When is a Housing Bubble Not a Housing Bubble?

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Abstract

Discussions of housing bubbles generally rely on indirect barometers such as rapidly increasing prices, unrealistic expectations of future price increases, and rising ratios of housing price indexes to household income and to rent indexes. These indirect measures cannot answer the key question of whether housing prices are justified by the anticipated cash flow. We show how to estimate the fundamental value of a house and use unique rent and price data for matched homes in several southern California cities to illustrate this approach. Our evidence indicates that the bubble is not, in fact, a bubble in that, under a variety of plausible assumptions, buying a house at current market prices still appears to be an attractive long-term investment.

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U. S. housing prices have risen 50% in the past five years, and more than 100% in some hot markets. Many knowledgeable observers believe that we are in the midst of a speculative bubble in residential real estate prices, particularly on the coasts, that rivals the dot-com bubble in the 1990s and that will have a similarly unhappy conclusion.

In December 2004, UCLA Anderson Forecast's Economic Outlook described the California housing market as a bubble, repeating their warnings made in previous years. Yale economist Robert Shiller has issued similar housing-bubble alarms for several years and, in June 2005, warned that, "The [housing] market is in the throes of a bubble of unprecedented proportions that probably will end ugly." Shiller suggests that real housing prices might fall by 50% over the next decade. In August 2005, Princeton's Paul Krugman argued that there was definitely a housing bubble on the coasts and that, indeed, the air had already begun leaking out of the bubble.

The evidence that has been cited in support of a housing bubble has been suggestive, but indirect, in that it does not address the key question of whether housing prices are justified by the anticipated cash flow. We show how to estimate the fundamental value of a house and use a unique set of rent and price data for matched homes in several southern California cities to illustrate this approach. Our evidence indicates that, even though prices have risen rapidly and many buyers have unrealistic expectations of continuing price increases, the bubble is not, in fact, a bubble in that, under a variety of plausible assumptions, buying a house at current market prices still appears to be an attractive long-term investment.

What is a Bubble?

Charles Kindleberger (1987) defined a bubble this way:

> A bubble may be defined loosely as a sharp rise in price of an asset or a range of assets in a

> continuous process, with the initial rise generating expectations of further rises and attracting new buyers—generally speculators interested in profits from trading rather than in its use or earning capacity. The rise is then followed by a reversal of expectations and a sharp decline in price, often resulting in severe financial crisis—in short, the bubble bursts.

Researchers often focus on specific aspects of this general concept: rapidly rising prices (Baker 2002), unrealistic expectations of future price increases (Case and Shiller 2003); the departure of prices from fundamental value (Garber 2000), or a large drop in prices after the bubble pops (Siegel 2003)

We define a bubble as a situation where the market prices of a certain class of assets (such as stocks or real estate) rise far above the present value of the anticipated cash flow from the asset (Kindleberger's use or earning capacity). This definition suggests many of the features noted above: prices rising rapidly, a speculative focus on future price increases rather than the asset's cash flow, and an eventual drop in market prices. However, these features are only suggestive. Market prices can rise rapidly if fundamental values are increasing rapidly. Large future price increases can be realistically anticipated during inflationary periods. Market prices can drop (for example, in a financial crisis) even when there has been no bubble. What truly defines a bubble is that the market prices are not justified by the asset's cash flow.

One appealing way to answer this question is, as with dividend-discount models of stock prices, assume that the investment is for keeps—that the buyer never sells and is therefore unconcerned about future prices. Few people literally plan to hold stocks or houses forever, but this assumption allows us to determine whether the cash flow alone is sufficient to justify the current market price. We will use this approach and we will also look at some finite horizons with modest assumptions about future prices; for example, annual increases of 0% to 3% over the next decade.

Is the Housing Market Efficient?

True believers in efficient markets might deny that there can ever be a bubble. The market price is always the correct price and is therefore justified by the expectations market participants hold. Even Siegel, who believes there can be bubbles, writes that, "We know that the price of any asset is the present value of all future expected cash flows." Contrast this with the opening sentence of John Burr Williams' classic treatise, The Theory of Investment Value (1938): "Separate and distinct things not to be confused, as every thoughtful investor knows, are real worth and market price." In the stock market, these two arguments can perhaps be reconciled by a consideration of whether the future expected cash flows investors use to calculate present values are reasonable. The residential real estate market is fundamentally different in that homebuyers do not calculate present values.

Case and Shiller (2003) report survey evidence of homeowners' naive beliefs about the real estate market. The residential real estate market is populated by amateurs making infrequent transactions on the basis of limited information and with little or no experience in gauging the fundamental value of the houses they are buying and selling. It is highly unlikely that residential real-estate prices are always equal to the present value of the expected cash flow if market participants almost never attempt to estimate the present value of the expected cash flow.

