

Understanding House-Price Dynamics*

BY MAKOTO NAKAJIMA

For most homeowners, housing is the single most important component of their nonpension wealth. Therefore, a change in house prices greatly affects the total wealth of many households. Furthermore, movements in house prices can affect people's lives indirectly. For example, the surge in the number of mortgage defaults and foreclosures during the recent recession was triggered in part by a drop in house prices, and this surge damaged the health of the financial institutions that either directly or indirectly owned mortgage loans. In turn, the deteriorating health of the financial sector was one of the factors contributing to the recession. Naturally, for both policymakers and for people who want to make sound financial decisions, it is important to understand how and why house prices move. In this article, Makoto Nakajima explains a simple theory that helps us better understand house-price dynamics. The theory — called the user cost-rent equivalence — is based on the close relationship between user costs, which are the costs of owning a house for a year, and rents.

For example, if there is a large drop in the price of a house, the homeowner is more likely to receive less money when selling his house in the future. Under this circumstance, it is probably a sound decision to cut back on household expenditures. House prices are also important for the one-third of households who are not homeowners, since many of them are young households that are saving money to buy their first house. Higher house prices could force many of them to delay or give up their plans to buy a house. Lower house prices help young households while hurting homeowners.¹

Moreover, the recent recession seems to suggest that movements in house prices also affect people's lives indirectly. The surge in the number of mortgage defaults and foreclosures was triggered in part by a drop in house prices. Furthermore, this surge damaged the health of the financial institutions that either directly or indirectly owned mortgage loans, and the deteriorating health of the financial sector was one of the factors contributing to the recession.

Naturally, for both policymakers and for people who want to make sound financial decisions, it is important to understand how and why house prices move. This article presents a simple theory that helps us better understand house-price dynamics. The theory — called the user cost-rent equivalence — is based

The ups and downs of house prices affect our lives substantially.



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About two-thirds of U.S. households own a house, and for most homeowners, housing is the single most important component of their nonpension wealth. Therefore, a change in house prices greatly affects the total wealth of many households.

*The views expressed here are those of the author and do not necessarily represent the views of the Federal Reserve Bank of Philadelphia or the Federal Reserve System.

¹See the *Business Review* article by Wenli Li and Rui Yao for a more detailed analysis of how house-price changes affect the consumption and well-being of American households.

on the close relationship between user costs, which are the costs of owning a house for a year, and rents.

We'll start with some observations about the housing market, then review recent economic research that analyzes house-price dynamics. Since economists are still trying to improve their understanding of how house prices move, there are many theories that explain house-price dynamics other than the one presented in this article. We will take a brief look at some of the other theories. Then we'll discuss the theory that we focus on in this article and examine how elements that affect house prices, according to our theory, change over time and the implications of such changes for house prices. Finally, we'll carry out a simple numerical exercise to see what fraction of the recent rise in house prices can be accounted for by the theory presented here and by the data.

Interested readers are encouraged to look at Wenli Li and Fang Yang's related *Business Review* article, which analyzes the economic benefits and costs of homeownership.

SOME OBSERVATIONS ABOUT HOUSE PRICES

The trend of the average house price between 1975 and 2009 is shown in Figure 1. This is a *real* index in the sense that the house prices shown in the figure are relative to the prices of nonhousing goods and services. A constant *real* house price doesn't mean that the *nominal* house price (the ones we see in newspaper ads) is constant; rather, it most likely means that house prices are, on average, rising at the same pace as other goods we regularly purchase. The average house price rose about 1.5 percent faster than other prices per year over this period. What is striking about the figure is that the trend is relatively flat until the mid-1990s. Since then, there has been

a substantial increase (until the end of 2006) and a substantial drop (since 2007). Around the end of 2006, when the average house price peaked, house prices were about 60 percent higher than their level in the mid-1990s.

