In this appendix, we develop a more complete model of the housing market that explains how housing prices are determined and how they interact with residential investment.

We start our analysis by examining how housing prices are determined. Then, using a Tobin’s q theory approach, we consider how the price of housing determines residential investment.

**Determination of Housing Prices**

Panel (a) of Figure 19.A1.1 shows a supply and demand analysis of the housing market, where the relative price of housing, that is, the nominal price of a house relative to the general price level, \( P_H/P \), is represented on the vertical axis and the stock of housing, \( K_H \), is represented on the horizontal axis. Residential housing takes time to build and wears out very slowly. As a result, we can say that in the short run, the stock of residential housing (which includes old as well as new housing) is essentially fixed. With this assumption, the supply curve of houses is vertical, that is, the stock of housing remains at \( K_H^* \) regardless of the relative price of houses. The demand curve for housing is downward sloping because people can afford less housing when prices are higher. In the face of higher prices, individuals may choose to live in smaller houses or live with their parents or relatives, or they might be unable to live in a house at all.

As in any supply and demand analysis, the equilibrium relative price of housing occurs at the intersection of the demand and supply curves of housing. With a demand curve at D, the equilibrium is at point E, with a relative price of housing at \( P_H^*/P \).

1More accurately, the supply curve for housing in the short run would have a slight upward slope because an increase in the relative price of housing leads to higher residential investment, which adds to the stock of housing. However, any increase in the supply of housing relative to the existing stock of housing will be very small because new housing takes time to build and will represent only a small fraction of the existing stock of housing, since houses last a long time. It is therefore reasonable to assume that the supply curve for housing is vertical.
From House Prices to Residential Investment

The residential investment curve $I_H$ in panel (b) of Figure 19A1.1 shows the relationship between the relative price of housing and the construction of new homes, that is, the flow of residential investment. It is upward sloping: a rise in the relative price of houses leads to a higher level of new home construction. At an equilibrium relative price of $P_H^*/P$, residential investment is at $I_H^*$.

To see why the $I_H$ curve is upward sloping, recognize that the relative price of housing is analogous to Tobin’s $q$ for the housing market. The replacement cost of a house is likely to move with the general price level $P$, while the price of housing $P_H$ is the market valuation of the house. Thus $q$ in the housing market is $P_H^*/P$.

To demonstrate the Tobin’s $q$ reasoning for residential investment, let’s first suppose that the builder of a house plans to sell it. If the market valuation of the house is above its replacement cost, that is, the relative price of housing is high, then the builder profits by building it. Indeed, the higher housing prices are relative to replacement costs, the more profits builders will make from building houses, and so residential investment will be higher. Suppose, on the other hand, that the relative price of a house is low, so that its market value is below its replacement cost. Then a builder will not build the house because he or she will suffer a loss by building it: the builder would have to sell the house for less than what it costs to build the house. This reasoning provides the following result: **the relationship between residential investment and housing prices is positive.**

The reasoning behind the upward slope of the residential investment curve $I_H$ holds even if the house is rented out or the builder plans to live in it. If the house is rented, then the landlord (the builder) earns the rent from the renter over the life of the house,

**FIGURE 19A1.1**

**Determination of Housing Prices and Residential Investment**

In panel (a), the demand curve for housing is downward sloping, while the supply curve is vertical at $K_H^*$. The equilibrium occurs at point $E$, where the supply and demand curves intersect, with a relative price of housing at $P_H^*/P$. The $I_H$ curve in panel (b) is upward sloping, that is, a rise in the relative price of houses leads to a higher level of new home construction. At an equilibrium relative price of $P_H^*/P$, residential investment is at $I_H^*$. 
A Model of Housing Prices

and so the house’s market valuation is the expected discounted value of that rent over the life of the house. The higher the market valuation of the house relative to the cost of building it, the more profits the landlord makes, and so the more houses he or she will want to build. If the person building the house plans to live in it, then he or she is, in effect, earning rent on the house, called implicit rent because if that person didn’t own the house, he or she would have to pay rent elsewhere. The value of the house to the homeowner is then the expected discounted value of the implicit rent he or she would otherwise pay. The higher this value is relative to the cost of building the house, the greater is the incentive for the homeowner to build the house.

Changes in the Demand for Housing

What happens if the demand for housing rises, so that the demand curve shifts to the right from $D_1$ to $D_2$ in panel (a) of Figure 19A1.2? The rightward shift of the demand curve moves the equilibrium in the housing market from point 1 to point 2, and the relative price of housing moves from $P^*_1 / P$ to $P^*_2 / P$. Then, as we see in panel (b), the higher relative price leads to a movement from point 1 to point 2 on the $I_H$ curve, and residential investment rises from $I^*_1$ to $I^*_2$.