Instead, the nearly universal yardstick in residential real estate is "comps," the recent sale prices of nearby houses with similar characteristics. Comps tell us how much others have paid for houses recently, but not whether these prices are justified by the cash flow. Is a Britannia the British Bear Beanie Baby worth $500 because a Princess Beanie Baby sold for $500? Is this house worth $1 million because a similar house sold for $1 million? The nearly universal use of comps by buyers, sellers, real estate agents, and appraisers is the very mechanism by which market prices can wander far from fundamental values. If no one is estimating fundamental value, why should we assume that market prices will equal fundamental values?

In the stock market, professional investors can, in theory, arbitrage and exploit the mistakes made by noise traders. In the housing market, however, professionals cannot sell houses short and cannot obtain the tax advantages available for owner-occupied housing by physically occupying multiple houses. If a myopic focus on comps causes market prices to depart from fundamentals, there is no effective self-correcting mechanism.

Of course, in an inefficient market, prices can be above or below fundamental value. Housing bubble enthusiasts implicitly assume that market prices were equal to fundamental values in the past and that recent increases have pushed prices above fundamental values. Perhaps housing prices were too low in the past and recent increases have brought market prices more in line with fundamentals.

Supply and Demand

Researchers have used a variety of proxies to gauge whether real estate prices have departed from fundamental values. For example, Case and Shiller (2003) look at the ratio of housing prices to household income, the idea being that housing prices are a bubble waiting to pop if the median buyer is priced out of the market. But the affordability of a house has nothing to do with its intrinsic value. Berkshire Hathaway stock currently sells for nearly $100,000 a share. It is not affordable for most investors, but it may be worth the price!

Aggregate measures of housing prices over time are notoriously imperfect because houses are so heterogeneous in their characteristics and location; it is difficult to measure depreciation and remodeling of existing homes; and it is difficult to measure changes in the quality of home construction over time. McCarthy and Peach (2004) show that, between 1977 and 2003, four popular home price indexes showed price appreciation ranging from 199% (constant quality new homes) to 337% (median price of sales of existing homes).

Even on its own terms, the ratio of housing prices to income doesn't really measure affordability. A better measure would be the ratio of mortgage payments to income. Mortgage rates have fallen dramatically and the ratio of mortgage payments on a constant-quality new home to median family income has fallen steadily, from 0.35 in 1981 to 0.13 in 2003 (McCarthy and Peach 2004).

Other analysts look at various barometers of supply and demand. A supply and demand analysis of the housing market inevitably leads to a consideration of rents since high housing prices might be justified by high rents. Would you be willing to pay a high price for rent-controlled housing in Santa Monica simply because the demand is high and the supply is fixed? Not unless you expect rents to rise in the future. Thus, restrictions on building, a limited supply of urban land, an increasing population, and growing incomes of home buyers, are all factors that might justify high prices, but only insofar as they justify high rents.

Some economists cite the fact that house prices have risen faster than rents as evidence of a bubble (Leamer 2002, Hatzius 2004). Krainer and Wei (2004) report that there has been a 30% real increase in house prices over the past decade and a 10% real increase in rents over this same period, suggesting that prices are departing from fundamentals.

Housing prices and rents are tied together by the fact that the fundamental value of a house depends on the anticipated rents, in the same way that the fundamental value of bonds and stocks depends on the present value of the cash flow from these assets. However, just as bond and stock prices are not tied rigidly to coupons or dividends, so the fundamental value of a house is not tied rigidly to rents. Among the many factors that affect the price-rent ratio are interest rates, risk premiums, growth rates, and tax laws (including property taxes and income tax brackets). Thus, just as with price-earnings ratios in the stock market, price-rent ratios in the housing market can rise without signaling a bubble if, for example, interest rates fall or there is an increase in the anticipated rate of growth of rents.

In addition, the dwellings included in price indexes do not match the dwellings in rent indexes, giving us a comparison of apples to oranges (McCarthy and Peach 2004). The ratio of a house price index to a rent index can rise because the prices of houses in desirable neighborhoods increased more than the rents of apartment buildings in less desirable neighborhoods. Or perhaps the quality of the average house in the price index has increased relative to the quality of the average property in the rent index. And, in any case, to gauge fundamental value, we need actual rent and price data, not indexes with arbitrary scales.

Buying Versus Renting

Thus we are inevitably drawn back to the need to estimate a house's use or earning capacity. Because shelter can be obtained either by renting or buying, the implicit cash flow from an owner-occupied house is based on the rent that would otherwise be paid to live in the house.

Buying and renting have sometimes been analyzed as demands for different commodities. Rosen (1979) wrote that, "In many cases it is difficult (say) to rent a single unit with a large backyard. Similarly, it may be impractical for a homeowner to contract for the kind of maintenance services available to a renter." A decade later, Goodman (1988) observed that, "Until recently, it was easier to purchase small (large) amounts of housing by renting (owning). As a result, households with tastes for small (large) units would rent (buy)."

Today, it is still true that rental and sale properties differ, on average, in location and attributes. But, on the margin, close substitutes are generally available. It is possible to buy small condominiums and to rent houses with large yards. It is possible to buy or rent small or large houses. Many households have the option of buying houses in communities that provide services very similar to those received by most renters.