The recent increase and decline in the average house price have been accompanied by similar changes in the homeownership rate (Figure 2). The figure plots both the homeownership rate (left scale) and the average real house-price index (right scale), which was shown in Figure 1. Until the mid-1990s, about 64 percent of U.S. households lived in housing that they owned. But in 2005, the homeownership rate went up to 69 percent and then came down to 67 percent. Matthew Chambers, Carlos Garriga, and Don Schlagenhauf find that the increase is an outcome of demographic changes as well as developments in the mortgage loan market, in particular, the proliferation of new types of mortgage loans with

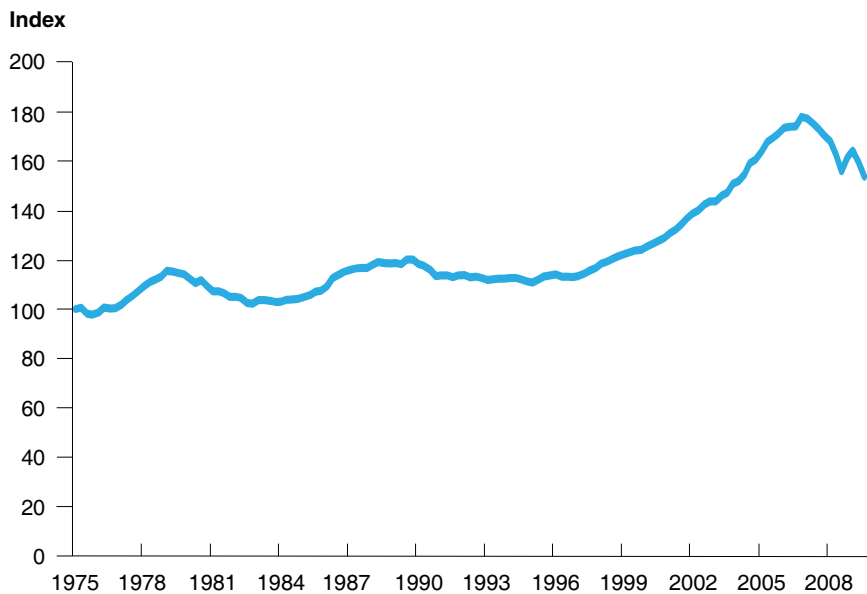
low down-payment requirements and low introductory rates.

Although this article focuses on how and why the national average house price moves, it is important to keep in mind that behind the average house-price dynamics, there are substantial differences across regions of the U.S. (Figure 3). The Pacific, New England, and Middle Atlantic regions exhibit the most volatile movements. On the other hand, the average house price in the West-South Central region changed very little between 1975 and 2009. The house-price bubble and subsequent burst that we often hear about does not apply equally to all regions of the U.S. In general, the regions that experienced a larger increase in house prices are also experiencing a larger drop in house prices. The level of average house prices in regions with volatile house-price movements is still high compared with that in the mid-1990s.

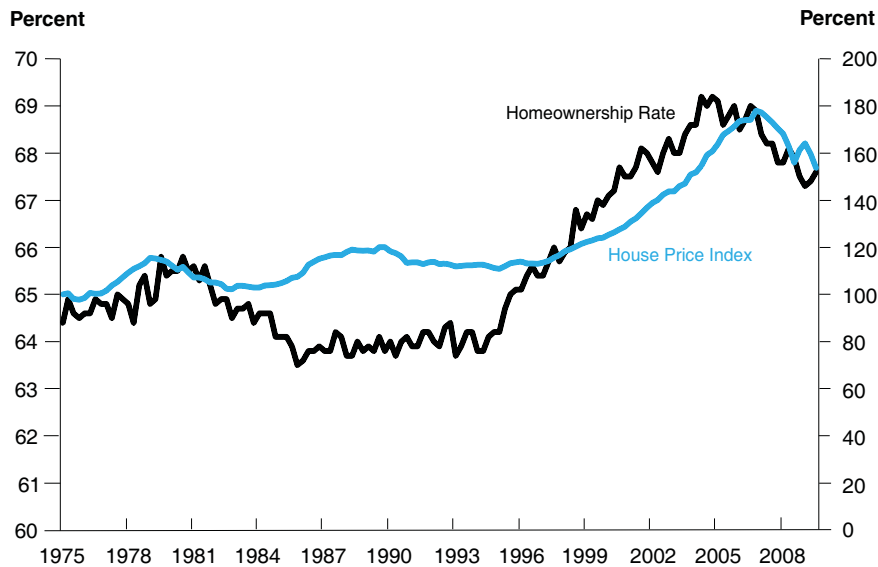
House-price dispersion across U.S.

