Housing and the wider economy in the long term - or who can ever buy a house in London or Manhattan again?

David Miles and James Sefton

Imperial College Business School

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Figure 9: House price to earnings ratio in London, 1969-2014

Ratio of mean house price to estimated median earnings

Figure 10: Median house price to 70th percentile earnings ratio by London Borough, 2014

Sources: Land Registry price paid data, and ASHE residence based full-time earnings at the 70th percentile. Notes: Earnings data for Lambeth and Richmond are based on 2013. Data for Kensington and Chelsea, Westminster and the City of London are not available due to the small sample sizes.
Figure 12: Income multiples in London and the UK, 1980-2015

Median loan-to-income ratios

Sources: CML Regulated Mortgage Survey (2005 onwards), Survey of Mortgage Lenders (pre-2005), and the Building Societies 5% sample of mortgage completions (prior to 1993). The figures since 1993 are not strictly comparable with earlier ones because of material differences in reporting methodologies and the sample of lenders.

Figure 15: Mean and median real house prices, 14 countries.
Land prices follow similar pattern as house prices

Figure 19: Mean real farmland and house prices, 11/13 countries.
But construction costs do not rise as much as land prices or real house prices

Looking to the very long term…

- Suppose population and labour productivity grow at a steady rate in an economy. Can we expect the price of houses to stabilise relative to incomes?

- When might the house price to income ratio be falling for long periods..when rising?

- What implications does this have for the return on capital?

- Can we have an ever rising house price to income ratio?

- Does that mean an ever declining owner occupation rate?

- The answer depends on four – largely unrelated – factors:
Looking to the very long

• Four factors:

  1. technology of producing houses – how are land and structures mixed.

  2. preference for housing versus other goods and preferences for different mixes of land and structure in housing

  3. the nature of bequests and how wealth is transferred from the old to middle aged and on to the relatively young.

  4. The available mortgage loan to value ratio.

• We focus on the first two…where it turns out that very different paths for the economy can emerge with even small changes in a couple of key parameters.
Looking to the very long

- Under plausible sets of parameters in a simple long run growth model we find house prices can rise forever relative to the price of other goods and also rise continually relative to incomes.

- The key parameter is the substitutability of land and structures in the production of housing services.

- This is a parameter that reflects technology and preferences. It is one that Muth investigated in detail some 40 years ago.

- Its interpretation is subtle and how it evolves is of great significance.
A MODEL OF HOUSING AND THE WIDER ECONOMY OVER TIME:
Assume a standard time-separable CRRA welfare function on aggregate consumption

\[ W = \int_{0}^{\infty} \frac{1}{1 - \gamma} Q_t^{(1-\gamma)} e^{-\theta t} dt \]

Aggregate consumption is a CES basket of the numeraire good, \( C \), and shelter, \( S \), (housing services)

\[ Q_t = \left[ aC_t^{1-1/\rho} + (1 - a)S_t^{1-1/\rho} \right]^{1/(1-1/\rho)} \]
Production Technology

- Production technology of the single good is described by Cobb Douglas function, \( F \) on capital \( K \) and fixed labour supply \( L_0 \).
- Technical progress, at rate \( g \), is labour augmenting.
- The single good can be consumed \( C \) or invested \( I_K \) in capital \( K \) or invested \( I_B \) in residential buildings \( B \) thus

\[
C + I_K + I_B = F(K_t, L_0 e^{gt}) = AK_t^\alpha (L_0 e^{gt})^{1-\alpha} \quad \text{where}
\]

\[
\dot{K} = I_K - \delta_K K
\]

\[
\dot{B} = I_B - \delta_B B
\]

- Shelter, \( S_t \), is produced from buildings, \( B_t \), and a fixed supply land, \( R \) according to the CES technology

\[
S_t = H(B_t, R) = \left[bB_t^{1-1/\varepsilon} + (1-b)R_t^{1-1/\varepsilon}\right]^{1/(1-1/\varepsilon)}
\]
We can write down the Hamiltonian for the problem

$$\max \left\{ \frac{1}{1 - \gamma} \left[ aC_t^{1-1/\rho} + (1 - a)H(B_t, R)^{1-1/\rho} \right] \frac{1-\gamma}{1-1/\rho} + \lambda_{1,t} (F(K_t, L_0 e^{gt}) - C - l_K - l_B) + \lambda_{2,t} (l_K - \delta_K K) + \lambda_{3,t} (l_B - \delta_B B) \right\}$$