We consequently view buying and renting as often being viable alternatives. If a household has the opportunity to buy or rent very similar properties (perhaps even the same property), then the relevant question is whether to pay for these housing services by buying the property or renting it.

Fundamental Value

Rental savings are the central, but not the only, factor in determining the fundamental value of an owner-occupied house. We have to look at everything that affects the cash flow, including transaction costs, the down payment, insurance, maintenance, property taxes, mortgage payments, tax savings, and the proceeds if the house is sold at some point.

Once we have the projected cash flow, we can value houses the same way we value bonds, stocks, and other assets—by discounting the cash flow by the household's required rate of return. Specifically, we can calculate the net present value (NPV) of the entire cash flow, including the initial outlay:

$$NPV = X_0 + \frac{X_1}{(1+R)^1} + \frac{X_2}{(1+R)^2} + \frac{X_3}{(1+R)^3} + \ldots + \frac{X_n}{(1+R)^n} \quad (1)$$

X_0 is a negative number equal to the downpayment and out-of-pocket closing costs. X_n is the net amount received when the house is sold and the mortgage balance (if any) is paid off. The intervening cash flows are the rent you would otherwise have to pay to live in this house minus the expenses associated with home ownership, plus or minus the value of nonfinancial factors (such as pride of ownership and a desire for privacy). The rent and other expenses can be estimated from observed data. The intangibles must be assigned values by the household.

The required return R depends on the rates of return available on other investments. The initial downpayment ties up funds that could otherwise be invested in bonds, stocks, and other assets; as the years pass, the net rental savings free up funds that can be invested elsewhere. The required return depends on current interest rates but, because there is considerable uncertainty about the net cash flow from a house, a homebuyer may use a required return similar to that applied to stocks and comparably risky investments.

A homebuyer can use the projected cash flow and a required rate of return to determine if a house's NPV is positive or negative. If the NPV is positive, the house is indeed worth what it costs; if the NPV is negative, renting is more financially attractive. We can also calculate the internal rate of return (IRR) that makes the NPV equal to zero. The cash flow from residential real estate is generally negative in the early years and positive in later years, with just one sign change, so that the NPV is a monotonically decreasing function of the required return. If so, the IRR identifies the breakeven required return for which the investor is indifferent about the investment, and the NPV is positive for any required return less than the IRR.

Data

To illustrate this approach, we gathered data in the summer of 2004 from the Internet and newspaper advertisements for matched pairs of single-family homes in the San Gabriel Valley, which is in the eastern portion of Los Angeles County, south of the San Gabriel Mountains. The San Gabriel Valley was once predominantly agricultural, but after World War II the farmlands began their now (almost complete) conversion into suburban communities. Today, nearly two million people (one fifth of the total population of Los Angeles County) live in the San Gabriel Valley. The two largest cities are Pomona and Pasadena. Among the low-income, middle-income, and high-income communities are El Monte, Alhambra, and San Marino.

We only looked at detached single-family homes, and excluded apartments, condominiums, and houses in gated communities. The Yahoo Maps web site was used to determine the driving distance between properties. The matched rental and sale properties could differ by no more than 100 square feet in size (or by no more than 250 square feet for houses with more than 2500 square feet), no more than 1 bedroom, and no more than half a bath. The driving distance between properties had to be less than 1 mile. The houses were also matched for style (for example, ranch) and in identified amenities, such as a pool. No doubt the properties often differed in other ways (carpet versus wood floors, fireplace or no fireplace), but we can hope that these differences averaged out over our sample. There were often multiple matches (for example, two sales to one similar rental), and we used the best overall match in terms of square footage, distance, and so on. In some cases, there was a perfect match in that a house that had been offered for rent was sold.

If the rental and sale data were for different months, the sales price was adjusted by 1 percent a month, which is the figure used by appraisers at this time. For example, if the rental was listed in July and the matching house sold in June, the sale price was adjusted upward by 1%.

We found 139 observations that matched a sale to a rent that was close by and had similar characteristics. The average distance between the matched properties is 0.33 miles. Table 1 shows the mean characteristics of the properties and the mean of the absolute value of the difference between the values of the matched properties.

Analysis

The following assumptions were used to determine the cash flow: 20% downpayment, 30-year mortgage, 5% mortgage rate, closing costs equal to 1% of the mortgage, insurance equal to 0.1% of the house's price, maintenance equal to 1% of the price, property taxes equal to 1% of the price, $2400 for annual utilities, 28% federal income tax rate, 9.3% state income tax rate, 15% capital gains tax (if the capital gains exceed $500,000), 6% required after-tax return, 8% sales transaction cost (including brokerage fees, closing costs, and fix-up expenses), 3% annual increase in housing rents and expenses (the average increase in the CPI in the Los Angeles area over the past 5 years), and 2% annual increase in property taxes (as limited by Proposition 13).