FIGURE 1

Real House Price Index for the U.S. (1975 = 100)

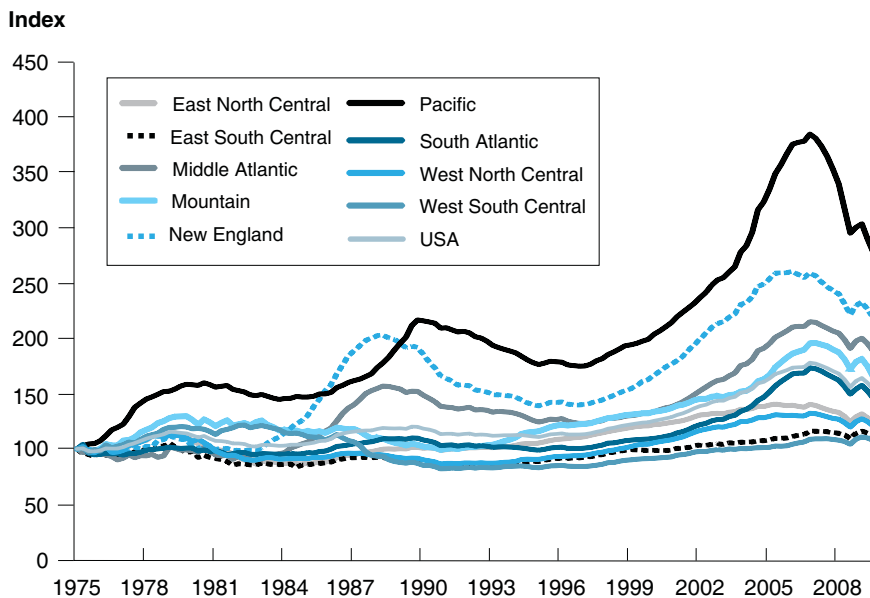


Data source: Federal Housing Finance Agency

FIGURE 2**Homeownership Rate and House Price**

Data source: U.S. Census Bureau and Federal Housing Finance Agency

Note: Homeownership rate is computed by dividing the number of households living in owner-occupied housing units by the total number of households.

FIGURE 3**Real House Price Index for U.S. Regions (1975 = 100)**

Data source: Federal Housing Finance Agency

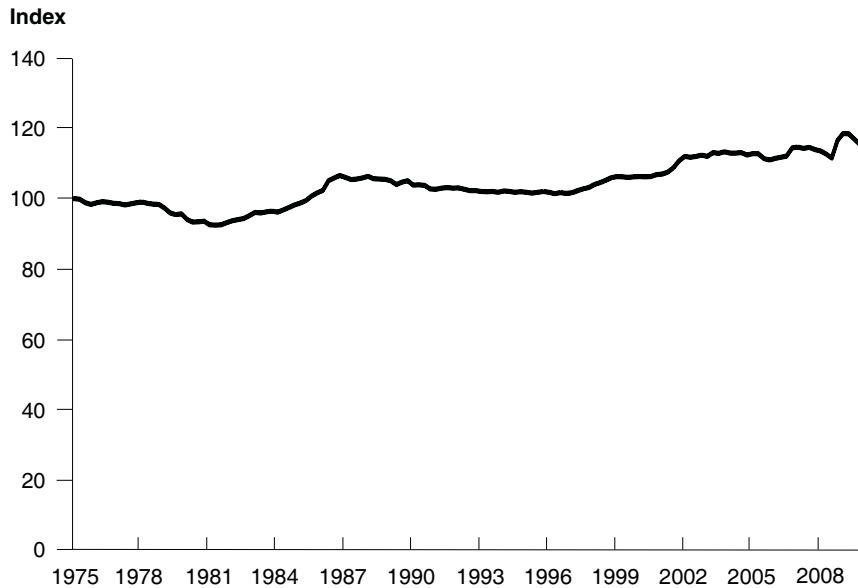
cities also increased, and the dispersion across cities is even larger than the dispersion across regions. A study by Stijn Van Nieuwerburgh and Pierre-Olivier Weill focuses on this increasing dispersion of house prices across U.S. cities. They show that house-price dispersion across U.S. cities can increase when the dispersion of wages across cities increases. For example, higher house prices in San Francisco reflect the higher wages earned by people living in San Francisco.