NEOClassical Theory and Housing Demand. Why does the demand for housing change? The answer is provided by the neoclassical theory of investment. If the expected future marginal product of capital curve shifts up, then the desired level of capital increases. In the case of housing, the equivalent analysis is that the higher the rent (explicit or implicit) that households are willing to pay, the higher the demand for housing, and so the housing demand curve will shift to the right, as in panel (a) of Figure 19A1.2. The relative price of housing will then rise, and residential investment will rise as well. Households will be able
to pay higher rent if their expected future income is higher, or if an increase in the number of households that will want housing bids up rent. The analysis in Figure 19A1.2 therefore produces the following result: **higher expected income or increases in household formation lead to higher demand for housing, an increase in relative housing prices, and higher residential investment.**

The user cost concept in the neoclassical theory of investment also applies in the housing market and provides another source of shifts in the demand curve for housing. Suppose the real interest rate on mortgage loans declines. Then the cost of financing a house purchase declines and the user cost of housing falls, so people will be able to buy a new or a bigger house. The analysis in panel (a) of Figure 19A1.2 then shows that the demand curve will shift to the right, yielding the following result: **a decline in real mortgage rates leads to a higher demand for housing, a higher relative price of housing, and an increase in residential investment.**

As we saw with the neoclassical theory, another component of user cost is the expected rate of change in the real price of the capital asset. In the context of housing, this term is the expected rate of change in real housing prices, and it can be a very important source of changes in housing demand. If households expect housing prices to appreciate, then the user cost declines, causing the demand for housing to increase and shifting the demand curve to the right, as in panel (a) of Figure 19A1.2. The relative price of housing will then rise, and residential investment will increase. Said another way, if housing is expected to be a good investment, demand for housing will increase and the demand curve will shift to the right. We thus have the following result: **a higher expected real appreciation of house prices leads to a higher demand for housing, a higher relative price of housing, and an increase in residential investment.**

Housing demand can also be affected by financing constraints. If mortgage lenders loosen lending standards and so make loans more readily available to households, then financing constraints become less binding and households that otherwise would have been unable to purchase houses will now be able to. As we have seen previously, the increased demand for housing will shift the demand curve to the right, as we see in panel (a) of Figure 19A1.2, causing the relative price of housing to rise, which, as shown in panel (b), will lead to higher residential investment. We then get the following result: **looser financing constraints lead to a higher demand for housing, a higher relative price of housing, and an increase in residential investment.** Using similar reasoning, **tighter financing constraints lead to a lower demand for housing, a lower relative price of housing, and a decrease in residential investment.**

**Summary: Residential Investment**

In summary, residential housing prices and investment are driven by the following determinants: expected future income, the rate of household formation, real mortgage rates, expected appreciation of housing prices, and financing constraints. We summarize the impact of each determinant on housing prices and residential investment in Summary Table 19A1.1.
**TABLE 19A.1**

**DETERMINANTS OF RESIDENTIAL INVESTMENT**

<table>
<thead>
<tr>
<th>Determinant</th>
<th>Change in Determinant</th>
<th>Change in Housing Prices and Residential Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected future income, $Y^e$</td>
<td>↑</td>
<td>↑</td>
</tr>
<tr>
<td>Household formation</td>
<td>↑</td>
<td>↑</td>
</tr>
<tr>
<td>Real mortgage rates</td>
<td>↑</td>
<td>↓</td>
</tr>
</tbody>
</table>

*Note: Only the effects of increases in the determinants are shown. The effects of decreases in the determinants on investment would be the opposite of those indicated in the third and last columns.*
### Table 19A1.1 Determinants of Residential Investment (Continued)

<table>
<thead>
<tr>
<th>Determinant</th>
<th>Change in Determinant</th>
<th>Change in Housing Prices and Residential Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected real appreciation of housing prices</td>
<td>$\frac{P^2_H}{P}$</td>
<td>$\frac{P^1_H}{P}$</td>
</tr>
<tr>
<td>Financing constraints</td>
<td>$\frac{P^2_H}{P}$</td>
<td>$\frac{P^1_H}{P}$</td>
</tr>
</tbody>
</table>

**Application**

**Boom and Bust in the Housing Market, 2001–2009**

From 2001 to 2006, U.S. housing construction was on a tear, with housing starts (the number of new houses put into construction) rising from around 1.5 million in 2001 to a peak of over 2 million in 2006, among the highest numbers of housing starts recorded in U.S. history (see Figure 19A1.3). Then, residential investment collapsed, with housing starts falling to around 500,000 in 2009. What caused this boom and bust in residential investment?