One way to gauge whether market prices can be justified without unrealistic expectations about future prices is to assume that the buyer never sells, analogous to dividend-discount models of stock prices that assume the investor "buys for keeps." If the buyer never sells, then future prices are irrelevant; all that matters is the cash flow from the asset. We also look at finite horizons with conservative assumptions about future prices. We calculated the NPV and IRR for an infinite holding period and also for finite holdings periods of up to 30 years with annual price increases ranging from 0% to 3%.

For example, we found two adjacent houses on Tulsa Avenue in Claremont. Both are 2530 square-foot ranch houses with four bedrooms, three baths, and a pool. One rented for $2650 a month; the other sold for $622,960. Although we used monthly data, Table 2 shows an annual summary of the projected cash flow for selected years, with a 3% annual increase in the sale price. The homebuyer's anticipated net cash flow is negative for the first 10 years, but the homeowner is building up equity in an appreciating asset and the after-tax IRR is positive by the third year. The NPV is negative until the IRR goes above 6%. As the horizon lengthens, the IRR rises initially as the transaction cost becomes less important, and then peaks and declines slightly as the tax-deductible mortgage is paid off. The forever horizon does not depend on an assumed growth rate for the house's price; the 7.3% after-tax forever IRR is slightly lower than the 7.9% value for a 30-year horizon with a 3% annual price increase.

Figure 1 shows the NPVs for 5-, 10-, and 20-year horizons using required returns ranging from 0 to 20%. For low required rates of return, the NPVs increase with the holding period because (a) the mortgage payments are fixed while the net rental savings grow over time, causing the cash flow to go from negative to increasingly positive; and (b) the homeowner is building up equity in an appreciating asset. The IRRs are where the NPV curves cross the horizontal line at NPV = 0. The household should buy if its after-tax required rate of return is less than the IRR and should rent otherwise. After-tax IRRs of 7-9% certainly appear attractive.

Price-Rent Ratios

Commercial real estate is commonly valued by applying a multiple of 5 or 6 times earnings or EBITDA. For our Tulsa Avenue properties, the annual rent is $31,800 and EBITDA is $31,800 - $6,230 - $2,400 - $623 - $6,230 = $16,317. The ratio of the price to the annual rent is $622,960/($31,800) = 19.6 and the ratio of the price to EBITDA is $622,960/($16,317) = 38.2, which are very high by commercial real estate standards.

In general, we shouldn't expect a constant multiple to give a theoretically correct fundamental value for either commercial or residential real estate, since the value of a property depends on interest rates, growth rates, tax laws, and even the down payment if the after-tax interest rate used to discount the cash flow is not equal to the after-tax mortgage rate. Similarly, we should not expect the price-rent ratio to be constant across properties or across time and we should not expect the rent-price ratio or the EBITDA-price ratio to be an accurate estimate of a house's IRR.

Figure 2 shows a scatter plot for all 139 matched pairs of the annual rent-price ratio and the after-tax IRR for a 10-year holding period with 3% annual price increases. The least squares line is IRR = -6.6 + 3.0(rent/price), with an R-square of 0.985. The NPV equation is very nonlinear and it is remarkable that the relationship between the IRR and the rent-price ratio is so tightly linear. Notice also that not only is the IRR not equal to the rent-price ratio, but the slope is not equal to 1. For every 1 percentage point increase in the rent-price ratio, the IRR increases by approximately 3 percentage points. For example, the IRR is 5.4% if the annual rent-price is 4% and the IRR is 8.4% if the annual rent-price ratio is 5%. Different assumptions about the various parameters will yield a somewhat different fitted line. For example, if we increase the growth rates of rent, price, and expenses to 4%, the fitted line is IRR = -3.5 + 2.8(rent/price), again with an R-square of 0.985.

Sensitivity Analysis

We can gauge the robustness of our results by varying our key assumptions. Table 3 shows the after-tax IRRs for the Tulsa Avenue house with a variety of assumptions regarding the growth rate of the house's price, rent, and expenses. The only buy-for-keeps scenario with an after-tax IRR below 5% is with rents growing by 1% a year forever. (Remember, price growth doesn't matter with an infinite holding period.) The after-tax IRRs for finite holding periods are reasonably attractive, except for a few scenarios, such as a 10-year horizon with 1% growth in prices, rents, and expenses or a 10-year horizon with 0% price growth.

For another kind of sensitivity analysis, we can incorporate stochastic changes in rent and prices into the model and use Monte Carlo simulations to estimate probability distributions for the NPVs and IRRs. We will illustrate this approach here with seemingly reasonable, but conservative, assumptions about the stochastic parameters. Because our matched rent/price data are unique, there are no directly comparable historical data that can be used to estimate the means, variances, and covariances of rent and prices that we need for our simulations. Instead, we use Los Angeles-area indexes to give ballpark estimates.

The Bureau of Labor Statistics has a consistent index for owner's equivalent rent of primary residence back to 1983; the Department of Housing and Urban Development has repeat-sales price indexes for this same period. Over the years 1983-2004, the annual growth rates of the Los Angeles-area rent and price indexes were 3.9% and 6.3% respectively, with a correlation of 0.57 (p-value = 0.01). The standard deviations of the annual percentage changes in Los Angeles-area rents and price were 2.3% and 8.8% respectively.

