Lectures 7 – Housing

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1 Intro to housing

1. Today we start 3rd section of the course
   (a) Section 1: Location choice models
   (b) Section 2: Transportation
   (c) Section 3: Housing
2. Why is housing important?
   (a) Macroeconomic asset
      i. End of 2007, total assets in UK economy £7 trillion
      ii. End of 2007, total value of UK housing £4.3 trillion (62%)
      iii. £4.1 trillion privately owned.
   (b) Individual household asset
      i. In the UK, approximately 75% of households own. In the US, approximately 65% own. Other OECD countries typically have lower rates of homeownership.
      ii. Housing is the largest component of wealth for nearly all households. The major components of wealth are: 1) housing, 2) value of human capital (present value of future earnings), 3) present value of pension, 4) savings.
      iii. In 2005, housing wealth made up roughly 80% of the non-pension wealth of households in the British Household Panel Survey (BHPS) sample.

(c) Consumption good

   i. In 2006, housing expenditures made up about 17% of UK household expenditures.

(d) Risky asset

   i. In the UK, the average house price to average income ratio rose from 2.64 in 1969 to 4.76 in 2006. It was higher in London.
   ii. In 2008, house prices fell roughly 20% after rising at rates of 10-20% for at least the past 10 years. The house price fall and its relationship to the mortgage market is a major contributor to the credit crisis of 2007-2009.

(e) Collateral

   i. Enables households to borrow against future income.
   ii. Mortgages (when risk is properly measured and monitored and when house price risks are understood) become tradeable assets, enabling risk to be shared.
   iii. When not properly measured and monitored and when asset price bubble collapses, can lead to crisis.

3. Key characteristics of housing markets

   (a) Houses are differentiated products.
   (b) Houses are durable.
   (c) Large fraction of national capital stock
   (d) Large fraction of consumer budget
   (e) Housing acts as collateral for loans
   (f) House prices and rents are volatile. Risk to homeowners and to renters.
   (g) Moving costs (or transaction costs) are important.

      i. Stamp duty, varies between 1-5% of the house value.
      ii. Search costs are large.
      iii. One day a week for a month is 4 days.
      iv. Two months, 8 days.

v. Moving costs in time and materials are large.
vi. Fees associated with buying and or selling are large: realtors fees, legal fees, insurance fees, etc.
vii. Management costs of rental property.

(h) Externalities

i. Fire hazard and other building safety issues.
ii. Architectural and aesthetic values.
iii. Noise and other nuisances from use.
iv. Potential spillovers of quality on labour productivity, crime, public health.
v. Pollution
vi. Water pollution.
vii. Air pollution.

4. What we will discuss

(a) Briefly discuss implications of differentiation.

(b) Implications of durability

i. No longer a static model. Both current prices and interest rates and future prices and interest rates matter.
ii. Consumer must decide whether to buy or rent.
iii. Chooses to buy if user cost of ownership is lower than rental cost.
iv. Housing value should equal present value of rent in equilibrium.

A. What is present value?

(c) Public interventions in housing markets.

i. Tax treatment of housing.
ii. Rent control.
iii. Housing subsidies: supply side vs demand side.
iv. Regulation.

(d) Externalities and market failures related to housing

i. Safety related externalities exist.

ii. Market insurance against housing price fluctuations is often not available.

iii. Borrowing constraints are important.

iv. Contracts between landlords and tenants and between neighbouring owners can be costly to enforce.

2 Relation between rent and value: simplest case

1. The issues above potentially make analysis of housing complicated. Instead of addressing all the issues at once, we will treat them one at a time. So, for the time being, we will ignore almost all of the above complications.

2. Instead, assume all housing is homogenous and each person consumes one unit. For example, one unit of housing could be defined as one one-bedroom flat in Camden. The consumer must decide whether to rent or buy. To analyse this problem we must take into account dynamics. Assume that the consumer would like to live in the flat for T years.

3. If the consumer rents, they pay rent R_t per year. Assume the first rental payment is made at time $t = 0$,at the beginning of year 0. That is, assume that $R_0 > 0$. The consumer rents for T years paying R_0, $R_1, ..., R_{T-1}$.

4. If the consumer buys, they pay V_0 now, hold the property for T years and then sell at the end of year $T - 1$ for value V_T.

5. Should they rent or buy? Remember, we are considering the choice between renting a flat and buying an **identical** flat. The two are **identical in every dimension** including size, quality, and location.