Finally, let's look at the trend of average rents. It is important to know the dynamics of rents because, as mentioned above, the theory presented in this article suggests a strong link between house prices and rents. Figure 4 shows the trend of average real rents for primary residences since the 1970s. Like average house prices, average rents have gone up since the mid-1990s. However, the fluctuations are much less pronounced. The average annual growth rate of rents is 0.5 percent, compared with a 1.5 percent average annual growth rate of house prices. However, we need to be aware that rents have some measurement issues. In their study, Theodore Crone, Leonard Nakamura, and Richard Voith argue that the growth rate of rents has been higher than the official data suggest.

RECENT ATTEMPTS TO UNDERSTAND HOUSE-PRICE DYNAMICS

Because of their obvious importance, particularly in recent years, house-price dynamics have been an active area of research. Perhaps the most important question is, why did house prices go up substantially? Theories that attempt to explain rising housing prices can be placed into three groups.

The first group of studies deals with the inflexible nature of housing supply; it takes time to build a

FIGURE 4**Real Rent of Primary Residence (1975 = 100)**

Data source: Bureau of Labor Statistics

Note: Real rent is computed by dividing the "rent of primary residences" (notice this does not include the imputed rents of owner-occupied housing) by the consumer price index (CPI) less shelter.

house, and land is not always available, especially in a city's center (think of Manhattan). Motivated by the observation that house prices went up more in metropolitan areas, where space is tighter, Edward Glaeser, Joseph Gyourko, and Raven Saks investigate the role of supply-side restrictions, such as land-use restrictions, in the recent house-price boom. They find that tightened housing-supply regulations played some role in generating an upward trend in house prices. Morris Davis and Jonathan Heathcote, in their study, break down the changes in house prices into changes in land prices and changes in the price of building materials and find that changes in land prices drive house-price dynamics. If the prices of building materials are volatile, it could explain at least a part of house-price dynamics, but they show that that is not the case. In another study, Nobuhiro Kiyotaki, Alexander Michaelides, and Kalin Nikolov look

at the role that a limited supply of land plays in shaping house-price dynamics. Their model indicates that in an economy in which the total value of land is large relative to the total value of real estate (consisting of land and the structures built on it), house prices react more strongly to changes in the economy's economic growth or interest rate. We can interpret their result as confirming the importance of the limited availability of housing supply in shaping house-price dynamics.

The second group of theories investigates why demand for housing increased over time. In interesting but controversial work, Gregory Mankiw and David Weil argue that house prices are driven by demographic changes. When baby boomers were in their prime (30s and 40s), a time when people tend to buy bigger houses, total housing demand was larger. A natural consequence is that as baby boomers age and retire, housing demand and

house prices decline. Whether and to what extent Mankiw and Weil's theory is true remains to be seen. In my 2005 study, I argued that demand for housing, especially owner-occupied housing, increases when income is more volatile. This is because housing is a big part of people's total wealth (housing made up about 40 percent of total wealth in 2004, according to the Survey of Consumer Finances), and it is natural for people to save more and prepare for bad times when income is more volatile. I find that a part of the rise in house prices can be attributed to the fact that individual wages have become more volatile since the 1970s.

The third group of theories focuses on the role of expectations in shaping house-price dynamics. The role of expectations might be important because house prices seem more volatile than factors that are naturally thought to affect house prices (often called *fundamentals*), such as income and mortgage rates. I will briefly describe three studies in this group. The *irrational exuberance* theory of Robert Shiller is the most well known.² If everybody thinks that house prices will go up, house prices could go up only because more people try to buy now, expecting capital gains from owning a house. When house prices are increasing only because people expect prices to go up, and not because the fundamental drivers of house prices are changing, the increase is commonly called a *bubble*. When increases in house prices are a bubble, there is no reason for prices to stay at a higher level.³ If people suddenly start thinking that house prices will drop, house prices could actually

² See Robert Shiller's 2005 book. Shiller analyzes the U.S. housing market in his 2007 article.

³ The *Business Review* article by Timothy Schiller analyzes the bubble hypothesis.

drop. Shiller discusses a variety of factors that contribute to bringing about such irrational exuberance, including cultural and psychological factors.