We will work with monthly cash flows, but assume that rent increases occur every 12-months. We simplify our Monte Carlo simulations by assuming that price increases also occur at 12-

month intervals. We should not assume that the future will replicate the past and, indeed, our objective here is to see if the purchase of a house can be justified financially even with conservative assumptions about future increases in rents and prices. Our illustrative calculations consequently assume that the annual changes in rent and price are lognormally distributed, each with a 3% mean, with standard deviations of 2% and 9%, respectively, and with a 0.60 correlation.

Specifically, we assume that rent Y and price P are determined by these stochastic equations:

$$Y_t = Y_{t-1}(1+\varepsilon_t)$$
$$P_t = P_{t-1}(1+\eta_t)$$

where $100\varepsilon_t$ and $100\eta_t$ are the annual percentage changes in rent and price, and the natural logarithms of $1+\varepsilon_t$ and $1+\eta_t$ are jointly normally distributed with means, standard deviations, and correlation coefficient that correspond to the means, standard deviations and correlation coefficient of ε_t and η_t. For example, if ε_t has a mean $\mu = 0.03$ and standard deviation $\sigma = 0.02$, then the log of $1+\varepsilon_t$ has this mean:

$$\begin{aligned} E\left[\ln\left[1+\varepsilon_t\right]\right] &= 0.5\ln\left[\frac{(1+\mu)^4}{(1+\mu)^2+\sigma^2}\right] \\ &= 0.5\ln\left[\frac{1.03^4}{1.03^2+0.02^2}\right] \\ &= 0.02937 \end{aligned}$$

For n independent simulations, each with a probability p of the IRR falling within a prespecified interval, the simulation standard error for the Monte Carlo estimate of p is approximately

$$\sqrt{\frac{p(1-p)}{n}}$$

One million simulations were used with a maximum standard error equal to 0.0005.

The fixed-rate columns in Table 4 shows the median IRRs, median NPVs (using a 6% after-tax required rate of return), and value-at-risk (VaR) for the NPV using a 95% confidence level over various horizons. A complete distribution of the IRRs is problematic for many horizons because there are some scenarios in which rents and prices do not rise sufficiently to ever generate a positive cash flow—which means there is no IRR. The medians reported in Table 4 treat these problematic IRRs as negative.

As before, the forever NPVs and IRRs do not depend on future housing prices. Figure 3 shows the complete probability distribution for the NPV with an infinite horizon and a 6% after-tax required return. There is an estimated 1.70% chance that the NPV will be negative (an IRR will be below 6%) and and a 0.00% chance that the IRR will be negative.

These calculations assume that the homebuyer chooses a 30-year mortgage with a fixed 5% mortgage rate. Many homebuyers instead choose variable-rate mortgages, perhaps because the initial interest rate is less than that on a longer-term fixed rate mortgage. There are, of course, a plethora of fixed-rate and variable-rate options. We will focus on the cash-flow risk inherent in a variable rate mortgage by assuming that the initial mortgage rate is 5%, the same as with our 30-year fixed-rate mortgage, and that the mortgage rate is adjusted every 12 months based on the average interest rate on 1-year Treasury securities during the most recent month, with a 2 percentage-point cap on the annual change in interest rates and a 10% maximum for the interest rate. Every time the mortgage rate is changed, the loan is amortized over the remaining years—30 years minus the years already elapsed.

For modeling monthly changes in the Treasury rate we use the discrete version of the well-known Cox, Ingersoll, and Ross (CIR) mean-reverting model: (1985):

$$R_t - R_{t-1} = a(b - R_{t-1})\Delta t + \sqrt{R_{t-1}}\,\sigma\varepsilon\sqrt{\Delta t}$$

where the time interval is $\Delta t = 1/12$, the long run equilibrium interest rate is b = 0.05, the pull-back factor is a = 0.20, the instantaneous standard deviation is $\sigma = 0.02$, and the stochastic term ε is normally distributed with mean 0 and standard deviation 1.

The Federal Reserve has monthly interest data on 1-year constant maturity Treasury securities back to April 1954. Since we assume that the adjustments in the mortgage rate are based on the monthly average interest rate at 12-month intervals, we use the changes in monthly average Treasury rates at 12-month intervals for guidance. During the years 1983-2004, the correlation between the annual percentage-point changes in the 1-year Treasury rate and Los Angeles-area housing prices was 0.11 ($p = .61$) and the correlation between annual percentage-point changes in the 1-year Treasury rate and Los Angeles-area rents was -0.16 ($p = 0.47$). We can also look at the historical correlations for more frequent data—quarterly for the price index and monthly for the rent index. The correlation between quarterly percentage-point changes in the 1-year Treasury rate and Los Angeles-area prices was 0.12 ($p = 0.20$) and the correlation between monthly percentage-point changes in the 1-year Treasury rate and Los Angeles-area rents was -0.01 ($p = 0.89$). Our Monte Carlo simulations consequently assume that percentage changes in 1-year Treasury rates are uncorrelated with rents and prices.