6. The consumer should rent if the cost of renting is lower than the cost of owning. The cost of owning is V_0. To make a proper comparison, we must compare this with the *present value* of the stream of rental payments. The *present value* of the stream of rental payments is the sum of the future rental payments discounted by the interest rate. See below.

7. We need to make some assumptions about borrowing and lending. Assume the consumer can borrow and lend at interest rate i.

   (a) We assume that i is contant across time.

   (b) We assume that there is no inflation and that the value of the house will not increase or decrease over time. That is, we assume that $V_0 = V_T$. Remember, this is the simplest case, we will relax some of these assumptions later.

   (c) We assume that the interest rate is the same for both borrowing and lending and that there are no limits on how much the consumer can borrow.

   (d) This is the simplest case.

   (e) We will relax some of these assumptions later.

8. How much would it cost to rent if paid R_t pounds per year for T periods?

$$\begin{aligned} C_0 &= R_0 + \frac{R_1}{1+i} + \frac{R_2}{(1+i)^2} + ... + \frac{R_{T-1}}{(1+i)^{T-1}} \\ &= \sum_{t=0}^{T-1} \frac{R_t}{(1+i)^t}. \end{aligned} \tag{1}$$

   (a) The value $\frac{R_1}{1+i}$ is the *present value* of R_1 pounds to be paid at the end of year 0 (or at the beginning of year 1). If one puts $\frac{R_1}{1+i}$ in the bank today at interest rate i, then at the end of the year one has $\frac{R_1}{1+i} * (1+i) = R_1$. If the consumer wants to save enough money today to pay rent R_1 at the end of the year, it will cost them $\frac{R_1}{1+i}$ today. If a consumer can borrow and lend freely at interest rate i, then they will be indifferent between paying $\frac{R_1}{1+i}$ now and paying R_1 paid at the end of year 0.

   (b) Similarly, a consumer will be indifferent between paying R_2 at the end of year 1 (at the beginning of year 2) and paying $\frac{R_2}{(1+i)^2}$ now. The cost of paying $\frac{R_2}{(1+i)^2}$ now is $\frac{R_2}{(1+i)^2}$. The cost of paying R_2 at the beginning of year 1 is also $\frac{R_2}{(1+i)^2}$. To save enough today to pay R_2 at the beginning of year 1, the consumer must save $\frac{R_2}{(1+i)^2}$ today. This money will be worth $\frac{R_2}{(1+i)^2} * (1+i)^2 = R_2$ in two years' time.

(c) The total cost now of paying R_0 now, R_1 at the end of year 0, R_2 at the end of year 1, etc., is the sum of all these payments as written in equation.(1).

9. For example, if $T = 3$, then

$$\begin{aligned} C_0 &= \sum_{t=0}^{2} \frac{R_t}{(1+i)^t} \\ &= R_0 + \frac{R_1}{1+i} + \frac{R_2}{(1+i)^2}. \end{aligned}$$

10. If $T = \infty$, then

$$C_0 = \sum_{t=0}^{\infty} \frac{R_t}{(1+i)^t}.$$

When $R_t = R$ for all t, there is a simple formula for this expression. Let $\delta = \frac{1}{1+i}$. Using this notation and the fact that $R_t = R$, the present value can be written

$$\begin{aligned} C_0 &= R \sum_{t=0}^{\infty} \delta^t \\ &= R \left(1 + \delta + \delta^2 + \delta^3 + ... + \delta^t + ...\right). \end{aligned}$$

Since $\delta = \frac{1}{1+i} < 1$, we can make use of an important fact

$$\text{FACT} \qquad \sum_{t=0}^{\infty} \delta^t = \frac{1}{1-\delta} \ .$$

This fact is very useful and can be either derived from first principles or memorized. Using this fact we can write the present value as

$$C_0 = \frac{R}{1-\delta}$$

and since $\delta = \frac{1}{1+i}$,

$$C_0 = R\frac{(1+i)}{i}.$$

Note that if $R_0 = 0$ and $R_t = R$ for $t > 0$,, then the present value becomes

$$
\begin{aligned}
C_0 &= R\frac{(1+i)}{i} - R \\
&= \frac{R + iR}{i} - R \\
&= \frac{R}{i}.
\end{aligned}
$$