Monika Piazzesi and Martin Schneider look at survey evidence to analyze expectations. They use the Michigan Survey of Consumers, which is a useful data set for this purpose because it asks respondents about current and future house prices. According to Piazzesi and Schneider's study, the proportion of households that are optimistic about future house prices is about 9 percent, on average. However, what is more interesting is that they also find that the proportion of such optimistic households increased from 10 percent to 16 percent during the recent house-price boom. Motivated by this evidence, Piazzesi and Schneider propose a theory whereby some households' expectations are driven by *momentum*. When house prices are increasing for a while for some reason, these momentum households can keep house prices going up for a bit longer, because they believe that house prices will keep increasing, based on their recent experience, and they behave like households with irrational exuberance.

James Kahn proposes an alternative theory as to how house prices are linked to expectations. When the economy is growing faster, as in the 1990s, people's income increases faster, and thus, future rents rise faster. Notice that house prices today reflect future rents because if you buy a house today, you don't need to pay higher rents in the future. Therefore, if income, and thus rents, are expected to grow faster, people try to buy rather than rent a house today. Consequently, house prices go up today just because of a positive change in expectations about future income growth. According to Kahn's theory, expectations for sustained high income growth were the

driving force for the recent increase in house prices.

How are the various studies presented above related to the user-cost theory of house prices that I will present? In what follows, a rising trend in rents, which is consistent with the combination of inflexible supply and growing demand for housing, and expectations for future house-price growth will be important in generating house-price growth. I will use these

The user-cost theory is based on two elements: how user costs are determined, and the equivalence between user costs and rents.

factors similar to the way they're used in a study by James Poterba and another by Charles Himmelberg, Christopher Mayer, and Todd Sinai. The latter study, using the same approach employed in this article, concludes that "as of the end of 2004, our analysis reveals little evidence of a housing bubble." Himmelberg and co-authors also look at differences in house-price dynamics across U.S. cities, while this article focuses on movements in average house prices nationally. This article also emphasizes the importance of expectations in driving house prices.

THEORY OF THE USER COSTS OF HOUSING AND RENTS

The user-cost theory is based on two elements: how user costs are determined, and the equivalence between user costs and rents. Let's look at these elements one at a time.

User costs are the costs of owning a house for a year instead of renting

it. What are the components of user costs? As explained by Poterba and by Himmelberg and co-authors, there are five major components of the user costs of housing. First, there is the interest cost, which can be interpreted in two ways. If a person buys a house with a mortgage loan, he has to pay interest on the mortgage every year. The total mortgage interest payment is approximately the annual mortgage interest rate multiplied by the house's value (house price). However, some people buy houses without mortgage loans. Even if a person buys a house without taking out a mortgage, there is an *opportunity cost*, which is the profit missed by taking one action over another. In the current context, he loses the interest income that he would have earned if he had saved and invested the money instead of using the money to buy a house. The forgone interest income can be expressed as the interest rate multiplied by the house's value (house price). In either case, the interest cost can be represented as the house price times the annual interest rate.

Second, homeowners are required to pay property taxes. Since property taxes also depend on the house's value, property tax payments can be computed as the house price times the property tax rate.

Third, in the U.S., homeowners can deduct mortgage interest payments and property tax payments from their taxable income, up to some limit.⁴ This deduction indirectly reduces the cost of ownership. The benefit derived from the deduction can be represented as the sum of mortgage interest payments and property tax payments multiplied by the deduction rate.

Fourth, homeowners have to pay

⁴ The amount of mortgage interest payment deduction is capped at the interest on the first \$1 million in mortgages.

for maintenance and repairs. It is also natural to assume that the cost is approximately proportional to the house's value. A bigger or more valuable house requires more money for maintenance and repairs.

Finally, expectations about future changes in house prices affect user costs today, even before the changes are realized. For example, suppose you expect that the value of your house will drop by 5 percent in the near future. That means that you will lose 5 percent of the house's value by keeping the house. The expected cost of owning would be higher, taking this future 5 percent loss into account. On the other hand, if you expect that the house's price will go up by 10 percent, this makes owning profitable by exactly 10 percent of the house's value. Thus, the cost of owning a house, taking into account the expected gain just by holding on to it, will decrease by the same amount. In sum, a change in the expected future value of the house has the effect of indirectly changing user costs.