The adjustable-rate column in Table 4 shows the median IRRs for the Tulsa Avenue house over various horizons for 1 million simulations. As before, the forever IRRs do not depend on future housing prices. There is an estimated 33.20% chance that the buy-for-keeps NPV will be negative (an IRR will be below 6%) and and an 0.52% chance that the IRR will be negative.

The adjustable-rate case is generally less favorable than the fixed-rate case because of the increase cash-flow risk and the asymmetry in interest-rate changes. When the index rate declines, it cannot go below 0%, and this forms a base from which the index rate can increase. However, index rate increases are unbounded and, while the adjustable mortgage rate is capped at 10%, the index rate can go much higher and consequently keep the mortgage rate at 10% much longer. Thus, although the adjustable rate starts at 5% and is as likely to rise as fall, the asymmetry in the boundaries skews the distribution of the adjustable mortgage rate upward. Even so, for horizons beyond 10 years, the negative NPVs reflect after-tax IRRs between 5% and 6%, which are reasonably attractive.

Conclusion

For our 139 matched pairs, the rent-price ratios ranged from 3.2% to 9.6%. To gauge whether the projected cash flow justifies the price, we focus on buying for keeps. With an infinite horizon (and no assumptions about future prices), the after-tax IRRs with a fixed 5% 30-year mortgage ranged from 4.3% to 20.5% with a median value of 6.9%. With a finite horizon, and assuming that prices increase, on average, by 3% a year, the after-tax IRRs range from 2.8% to 23.1% with a 10-year horizon and from 4.1% to 20.7% with a 30-year horizon. These conclusions are relatively robust with respect to a plausible range of assumptions about future rents and (for the finite-horizon case) future prices. If, however, the homebuyer uses an adjustable-rate mortgage, the median IRRs are somewhat lower and there is a greater chance that the IRR will turn out to be disappointing.

Housing prices have increased rapidly in the Los Angeles area in recent years and many homebuyers have unrealistic expectations about future prices. The relevant question, however, is not how much prices have increased in the past or how fast people expect them to increase in the future, but whether, at current prices, a house is still a fundamentally sound investment. Our answer is yes, even if the owner either buys for keeps (with no assumptions about future house prices) or makes conservative assumptions about future housing prices.

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Table 1 Mean Values for Rental and Sale Properties

	Rental House	Sale House	Absolute Difference
rent or price	$2189/month	$528,236	
square feet	1808	1801	44
bedrooms	3.4	3.3	0.1
bathrooms	2.1	2.2	0.1

Table 2 Cash Flow for Claremont Houses on Tulsa Avenue, sale price increasing 3% annually

Year	Rent Savings	Mortgage Payments	Property Taxes	Tax Savings	Other Expenses	Net Cash Flow	Net Sales Price	Mortgage Balance	NPV R = 6%	IRR (%)
1	31,800	-32,104	-6,230	10,749	-9,253	-5,037	590,317	-491,015	-40,920	-30.7
2	32,754	-32,104	-6,354	10,662	-9,531	-4,573	608,026	-483,286	-27,955	-5.7
3	33,737	-32,104	-6,481	10,569	-9,817	-4,096	626,267	-475,162	-15,870	1.9
4	34,749	-32,104	-6,611	10,470	-10,111	-3,608	645,055	-466,622	-4,615	5.2
5	35,791	-32,104	-6,743	10,364	-10,414	-3,106	664,407	-457,645	5,862	6.8
10	41,492	-32,104	-7,445	9,725	-12,073	-405	770,230	-405,383	48,067	8.9
15	48,100	-32,104	-8,220	8,861	-13,996	2,642	892,907	-338,312	76,654	8.8
20	55,761	-32,104	-9,075	7,704	-16,225	6,061	1,035,12	-252,235	95,221	8.5
25	64,643	-32,104	-10,020	6,166	-18,809	9,876	1,188,438	-141,769	104,012	8.2
30	74,939	-32,104	-11,063	4,134	-21,805	14,101	1,350,896	0	105,710	7.9
forever									142,450	7.3

Table 3 IRRs for Various Growth Rates of Price g_P and Rent and Expenses g_R

		IRR (%)			
g_P	g_R	10 years	20 years	30 years	forever
1%	1%	2.70	3.97	4.06	3.66
2%	2%	6.07	6.43	6.12	5.63
3%	3%	8.89	8.52	7.86	7.26
4%	4%	11.34	10.28	9.45	8.78
1%	3%	3.91	5.78	6.22	7.26
0%	4%	1.45	5.40	6.80	8.78

Table 4 IRRs and NPVs for Stochastic Simulations with Fixed and Adjustable Mortgage Rates