Rearranging the FOC and co-state equations gives the necessary optimality conditions

$$\frac{\partial F}{\partial K} - \delta_K = \frac{b(1 - a)}{a} \left( \frac{C_t}{S_t} \right)^{1/\rho} \left( \frac{S_t}{B_t} \right)^{1/\epsilon} - \delta_B \quad \text{(return to capital = return to buildings)}$$

$$r_t - \theta = \gamma \frac{\dot{C}}{C} - \left( \frac{1}{\rho} - \gamma \right) (1 - a) \left( a \left( \frac{C_t}{S_t} \right)^{1-1/\rho} + (1 - a) \right)^{-1} \left( \frac{B}{S} \frac{\partial H}{\partial B} \right) \frac{\dot{B}}{B} \frac{\dot{C}}{C}$$

and the transversality condition  $$\lim_{t \to \infty} K_t e^{-\int_0^t r d\tau} = 0.$$
Housing Sector

- If we define the relative price of shelter, \( p_S = \frac{\partial Q}{\partial S} / \frac{\partial Q}{\partial C} \) then national accounting identity follows from CRS

\[
\frac{p_S S_t - \delta B B_t}{\text{Net Consumption of housing services}} = \left( p_S \frac{\partial H}{\partial B} - \delta_B \right) B_t + p_S \frac{\partial H}{\partial R} R_t \quad \text{Land Rental}
\]

- Define the price of land as \( p_R = \int_0^\infty p_S \frac{\partial H}{\partial R} e^{-\int_0^t r d\tau} \) then the price of house, \( p_H \) follows as

\[
p_H = \frac{B_t + p_R R_t}{S_t}
\]

and user cost of housing

\[
r_t p_H = p_S - \delta_B \left( \frac{B_t}{S_t} \right) + \dot{p}_R \left( \frac{R_t}{S_t} \right)
\]
Housing Sector (II)

- Key parameter, $\varepsilon$: The net return on residential buildings equals the interest rate

$$r = p_s \frac{\partial H}{\partial B} - \delta_B \quad \implies$$

$$p_s = \frac{r + \delta_B}{\partial H/\partial B}$$

- Hence the rise in the price of housing services depends critically on $\varepsilon$

$$\lim_{B \to \infty} \frac{\partial H}{\partial B} = \lim_{B \to \infty} b \left[ b + (1 - b) \left( \frac{R_t}{B_t} \right)^{1 - 1/\varepsilon} \right]^{1/\varepsilon} = b^{1/(1 - 1/\varepsilon)} \quad \varepsilon > 1$$

$$\lim_{B \to \infty} \frac{\partial H}{\partial B} = \lim_{B \to \infty} b \left[ b + (1 - b) \left( \frac{R_t}{B_t} \right)^{1 - 1/\varepsilon} \right]^{1/\varepsilon/(1 - 1/\varepsilon)}$$

$$= \lim_{B \to \infty} b (1 - b)^{1/\varepsilon/(1 - 1/\varepsilon)} \left( \frac{R_t}{B_t} \right)^{1/\varepsilon} = 0 \quad \varepsilon < 1$$
Land is not homogeneous

- Imagine a circular country radius $\Gamma$, where land effectiveness/desirability declines at rate $\lambda$ from the centre. Then

$$R = \int_0^\Gamma e^{-\lambda s}2\pi s \, ds = \frac{2\pi}{\lambda^2} \left( 1 - e^{-\lambda \Gamma} (1 + \lambda \Gamma) \right)$$

and so the ratio of effective useable units of land is

$$\frac{R}{\pi \Gamma^2} = \frac{2}{(\Gamma \lambda)^2} \left( 1 - e^{-\lambda \Gamma} (1 + \lambda \Gamma) \right)$$

- So imagine a circular country $\Gamma = 100$ miles, value of land falls by 1% per mile ($\lambda = 0.01$) then this ratio is 0.528. If $\Gamma = 500$ miles the ratio is only 0.077.

- As $\Gamma \to \infty$ then $R \to 2\pi / \lambda^2$. So with $\lambda = 0.01$ the area of effective land tends to 62,832 square miles, which is equivalent to a country of constant land quality and radius 141 miles.
Falling Transport Costs (technological progress).

- Price of land will also decline with the distance, $s$, from the centre

$$p_R(s) = p_R(0)e^{-\lambda s}$$

implying the building / land mix of housing varies with the distance from the centre.

- For 70 years prior to 1945, transport costs fell dramatically - massive road and rail building programmes - falling journey times.