How can we use these components of user costs to understand house-price dynamics? This is where the other important element of our theory — the close relationship between user cost and rent — comes into play. If there is a house that can be either rented or purchased, the cost of renting the house must be close to the user costs if the house is owned. Why? If the rent is much higher than the user costs, somebody can buy the house, rent it out, and make a profit because the costs of owning and maintaining the house (user costs) are lower than the income from renting the house (rent). Under this circumstance, demand for housing will rise as people try to buy houses and exploit the opportunity, and this pushes up house prices. On the other hand, if the rent is much lower than the user

costs, the opposite is likely to happen: A homeowner can save money by selling his house and renting one instead. If there are a lot of people trying to sell their houses and rent, house prices would fall, reflecting the weak demand for housing. In the end, we should expect that user costs and rents will end up close to each other when houses are both rented and purchased.⁵ We will use this (approximate) closeness between user costs and rents to examine how house prices are affected by changes in interest rates, rents, and so forth.

From the discussion above, we know how user costs are determined, and we also know that user costs should be close to rents. In addition, all of the major components of user costs — interest cost, property taxes, deduction of mortgage interest payments, maintenance and repair costs, and expectations about future changes in house prices — are approximately proportional to house prices. In other words, in general, all of the components will be larger if the house price is higher. Now, consider a normal situation in which user costs are equal to rents. Suppose the interest rate goes up. Since the interest cost is a part of the user cost, when the interest rate goes up, user costs should go up if nothing else changes. However, as discussed above, when the user cost exceeds rent, it is beneficial for homeowners to sell their house and rent instead. This decline in demand for housing would put downward pressure on house prices, bringing house prices

⁵ In the language of finance and economics, this condition, which indicates that prices of substitutable things should be close to each other, is called an arbitrage-free condition: Nobody can make a profit by taking advantage of the price difference between two assets (arbitrage), because the prices will adjust to eliminate the arbitrage opportunity.

and thus user costs back to their initial level. As a result, user costs and rents will be equalized, with a higher interest rate and lower house prices.

Let's look at another example. What happens if rents turn out to be higher than in the normal situation, but other things remain unchanged? When rents are higher than user costs, renters would become homeowners and save money. This would push up housing prices. House prices would rise until user costs and rents are balanced again. In summary, here's how each element in user costs and rents is related to house prices: House prices are higher when rents are higher, interest rates are lower, property tax rates are lower, the tax deduction rate is higher, maintenance and repair costs are lower, and house prices are expected to rise in the future. (See *User Cost-Rent Equivalence* for a more formal representation of the theory.)

However, these relationships are valid only when all other things do not change. For example, suppose the government decides to raise the property tax rate. Higher property taxes mean higher user costs and lower house prices, if nothing else has changed. However, a landlord's natural response might be to increase rents so that (at least a part of) the additional property tax is passed on to the tenants. When rents and the property tax rate both increase, it is hard to say what should happen to house prices, according to our theory.

THEORY MEETS DATA

Now let's look at how three of the six elements that affect user costs — rents, interest rates, and expected changes in house prices — have changed over time and discuss whether and to what extent such changes help us rationalize the changes in house prices. I do not discuss the other three — property tax rate, tax deductions,

and maintenance and repair costs — since it is hard to capture changes in the trends of these factors.⁶

Rents. As we saw in Figure 4, house prices and rents tend to move together (for example, look at the early 1980s). These synchronized dynamics are exactly what the equivalence between user costs and rents would suggest. Although rents have been less volatile than house prices, real rents and real house prices, on average, have been steadily increasing over time. To understand why, we will look at both the supply side and the demand side. On the supply side, a natural answer is the limited supply of land, especially in and around metropolitan areas. House prices and rents are increasing because the land on which houses and apartments are built has become more and more scarce. The two studies mentioned earlier — the one by Edward Glaeser and his co-authors and the one by Nobuhiro Kiyotaki and his co-authors — find evidence that supports the importance of the limited availability of land for the rising trend in house prices. On the demand side, it is natural that house prices and rents increase when the supply cannot adjust flexibly and the population — and therefore demand — is growing. That is the implication of the work by Mankiw and Weil reviewed earlier. My own research, cited earlier, supports the notion that demand for housing increases when individual income is becoming more volatile. When the availability of land, and thus housing,

⁶ Property tax rates differ state by state, and thus, it is hard to capture the trend of the average property tax rate. The effect of tax deductions on house prices is difficult to measure because the federal income tax features a progressive structure and various kinds of deductions and exemptions. Moreover, there has been no clear trend in terms of different levels of the income tax rate since 1975. Finally, there has been no substantial change in maintenance and repair costs.