Our theory of the housing market suggests that we should first examine housing prices. Notice in Figure 19A1.3 that housing prices inflated like a bubble and then burst: relative...
housing prices boomed from 2001 to 2006 by over 70%, but then collapsed, falling by over 25% by 2009, marking the greatest swing in home prices in the U.S. post–World War II period. Our Tobin’s $q$ theory of residential investment indicates that this housing price boom and bust should result in a similar boom and bust in residential investment. That trend is exactly what we see in Figure 19A1.3, in which housing prices and housing starts move closely together, with the upward and downward swings of both series coinciding.

The relationship between residential investment and housing prices begs a deeper question: what caused such large swings in housing prices? Our theory of the housing market again suggests several contributing forces that increased the demand for housing, shifted the demand curve to the right, and increased housing prices, as is shown in panel (a) of Figure 19A1.4. The first force was the decline in real mortgage rates, which lowered the user cost of capital and thereby increased the demand for housing. Some economists attribute the fall in real mortgage rates to loose monetary policy, which kept real interest rates below zero from 2001 to 2005. Others attribute the decline in real mortgage rates to the large flows of capital from countries like China into the United States.² No matter the source, declining real mortgage rates lowered the cost of financing a housing purchase and decreased the user cost of housing. The result was increased demand for housing, a rightward shift of the housing demand curve from $D_1$ to $D_2$, and a rise in housing prices, as depicted in panel (a) of Figure 19A1.4.

A second and very important force was the “irrational exuberance” displayed by households that believed housing prices would keep on climbing at a rapid rate. Households

²See the Policy and Practice case in Chapter 15 that discusses the role of monetary policy in the housing boom.
expected large appreciation of housing prices, which lowered the user cost of housing and stimulated demand. The result is depicted in panel (a) of Figure 19A1.4: the demand for housing increased, the demand curve shifted to the right from $D_1$ to $D_2$, the relative price of houses rose, and residential investment boomed.

A third important force in creating the housing boom was the relaxation of lending standards, as described in Chapter 15. So-called subprime borrowers, borrowers who were not especially good credit risks, now found that they had easier access to credit. This relaxation of lending standards increased the demand for housing, shifted the demand curve to the right from $D_1$ to $D_2$, raised housing prices, and increased residential investment, as indicated in Figure 19A1.4.

The bust in housing prices occurred when the second and third forces turned in the opposite direction. At some point, households recognized that the boom in asset prices could not go on forever. Once they came to this realization, expected appreciation of housing prices ended, thereby raising the user cost of housing and causing demand to fall. The bubble burst and housing prices began to decline. Even worse, when housing prices began to decline, sentiment changed so drastically that the public began to expect declines in housing prices, lowering housing demand even further. With the bursting of the housing bubble and the onset of the financial crisis in 2007 (discussed in Chapter 15), financial frictions rose sharply, and so mortgage lenders began to tighten credit standards appreciably. Increased financing constraints made it harder to finance homes with mortgages, and demand for housing fell. The combination of the end of expected appreciation of housing prices and the tightening of financing constraints cut the demand for housing and shifted the demand curve to the left, as shown in panel (a) of Figure 19A1.5. The result was a decline in housing prices and a collapse of residential investment, as demonstrated in panel (b) of Figure 19A1.5. As we saw in Chapter 15, the housing price collapse resulted in the most serious financial crisis since the Great Depression, leading to a sharp contraction in economic activity.
A Model of Housing Prices and Residential Investment

Figure 19A1.5
Housing Bust
Starting in 2006, expected declines in housing prices and tightening of credit standards led to a drop in the demand for housing and a leftward shift of the demand curve, as shown in panel (a). The result was a decline in housing prices and a collapse of residential investment, as demonstrated in panel (b).

(a) Supply and Demand for Housing

- Step 1. Expected declines in prices and tightening credit standards decreased the demand for housing...
- Step 2. Shifting the demand curve to the left...
- Step 3. and lowering the relative price of housing...

(b) Residential Investment

- Step 4. which led to lower residential investment.

Relative Price of Housing: \( P_n/P \)
Stock of Housing: \( K_n \)
Residential Investment: \( I_n \)
SUMMARY

1. Residential housing prices and investment are positively related to expected future income, the rate of household formation, and the expected appreciation of housing prices.

2. Housing starts remained very depressed. How can financing constraints and expected real appreciation of housing prices explain this situation?

3. What would happen to housing prices and residential investment if, as part of an effort to balance the federal budget, Congress rescinded tax deductibility of mortgage interest payments?

REVIEW QUESTIONS AND PROBLEMS

1. How is residential investment related to housing prices?

2. What forces cause the demand for housing to increase, and how do each of these determinants affect housing prices and residential investment?

3. By 2012, in the aftermath of the global financial crisis, mortgage rates in the United States had fallen to historically low levels. Yet both housing prices and

4. Residential housing prices and investment are negatively related to real mortgage rates and financing constraints.