	Fixed Rate			Adjustable Rate		
Horizon (years)	median IRR (%)	median NPV ($)	VaR NPV ($)	median IRR (%)	median NPV ($)	VaR NPV ($)
1	-33.06	-43,092	-117,177	-33.09	-43,166	-117,042
2	-7.66	-32,103	-130,718	-8.30	-33,503	-132,823
3	0.14	-21,896	-136,509	-1.44	-27,454	-144,466
4	3.66	-12,253	-138,645	1.43	-23,381	-153,885
5	5.49	-3,406	-138,482	2.89	-20,579	-161,281
10	8.03	32,464	-123,638	4.86	-16,259	-183,029
15	8.18	56,558	-103,177	5.24	-17,004	-190,343
20	8.02	72,581	-84,572	5.44	-17,404	-189,361
25	7.80	81,714	-69,551	5.57	-17,631	-183,603
30	7.57	84,670	-58,500	5.66	-17,048	-175,580
forever	7.23	139,202	28,857	6.23	35,422	-89,513

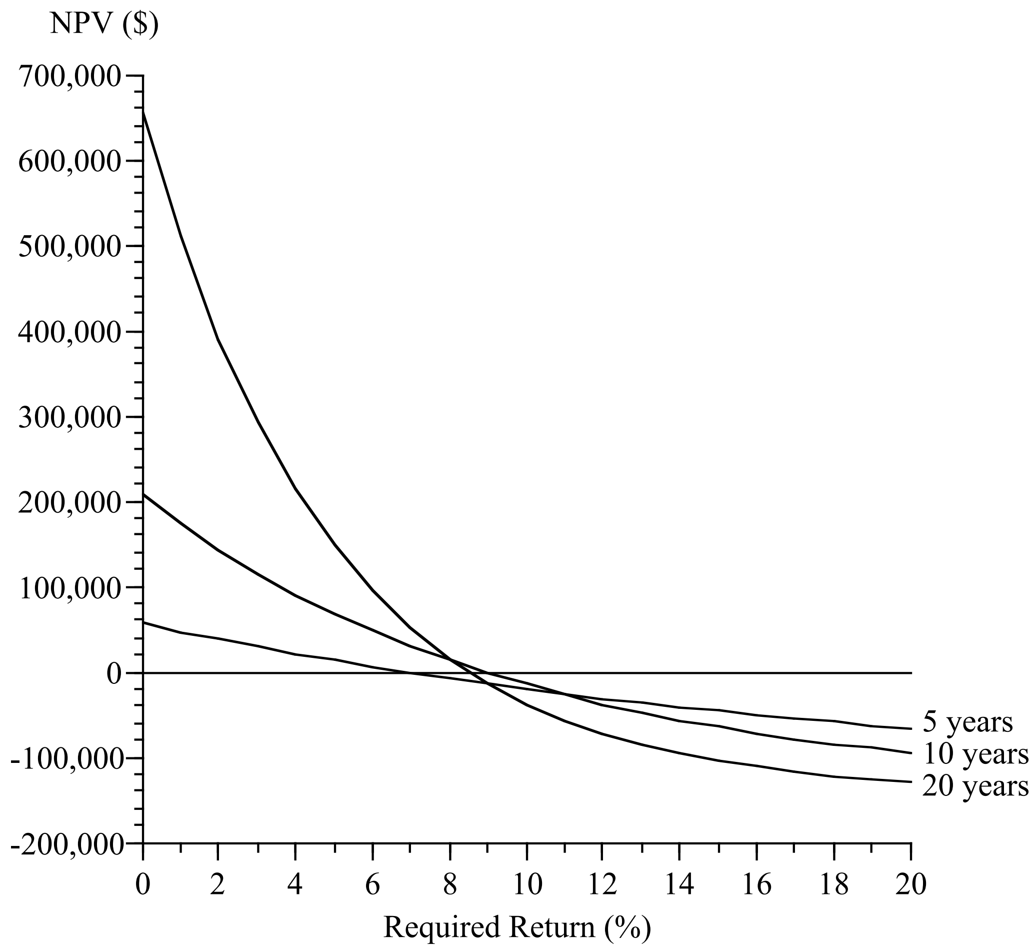

Figure 1 NPVs for Different Horizons, 3% annual price increase

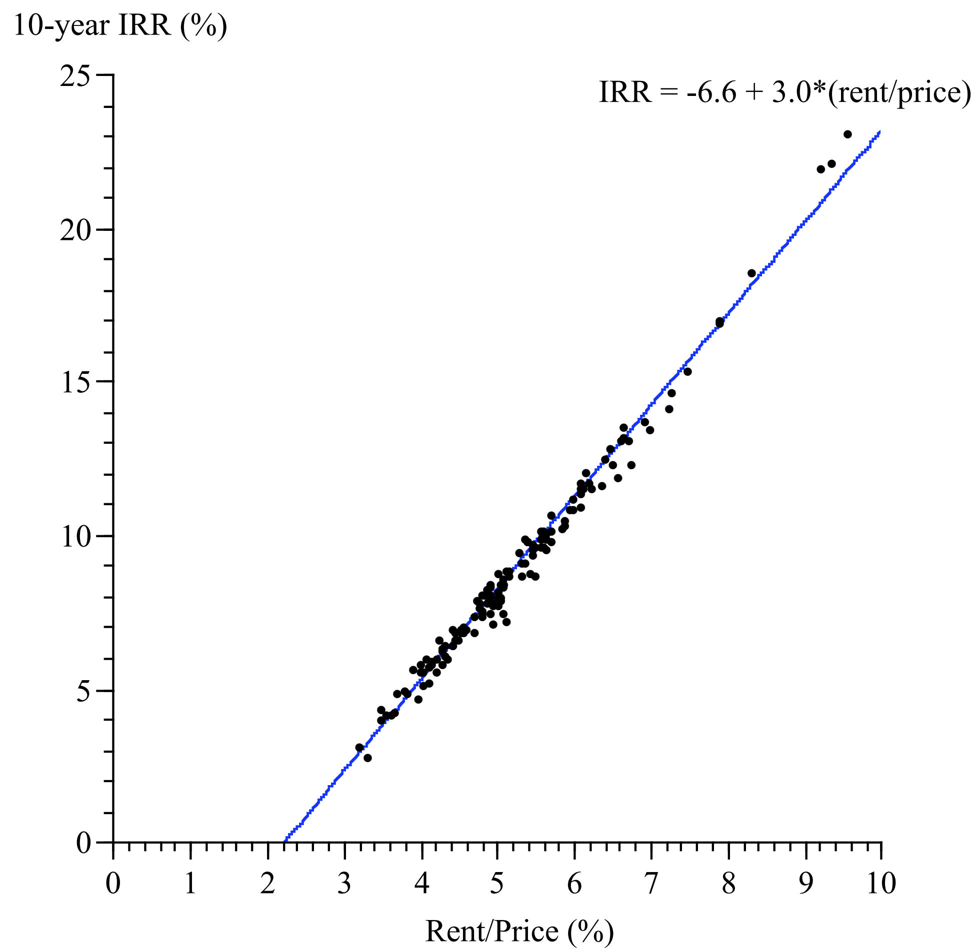

Figure 2 10-year After-Tax IRR vs. Rent/Price

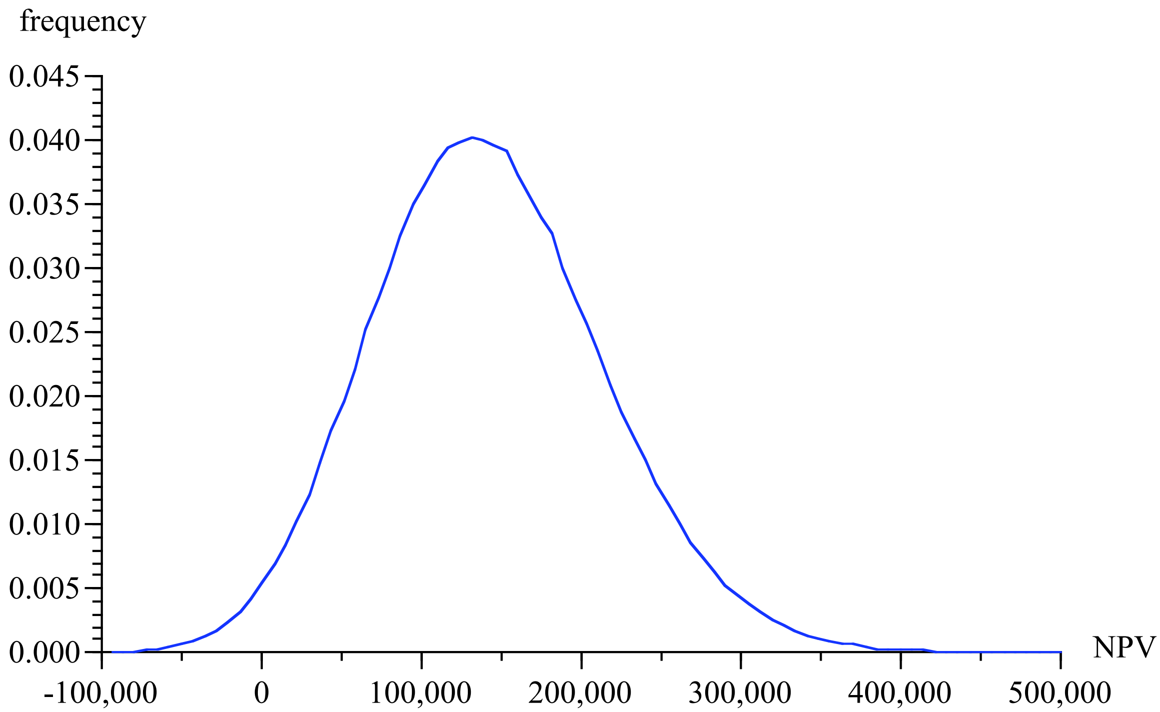

Figure 3 Net Present Value (NPV) if Buy for Keeps with Fixed 30-Year Mortgage