- In the 70 years since 1945, both transport costs and journey times have remained relatively constant.
## Base Case Parameters

<table>
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<th>Parameter</th>
<th>Value</th>
<th>Notes</th>
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<td>$g$</td>
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<td>$\rho$</td>
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<td>$\rho &lt; 1$ Ermisch, Findlay, Gibb (1996)</td>
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<tr>
<td>$\epsilon$</td>
<td>0.5, 0.75, 0.99, 1.25</td>
<td>$\epsilon &lt; 1$ Muth (1971), Thorsnes (1997) and Ahlfeldt, Daniel McMillen (2014)</td>
</tr>
</tbody>
</table>
$\varepsilon = 0.5$
$\epsilon = 0.5$  average annual house price growth 2.81%, growth in Y 1.90%
\[ \varepsilon = 0.75 \]
$\varepsilon = 0.75$  
average annual house price growth 1.95%, growth in Y 1.90%
\( \varepsilon = 0.99 \)
$\varepsilon = 0.99$ average annual house price growth 1.18%, growth in Y 1.90%
$\varepsilon = 1.25$
\[ \varepsilon = 1.25 \] average annual house price growth 0.73%, growth in Y 1.90%
ε = 0.5, ρ = 0.8
\( \varepsilon = 0.5, \rho = 0.99 \)
$\epsilon = 0.6, \ \rho = 0.8$
$\varepsilon = 0.7, \rho = 0.7$
$\varepsilon = 0.99$, $\rho = 0.99$
$\varepsilon = 0.5, \rho = 0.6$ and growth in effective land area of 0.5% a year for first 100 years.
Looking to the very long term...the key parameter

Muth – forty years ago – estimated that $\epsilon$ was about 0.5. But that was for US and it reflected 1970s and 1960s house building technology.

Maybe it reflected preferences too.

Both may change....

Super tall buildings with very small footprints are now feasible...and desired.

http://nyti.ms/1OjcE9l
Looking to the very long term…

From the NY Times, December 2015:

“As recently as two years ago, only five towers in NYC topped 1,000 feet. Now, there are that many “supertall” towers in the works on 57th Street alone, and roughly two dozen either under construction or on the drawing boards across Manhattan and in Brooklyn.

These slender cloud-busters would not have been built without the confluence of new technologies and wealthy buyers seeking a Manhattan address. Superstrong concrete and new wind testing made possible buildings like 432 Park, which, at 93 feet wide, is 15 times as tall as it is wide. In effect, developers now need only a lot the size of a brownstone or three to build a tower, rather than much of a block, as with the 1,250-foot Empire State Building, which, when it opened in 1931, was the tallest building in the world.”
So what is $\varepsilon$??

- Q: By how much would you need to spend more on structure as the land used by a house is reduced to keep the house equally desirable?

- With the production relation specified above (a CES function) the answer depends on the existing ratio of B to R and also on $\varepsilon$.

- The next table shows the story.....
percentage change in B to compensate for 1% fall in R, evaluated at various ratios of B/R and for various values of $\varepsilon$

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<th>B/R</th>
<th>$\varepsilon$</th>
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<td>2.20</td>
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<td>6.45</td>
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</tbody>
</table>
Looking to the very long term…

- I think intuition suggest that $\varepsilon < 1$
- That means that if land is fixed the elasticity of housing supply will go to zero.
Looking to the very long term... issues for a richer model

Suppose house price to income ratio keeps on rising. But people can only borrow 90% of a house. Then it takes ever longer to buy.

Does the owner occupation ratio fall consistently?

What about bequests?

What does a society with 90% renting look like? This is Britain in 1914.

BUT: the houses would probably be owned much more equally – indirectly in savings vehicles owned quite widely.

There is no reason why a country with a low owner occupation rate need be one with very unequal ownership of wealth.
Conclusions

• Plausible parameter estimates plugged into a simple growth model can easily generate ever rising house prices – relative to other goods AND to incomes.

• But there is great sensitivity to parameters that reflect both preferences (between different characteristics of houses) and technology.

• The key technology factor is how one combines structures and land to create housing. That has changed …see the New York and London skylines. But can it make $\varepsilon > 1$?

• Ownership structure cannot be assessed in our stylised infinite horizon, representative agents model. You have to introduce credit markets, finite lives and bequests.

• Housing over long term could become increasingly rented. Houses could become like jets - too expensive for most people to own so almost exclusively rented…with people indirectly owning claims on houses (jets) via holding shares in property companies (airlines).