This Paper

- Estimate carefully the discount associated with homes with different lease terms.
- Being very intuitive in using these discount rates to estimate the term structure for the very long-run discount rate.
  - Inconsistent with constant discount rate model (Gordon model).
  - Inconsistent with a simple stochastic discount factor model.
  - Inconsistent with models that have upward sloping term structure for the long run risk.
Implications for the term structure

Main puzzle:

1. short-term return to housing at least 6.5 % (consistent with housing being a very risky asset)
2. long-run discount rate for housing return should be much lower to be consistent with the estimated discount rates for different leaseholds.

The result is only consistent with models that have downward sloping term structure.

- Authors preferred solution: a mix of hyperbolic and exponential discounting
- Another possible solution: mean reversion in housing returns (Lettau-Wachter framework)
Sample selection bias

- both leaseholder liquidity constraint and lease extension fixed costs can result in positive correlation between property value and lease-term.

The estimated discount rates are not necessarily a puzzle for a stochastic discount model.

- in order to be a puzzle we need to assume both:
  1. low long-run house prices growth
  2. high risk premium for claims to long-run house prices.

Leaseholds holdup problem can also result in a “downward sloping term structure”.

Sample selection bias

- In UK, you can extend your lease by 90 years. The cost for a 80.001 year leasehold is:
  - a fixed legal cost: £4,000-£5,000
  - a variable cost less than 2% of the property value.

- *Fixed cost of lease extension* → *lease extension is relatively cheaper for more expensive houses.*
  - For an average flat in UK (£100,000) extension cost is about 7% of the value of the property.
  - For a £400,000 flat this cost is about 3% of the value of the property.

- Sample selection bias I: positive sorting into lease extension.

- A test for selection to lease length based on property value:
  - Estimate the discount between 80-100 year leasehold and 170-190 year leaseholds for different cities
  - estimate the relation between the estimated discount rate and city-average house prices.
The estimated discount rate between a 80 year leasehold and 170 year leasehold is about 13%

- For an average flat (£100,000) lease extension is a £6,000 arbitrage opportunity.
- For an average flat in London (£400,000) lease extension is a £40,000 arbitrage opportunity.

Question: Why there is such a huge arbitrage opportunity?

- If the answer is that the seller is constrained, then this can result in further sample selection bias

Regression of rents on leaseholds (Table 3) does not address liquidity problem.
Let’s go to the puzzle

Let’s keep the assumption that leaseholds and freeholds have the same flow of rent income during the leasehold period.

Arbitrage equation:

Freehold Price = a T-maturity leasehold price + present value of a freehold starting at time T.

\[
Disc^T = \frac{E_t[P_T]/P_t}{R^{f}_{t,t+T} + R^{P}_{t,t+T}}
\]

This equation only requires:

- risk free rate in long run
- average house price growth in long-run
- risk premium of long run house prices.
Long run house prices growth

- Historical data: 2.9% for UK (1952-2009), 7.2% for Singapore (1975-2009)
  - It is possible that it is an overestimation of long run growth
- If housing supply is relatively inelastic (and constant share of housing expenditure): real house prices is co-integrated with consumption, \( \text{GDP} = \text{long-run growth} = 2\% \)
  - Both Singapore and UK look inelastic (not only 70 years from now but also today)
  - We will check robustness to other values of house prices growth as well.
How risky are long run house prices?

- Let's look at the variance of annual house price growth rate from $t$ to $t + T \left( \frac{\ln(hpi_{t+T}/hpi_t)}{T} \right)$ for different values of $T$ (similar to Cochrane JPE 1988).

- Downward sloping term structure or downward sloping risk?
Baseline: $h_{pg} = 2\%$, $RP = 3.8\%$, $R^f = 1.4\%$

Low Growth-Low Risk: $h_{pg} = 0.7\%$, $RP = 2.3\%$, $R^f = 1.4\%$

Low Growth-High Risk: $h_{pg} = 0.7\%$, $RP = 4\%$, $R^f = 1.4\%$
What about high rates of return on housing?

Does high rate of return imply long-run house prices are risky?

- Median household moves every six years → The main risk is asset value risk in the short term.
  - From historical data, volatility of $g_{t,t+6}$ is at least five times larger than volatility of $g_{t,t+25}$.

- Housing is a very illiquid asset (6% transaction cost)
  - Even if housing is not risky, it should have a high return to compensate homeowners for its illiquidity / transaction cost (Kaplan and Violente 2010).
An alternative model of “downward sloping term structure”

- So far we assumed that rent incomes from a leasehold and rent incomes from a freehold are the same.
- However a hold-up problem can result in:

\[(Rent \ Leasehold)_t = (Rent \ Freehold)_t \times [1 - \alpha e^{-\gamma(T-t)}]\]

- Basically you don’t remodel your kitchen if you know you won’t be the owner of the home the next year.
- Then even assuming a constant rate of return for housing \((r)\) and a constant growth rate for freehold rental income \((g)\), leasehold discount is equal to:

\[
\frac{P^T_t}{P_t} = \left(1 - e^{-(r-g)T}\right) - \alpha \frac{r - g}{r - g - \delta} \left(e^{-\gamma T} - e^{-(r-g)T}\right)
\]

\(\text{Gordon Formula}\)

\(\text{Present Value of Hold-up}\)
The importance of holdup problem

- Present value of hold-up problem is a decreasing function of remaining years of lease.
- This result in shorter leaseholds being discounted faster than what Gordon Formula predicts.
- Hold-up problem can be quantified by extending the regression of rents for leases below 80 years.

\[ \alpha = 0.3, \quad \gamma = 0.02, \quad r = 4.5\%, \quad g = 1\% \]
Almost all the asset pricing puzzles between a freehold and a 80 years leasehold exist between a 80 years leasehold and 150 years leasehold.

Within differences emphasis keeps paper more focused.

Compute the discount between 80 year leasehold and 150 leasehold during a boom period and during a bust and see if they are different.

A robustness check for stochastic discount factor model.

It is hard to reject even upward sloping term structure models if either rental income (relative to a freehold) or riskiness of housing capital gain is declining over time.

Model needs representative agent to be hyperbolic and exponential discounting but individual agents to not
Conclusion

- This is a unique framework to quantify how long-run risk interacts with short-run risk in determining asset prices.
- Can’t imagine a better setting (or data) to learn about how people value and form expectations about 200+ years from now.
- Puzzle is very intriguing, but
- without putting some more structure on the data it is very hard to rule out other stories about the term structure.