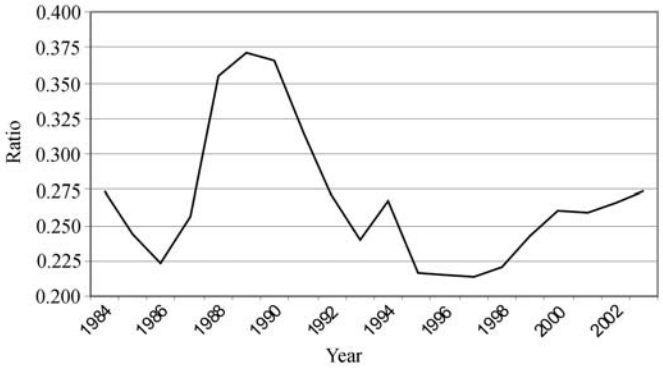


Sources: CAR; Assessor's Office and Clerk-Recorder Department of the City of Irvine; The Community Development Department of the City of Irvine; The Finance and Budget Department of the County of Orange, California; Bureau of the Census; authors' calculations.

Note: The three series from 1991 to 2002 use CAR data on median prices. The Trended Irvine RS Index uses the median home price from 1984 and trend it using the Irvine RS index to maintain the constant-quality comparison. Annual Irvine income data is not available, but the Irvine income increases from 1989 to 1999 and from 1999 to 2003 are virtually identical to those of Orange County (OC). So, the remaining years are increased by percentage increments parallel to those of Orange County. Annual income data is available for California (CA) and Orange County from the Bureau of the Census.

Figure 5 includes mortgage rates for consideration. Mortgage rates have a dramatic impact on the size of monthly mortgage payments. In 1984, the average annual rate on a thirty-year fixed-rate mortgage was 13.88%. In 1991, it was 9.25%, and in 2003 it was 5.83%. Figure 5 graphs the ratio of annual average mortgage payments for a constant-quality home to median household income. The significance of mortgage rate changes is clear; the period of 1988 to 1991 saw median households burdened with relatively much larger mortgage payments. The late 1990s, because of lower rates, actually had relatively smaller mortgage payments, with the 2003 rate making mortgage payments relatively the same size as those in 1984.

Figure 5: Ratio of annual mortgage payments for constant-quality median home price to median household income



Sources: Freddie Mac; Assessor's Office and Clerk-Recorder Department of the City of Irvine; The Community Development Department of the City of Irvine; Bureau of the Census; authors' calculations.
Note: The owner's equivalent rent index comes from the CPI of the BLS. The calculations assume a 30-year fixed rate mortgage with an 80% loan-to-value ratio. The monthly payments are calculated using the trended median home price values from Figure 2 and the average annual mortgage rate on a 30-year fixed rate mortgage. The monthly payment for principal and interest is then multiplied by twelve and divided by median household income. This method follows that of McCarthy and Peach (2004).

Conclusion

The results illustrate that Irvine's housing market has not always behaved identically to the housing market on the national level, state level, or even county level. Our data demonstrate signs of a housing bubble for certain periods of time. However, there is not sufficient evidence to suggest that a housing bubble existed (or continues to exist) in recent years.

The well-known real estate bubble of the late 1980s and early 1990s is apparent in our data. The Irvine RS index (Figure 1) demonstrates how home price changes were more dramatic in Irvine than in either California or Los Angeles during the same time period. Given the size of our sample, this is the only period in which there is a statistically significant difference between the Irvine index and the other indexes. Additionally, the owner's equivalent rent to price index ratio bottomed out during this period, especially in Irvine (Figure 2). Real prices (Figure 3), median home price to median household income (Figure 4), and the size of mortgage payments relative to income (Figure 5) all support this claim. These results, with "bubble indicators" showing up

in all of our measures, demonstrate that our data sample accurately reflects widely acknowledged real estate trends. In a town of significantly above average homogeneity and in neighborhoods where the majority of the homes were constructed in the 1970s and 1980s, such increases in price and decreases in affordability cannot be dismissed. Our analysis indicates that a housing bubble existed in Irvine during those years.

However, the existence of a bubble during this period is not certain. This is because we cannot dismiss the importance of housing supply, among other factors. Indeed, the greater Los Angeles area is one of the highest-priced real estate markets in the country, but new construction has been declining in high-price areas around the country (Glaeser et al., 2005). Additionally, taking transaction costs into account, market prices and fundamental value may vary significantly in an efficient housing market (Meese and Wallace, 1994).

The second time period that demonstrates some characteristics of a housing bubble spans from approximately 1996 to 2003. This is the period when the ratio of rent equivalency to price index (Figure 2) begins to decline; it has not gone up since 1996. Third, real home prices (Figure 3) have been steadily increasing. However, there are other indicators that speak against the existence of a housing bubble. One is interest rates. Real interest rates were, in general, steadily declining for the entire period of 1984 to 2003. The late 1990s and early 2000s saw exceptionally low rates. This drop in interest rates helps explain the drop in rent to price ratios. Furthermore, drops in nominal interest rates (which had also been occurring) affect mortgages available to the median household income; Figure 5 demonstrates that the same caliber of home was in fact more affordable during much of 1996 to 2003. Other studies argue that such strong home price appreciation (Figures 1 and 3) is the result of improving economic conditions and a relatively inelastic supply of housing (McCarthy and Peach, 2004). Indeed, the higher prices of homes in Irvine during this period appear to have fundamental explanations, given a sample dominated by falling interest rates.

There is room to expand our study, however. The data does not include the most recent (2004 and 2005) activity in the real estate market. A review of our work in a few years, with more recent data, might yield different conclusions. Second, while micro-oriented studies are more effective, we were not always able to use Irvine-specific data. Other measures that are not available on an annual basis, such as income, would provide more accurate ratios. Our data set is also small; a

sample size of 500 or 1000 is more desirable. A larger sample would allow for the calculation of a quarterly index. A quarterly index would pick up possible seasonal trends more effectively. Additionally, a more complete picture of the Southern California housing market would be possible if similar RS indexes were constructed for surrounding towns. Such indexes would allow a comparison between assets of rationally specified geographical areas, i.e. southern Irvine or coastal Newport Beach, and not arbitrary comparisons across zip codes or MSAs. Despite these limitations, though, this study shows that Irvine's housing market has, for most of the past two decades, not been experiencing a bubble.

Acknowledgements

The authors would like to thank the other students in their senior economics seminar at Pomona College for their repeated and helpful comments, as well as the three anonymous referees. Finally, they would like to thank the Pomona College Economics Department for funding and Gary Smith for his ongoing assistance and support. All remaining errors are our own.

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