11. Assuming $R_0 = R_t = R > 0$, in the case where $T = \infty$, the consumer should rent if $\frac{R(1+i)}{i} < V_0$ and should buy if $\frac{R(1+i)}{i} > V_0$. The consumer is indifferent between renting and buying if

$$V_0 = \frac{R\,(1+i)}{i}$$

This view treats housing as a consumption good and compares renting and ownership based on their cost. An alternative but equivalent view is to view housing as an asset and compare the values of two alternative investments: investing in housing vs. renting and investing in an alternate asset. From this perspective, the fair market value for a flat that earns rent R per year over an infinite horizon is

$$
\begin{aligned}
V_0 &= C_0 = \sum_{t=0}^{\infty} \frac{R}{(1+i)^t} \\
&= \frac{R\,(1+i)}{i}.
\end{aligned}
$$

This is the fair market value because an investor is indifferent between having V_0 in cash and owning a flat that pays R per year if and only if the value of the flat is equal to V_0. This simple relationship assumes:

(a) The ability to borrow and lend at a single interest rate i.

(b) i, R, and V are constant forever.

(c) Zero transaction costs.

12. Note the dual role of housing. When considered as a consumption good, a consumer is indifferent between paying V_0 and R per year to

enjoy the services of the flat. From this perspective, both V_0 and R are costs. When considered as an investment good, an investor is indifferent between having V_0 in cash and paying V_0 to buy a flat that earns R per year in rent. From this perspective, V_0 is the value of the flat or asset and R is the flow of dividends. An investor who lives in their flat (a flatowner) is both an investor and a consumer. The owner of a flat of value V_0 who lives in that flat is effectively paying himself or herself rent of R per year. Their income from rent is R per year. Their costs in rent are also R per year. This is the opportunity cost of using the flat. If the owner did not use the flat, they could rent it to someone else.

13. User cost or opportunity cost of ownership

    (a) Consider a flatowner who owns a flat of value V. If they sell the flat and invest the money at interest rate i, then they will earn $R = iV$ forever. We define $R = iV$ to be the user cost of owning a flat outright. It is the opportunity cost of *not selling* the flat.

    (b) Consider a flatowner who borrows V to purchase the flat. They must pay iV at the end of every year in interest costs. Hence, $R = iV$ is the user cost of ownership to an owner who borrows to purchase their flat.

    (c) In both cases, the user cost of owning the home is $R = iV$

14. Suppose instead that a household faced two different interest rates, one for borrowoing and one for lending with $i_B > i_L$. In this case, the discussion above can serve as a starting point, but does not resolved all the issues. First of all, which interest rate should be used in the calculations of present value? For someone who is purely a borrower and who is not lending (or saving) the relevant interest rate is the borrowing interest rate. For someone who is purely a saver and does not need (want) to borrow, the relevant interest rate is the lending interest rate. So, one could define two present values : one for borrowers, one for lenders. Whether someone is a borrower or a lender will depend on their initial wealth, their expected future income, and their preferences for consumption now versus consumption in the future. More generally, suppose someone has initial wealth E and is considering whether to buy a house of current value $V > E$ or to rent an equivalent house at annual

rental price R. If they rent the house, then they invest the money E and earn interest i_L. If they buy the house, they invest E in the house but must borrow $M = V - E$ and pay interest i_B. The annual cost of the housing investment (as a percentage of house value) is $i_{avg} = \frac{E}{V} i_L + \frac{M}{V} i_B$ because the total interest cost of the investment is the weighted sum of the opportunity cost of the investment, i_L, and the direct cost of the investment i_B. The household could compare the costs by comparing $i_{avg} V$ to R. Alternatively, rather than looking at present value at time $t = 0$ or annual cost per year, the household could compare the total wealth obtained at the end of their stay. If both owning and renting provide the same flow of utility but one results in a higher level of wealth at the end of T periods, then it is the higher value option. Which provides the higher value will depend on i_B, i_L, V and E.

15. The discussion above treats the simplest case. Now, we will consider the impact of:
    (a) Taxes.
    (b) Maintenance costs.
    (c) Capital gains.
    (d) Inflation.

3 Other factors affecting the user cost of housing capital

1. As discussed above, housing is durable. In the simple model above with $i_B = i_L = i$, the user cost of owning a home of value V is $R = iV$. The user cost is also called the cost of capital.