User Cost-Rent Equivalence

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ormally, the equivalence between user costs and rents can be written in the following way:

$$\text{Rent} = \text{User cost} = (\text{Interest rate} + \text{Property tax rate} - (\text{Mortgage interest rate} + \text{Property tax Rate}) * \text{Tax deduction rate} + \text{Maintenance cost rate} - \text{Expected rate of capital gain}) * \text{House price}$$

For the simple exercise on page 27, I set the parameters as follows. The property tax rate is set at 1.5 percent per year. Maintenance and repair costs are set at 2.5 percent of house value per year. The tax deduction rate is set at 25 percent. These are the numbers used in the study by Charles Himmelberg, Christopher Mayer, and Todd Sinai. The expected nominal house-price growth rate is set at 3.7 percent per year, which is the average between 1975 and 2004. Finally, I add 2 percent as the risk premium of owning instead of renting, following Himmelberg and co-authors. Rents are 102 in 1997 (normalized such that the 1975 level is 100) and 115 in 2007. The interest rate is 6.6 percent in 1997 and 4.7 percent in 2007.

is limited, such an increase in demand pushes up house prices.

Interest Rates. Let's look at the interest rate, which is the second element that affects user costs. Figure 5 shows two types of interest rates: a 30-year fixed-rate conventional mortgage interest rate and the interest rate on 10-year Treasury securities. Thirty-year fixed-rate conventional mortgage loans are the type of mortgage loans the majority of homeowners obtain when purchasing a house. According to the American Housing Survey, in 2005 90 percent of U.S. primary mortgages were fixed-rate mortgage loans.

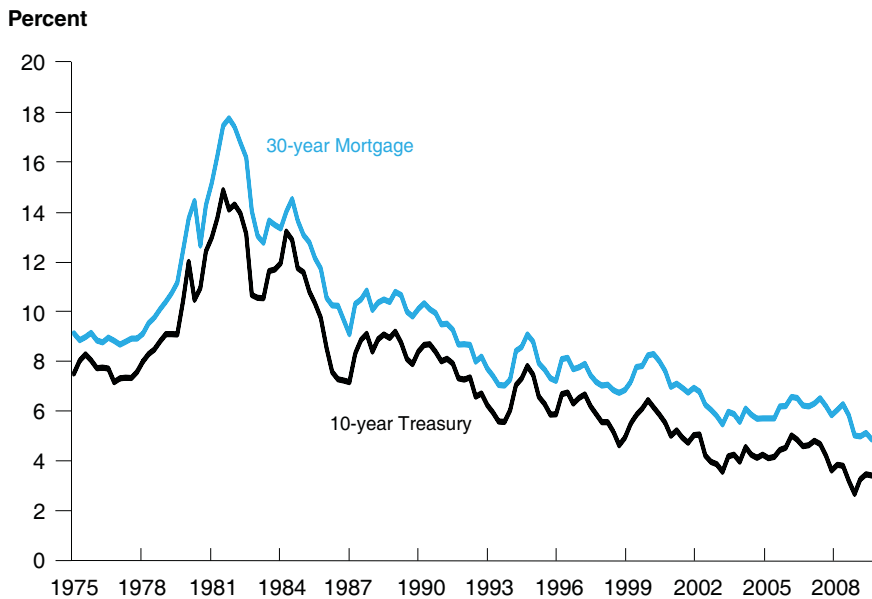
As easily seen in Figure 5, both interest rates have been dropping steadily since the early 1980s. According to the theory of user costs and rents, when the interest rate is declining, so is the user cost of owning a house, and house prices will increase.

