House Prices and Consumer Spending

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Consumption Decline in Great Recession
Consumption Response to House Prices in the Data

- deep consumption decline in Great Recession, even relative to other bad recessions
- growing literature points to large decline in housing wealth
- various measures of consumption respond strongly to house price movements under various identifications:
  - Campbell and Cocco (2007): UK non-durable exp ($\approx 1.22$)
  - Case, Quigley and Shiller (2013): state-level data (0.03 – 0.18)
  - Mian, Rao, and Sufi (2013): county Mastercard spending + autos spending (0.13 – 0.26)
  - Stroebel and Vavra (2015): Nielsen homescan spending
Question

broad question: can consumption models rationalize this evidence?

in particular:

• can a standard model with incomplete markets work?

• what are the channels?

• does the level/distribution of household debt matter?

• does the type of shock to house price matter?
Results I: Model

- wide class of Bewley-type of models $\rightarrow$ simple formula:

$$\frac{\Delta C_{it}}{\Delta P} = MPC_{it}(1 - \delta)H_{it-1}$$

- special case: PIH $\rightarrow$ very low consumption elasticity

- uncertainty + borrowing constraint $\rightarrow$ higher leverage
  $\rightarrow$ MPC bigger and sufficiently correlated with housing $\rightarrow$ very large elasticity

- adjustment costs $\rightarrow$ formula holds approximately and response does not change much

- rental option $\rightarrow$ formula still holds approximately, but elasticity smaller because high MPC HH will decide to rent
Results II: Data

- we then try to estimate our formula in the data with different approaches

- preliminary results:
  large elasticities roughly consistent with the model
Results III: “Bubble”

• counterfactual responses of housing demand and debt to house price shocks

• ⇒ explore changes in expected housing appreciation

• realistic implications for the housing market

• ... but formula does not hold anymore

• asymmetric response of consumption to boom and bust
Set up

- households indexed by $i$ live $J = 60$ periods
- work for $J_y = 35$ periods and retired for $J_o = 25$
- $j_{it} = \text{age of household } i \text{ at time } t$
- two assets: a risk-free asset ($A_{it}$) and housing ($H_{it}$)
- risk-free asset yields interest $r$
- housing stock yields housing services one for one
- depreciation rate $\delta$ and deterministic house prices $P_t$
Preferences

- for household $i$ at time $t$ with $j_{it} < J$:

$$U(C_{it}, H_{it}) = \frac{(C_{it}^\alpha H_{it}^{1-\alpha})^{1-\sigma}}{1 - \sigma}$$

- bequest motive for $j_{it} = J$:

$$U(C_{it}, H_{it}) + \beta \frac{\Psi}{1 - \sigma} \left( \frac{\Gamma_i + (1 - \delta) P_{t+1} H_{it} + (1 + r) A_{it}}{\hat{P}_{\chi t}} \right)^{1-\sigma},$$

$\hat{P}_{\chi t} =$ price index that converts nominal into real wealth
Constraints

- **budget constraint**

\[ C_{it} + P_{t}H_{it} + A_{it} = Y_{it} + (1 - \delta) P_{t}H_{i,t-1} + (1 + r) A_{i,t-1} \]

- **borrowing constraint**

\[-(1 + r)A_{i,t} \leq (1 - \theta)(1 - \delta)P_{t+1}H_{i,t} \]

- **income process when agent works:**

\[ Y_{it} = \exp\{\chi(j_{it}) + Z_{it}\} \]

where and

\[ Z_{it} = \rho Z_{i,t-1} + \eta_{it} \]

- **social security process as in Guvenen and Smith (2014)**
Recursive formulation

- state \((W, s)\) where \(W \equiv \) total wealth and \(s \equiv (z, j)\)

- for all \(j < J\):

\[
V_t(W, s) = \max_{C, H, A, W'} U(C, H) + \beta E[V_{t+1}(W', s')|s]
\]

subject to

\[
C + P_t H + A = W + Y(s)
\]
\[
W' = (1 - \delta)P_{t+1} H + (1 + r)A
\]
\[
(1 - \theta)(1 - \delta)P_{t+1} H + (1 + r)A \geq 0
\]

- for \(j = J + 1\), bequest motive:

\[
V_t(W, s) = \frac{\Psi}{1 - \sigma} \left( \frac{\Gamma(s) + W}{\hat{P} \chi_t} \right)^{1-\sigma}
\]
Benchmark