2. Note, iV is the full interest cost whether one borrows money to buy or not:
    (a) Buy a house for £100,000, pay £20,000 in equity E, borrow $M =$ £80,000 at $i = 0.05$. $M + E = V$
    (b) Mortgage interest cost $iM = 0.05 * 80,000 = £4,000$
    (c) Foregone interest from equity $iE = 0.05 * 20,000 = £1,000$

(d) Total interest cost equals $i\,(M+E) = iV = \pounds 5,000$

(e) User cost is not the same as the mortgage payment

i. The mortgage payment is $P_t = iM_{t-1} + \Delta M_t$ where M_{t-1} is the amount of the mortgage at time $t-1$ and ΔM_t is the amount of the principal that the consumer pays back at time t. If M_{t-1} is the amount of the mortgage at time $t-1$ and ΔM_t is the amount of the mortgage that the consumer pays off at time t, then $M_t = M_{t-1} - \Delta M_t$.

3. Interest costs are not only costs of owning/renting a home. Other costs include:

(a) Property tax or council tax at rate T : cost $= TV$

(b) Operating cost (maintenance, repairs, insurance, utilities, book-keeping, etc.) at rate c: cost $= cV$

(c) Capital gains at rate g : cost $= -gV$

i. If the value of the property increases at 3% per year, you buy a house at £100,000 and can sell it a year later for £103,000 you have made £3,000. This reduces your cost of ownership by £3,000

ii. If value falls by 5%, you can sell it a year later for £95,000 you have lost £5,000. This increases cost by £5,000

4. User cost with these considerations is

$$R = (i + T + c - g)\,V$$

5. User cost is the total cost of holding a house for one year

(a) Imagine you have £100,000 in assets and you can either buy a house for £100,000 or invest the money elsewhere at $i = 0.05$ and rent the same house. $T = 0.01$, $c = 0.01$, and $g = 0.01$

(b) If you buy the house

i. You earn zero interest income

ii. You spend £1,000 on property tax, £1,000 on maintenance/insurance.

iii. Direct costs are £2,000

iv. At the end of a year you have £101,000 minus £2,000 in direct costs: £99,000

v. But user cost is £6,000. Think of it as follows

   A. Homeowner is both consumer and landlord

   B. As consumer pays landlord £6,000 in rent: consumer housing costs = £6,000

   C. As a landlord (owner of capital), income is £6,000 + £1,000 in capital gains and costs are £2,000 in direct costs

   D. Homeowner has total income of £7,000, direct costs of £2,000, and rental costs of £6,000. The rental income and rental costs cancel out and the net exenditure is £1,000

   E. At the end of the year you have £99,000

(c) If you rent from someone else

   i. The owner of the house sets

$$R = (.05 + .01 + .01 - 0.01)\, V = \pounds 6,000$$

   ii. You pay £6,000 in rent

   iii. You earn £5,000 in interest

   iv. Net expenditure is £1,000. At the end of 1 year you have £100,000 minus £1,000 in living expenses

6. So, if $R = (i + T + c - g)\, V$ then indifferent between renting and owning.

7. Inflation

   (a) Let π = inflation rate = $\frac{p_{t+1}}{p_t} - 1$ where p_t is the price level for consumption.

   (b) Must distinguish between real interest rate i^r and nominal interest rate i.

   (c) Ignoring income taxes, the real interest rate or real cost of borrowing is approximately the nominal interest payment minus inflation

$$\begin{aligned} i^r &\simeq i - \pi \\ i &\simeq i^r + \pi \end{aligned}$$

i. Suppose the nominal annual interest rate is 10% and inflation is 5%. If you borrow £100 pounds you must pay £110 next year. But, £110 next year is only worth 104.76 which is approximately 105 pounds. So the real interest rate is approximately 5%.

ii. When there is inflation of 2%, and real interest rate is 3%, the nominal interest rate must be 5%.

iii. If you borrow £100 and pay back £100 with 2% inflation, the £100 is only worth \$98.04. Just to break even, the lender must charge 2% interest.

(d) Similarly, if nominal house prices increase by g percent, the real capital gains rate, g^r is

$$\begin{aligned} g^r &\simeq g - \pi \\ g &\simeq g^r + \pi \end{aligned}$$

(e) Capital cost with inflation is

$$R = (i^r + \pi + T + c - g^r - \pi)\, V$$

or

$$R = (i^r + T + c - g^r)\, V$$

(f) In a world without income taxes, with perfect markets and no uncertainty, inflation has no effect on user cost of housing. The user cost of housing can be expressed as before with real interest rates and real capital gains replacing nominal interest rates and nominal capital gains.