Moreover, the effect of changes in interest rates on house prices becomes stronger when the interest rate is lower. For example, suppose the mortgage

interest rate declines from 2 percent to 1 percent. This 1 percentage point decline in the interest rate halves the interest rate and, thus, the interest cost. On the other hand, suppose the interest rate drops from 10 percent to 9 percent. Although the interest rate drops by 1 percentage point again, this reduces the interest cost by only one-tenth.

Expected Changes in House Prices. The third element that determines user costs is expectations. Although expectations about future changes in house prices are difficult to measure precisely, the literature discussed earlier supports the idea that people might have expected possibly rapid increases in house prices to continue in the future, especially from the mid 1990s through 2006. These expectations lowered the user cost of housing and resulted in an increase in house prices.

In summary, there is evidence to suggest that rents gained consistently, interest rates fell steadily, and people

FIGURE 5**Mortgage and Treasury Interest Rates**

Data source: Federal Home Loan Mortgage Corporation and Board of Governors of the Federal Reserve System

expected strong growth in house prices between the mid-1990s and the mid-2000s. According to the theory presented in this article, these elements are consistent with rising house prices during the same period. Moreover, if we were to observe the opposite — that is, rents falling, interest rates rising, and expected house prices falling — the user-cost theory would suggest that it would not be surprising to see house prices decrease.

A NUMERICAL EXAMPLE

By combining the user-cost theory and the actual data on rents and interest rates described above, we can generate house-price dynamics implied by the theory and the data. By comparing the actual house-price data and the data implied by the theory, we can learn to what extent the theory helps us understand house-price dynamics.

As an example, let's look at the

question of how much of the observed rapid increase in house prices between 1997 and 2007 can be explained by the user-cost theory. As explained above, the combination of steadily increasing rents and declining interest rates is consistent with an upward trend in house prices. We basically follow the strategy of Himmelberg and co-authors in setting numbers for this exercise. (More details can be found in *User Cost-Rent Equivalence*.) An important assumption is the expected growth rate of house prices. Let's assume that people expect that a nominal house-price growth rate of 3.7 percent per year will continue. This is the average house-price growth rate between 1975 and 2005. Notice that this is a rather conservative assumption because this growth rate is lower than the growth rate we observed between the 1990s and early 2000s.

The user-cost theory, combined with the observed changes in rents and

interest rates and a moderate assumption about expectations, implies that house prices went up by an average of 3.3 percent per year (39 percent between 1997 and 2007). This increase is smaller than 4.2 percent, which is the actual annual growth rate in average house prices from 1997-2007 (51 percent during the entire period). The simple theory of user costs accounts for about 80 percent of the growth rate of house prices during the period. The unexplained part might be due to changes in expectations or innovations in the mortgage market, such as the introduction of new types of mortgage instruments.


How sensitive is the result to a different assumption about the expected growth rate of house prices? For example, if we assume a low expected house-price growth rate of 1.85 percent per year (which is half of 3.7 percent), our theory implies that house prices went up by 2.8 percent per year between 1997 and 2007 — lower than 3.3 percent but still a large proportion of the observed 4.2 percent annual growth rate during the same period.

Finally, let me briefly discuss the recent sudden reversal of the trend in house prices. The numerical example generates a sudden reversal of the trend when there is a sudden reversal in expectations about the future trend of house prices. For example, suppose, in 2007, the expected annual growth rate of house prices suddenly dropped from 3.7 percent to zero, but everything else remained the same. Then the house price suggested by the model becomes 12 percent lower. The size of the drop is exactly the same as the drop in the national average house price index between 2007 and the third quarter of 2009. The change in expectations can be related to changes in fundamentals (for example, prospects for future income growth may have suddenly become bleak with the

economy slowing down) or it could be unrelated to changes in fundamentals (for example, the bursting of a bubble). We need a dynamic model that incorporates expectations to systematically analyze the sudden reversal in the trend, and many attempts, some of which are mentioned in this article, are being made to improve our understanding in this area.

CONCLUSION

This article presents a simple theory of house prices based on the equivalence between user costs and rents. Although it is a simple relationship, the theory tells how different types of housing market data are related to each other. For example, we use the theory to show that the observed increase in house prices since

the mid-1990s is consistent with the increase in rents, declining interest rates, and reasonable expectations about future house-price growth. The theory indicates that the sudden reversal of the trend in house-price growth is related to changes in expectations. 

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