- special case = permanent income:
  1. no income uncertainty
  2. constant house prices
  3. no borrowing constraint

- assume

  \[ \beta (1 + r) = 1 \]

- optimal consumption with a specific choice of \( \Psi \):

  \[ C_t = \alpha (1 - \beta) \left[ \sum_{j=0}^{J} (1 + r)^{-j} Y_{t+j} + (1 - \delta) PH_{t-1} + (1 + r) A_{t-1} \right] \]
Benchmark: Some Numbers

- elasticity of consumption to house prices

\[
\frac{dC}{C} / \frac{dP}{P} = \frac{(1 - \delta)PH_{t-1}}{\sum_{j=0}^{j}(1+r)^{-j}Y_{t+j} + (1 - \delta)PH_{t-1} + (1 + r)A_{t-1}}
\]

- set \( r = 2.5\% \), then human wealth is \( \approx Y/r = 40Y \)

- set \( (1 - \delta)PH = 2.15Y \) and \( A = -0.32Y \)

  \[ \text{elasticity} = 0.0514 \]

- suppose household debt goes up by 0.5Y so that \( A = -0.82Y \)

  \[ \text{elasticity} = 0.0520 \]
Benchmark: Take Out

- implication 1: aggregate elasticity is very small
- implication 2: aggregate elasticity minimally affected by household debt
- implication 3: the old are the ones with higher elasticities
General Model

- **Proposition**: individual consumption response to a permanent change in house price:

  \[ \Delta C_{it} / \Delta P_t = MPC_{it} (1 - \delta) H_{it-1} \]

- two key assumptions:
  1. liquid housing wealth
  2. Cobb-Douglas/CRRA preferences (we can extend the formula for CES and \( \theta = 0 \))

- \( \rightarrow \) individual elasticity:

  \[ \eta_{it} = MPC_{it} \frac{P_t (1 - \delta) H_{it-1}}{C_{it}} \]
Simple Formula

- this is not just a definition!

- MPC is out of a temporary income shock

- important implication: leverage \((A/H)\) and the collateral parameter \((\theta)\) only matter through MPC

- 3 effects cancel out:
  income effect + substitution effect + collateral effect

- 1 effect survives: endowment effect!
Proof

• let \( \tilde{H} = PH \):

\[
V(W, s) = \max_{C, \tilde{H}, A, W'} P^{(\sigma-1)(1-\alpha)} U(C, \tilde{H}) + \beta \mathbb{E}[V(W', s')]
\]

subject to

\[
C + \tilde{H} + A = W + Y(s)
\]
\[
W' = (1 - \delta) \tilde{H} + (1 + r)A
\]
\[
(1 - \theta)(1 - \delta) \tilde{H} + (1 + r)A \geq 0
\]

• \( \Rightarrow \) consumption policy \( C(W, s) \) does not depend on \( P \! \)

• \( \Rightarrow \) \( dC(W, s)/dP = dC(W, s)/dW \cdot dW/dP \)
Calibration

- model is annual
- interest rate \( r = 3\% \)
- intertemporal elasticity \( \sigma = 1 \) (log utility)
- depreciation rate of housing is \( \delta = 2.2\% \)
- collateral constraint \( \theta = 0.25 \)
- income process with \( \rho = 0.91, \sigma = 0.21 \) (from PSID/Floden and Linde 2001)
- \( \alpha = 0.93 \) and \( \beta = 0.945 \) chosen to obtain

\[
\frac{PH}{Y} = 2.56 \quad \frac{A}{Y} = -0.30
\]

from Survey of Consumer Finances 2001
Elasticities over the Life Cycle

Average elasticities over the lifecycle
Housing and Net Liquid Wealth over the Life Cycle

Lifecycle averages

Housing
Non-housing wealth
Data: Housing and Net Liquid Wealth over Life Cycle

Age Profile of Home values and Liquid Wealth

-500000 -500000 -50000 0 50000 100000 150000 2001 Dollars

Age Profile of Home values and Liquid Wealth

AGE

2001 Dollars

0 0 50000 100000 150000

0 0 50000 100000 150000

-50000 -50000 -50000 0 50000 100000 150000

20 30 40 50 60 70 80

AGE

Home Values

Liquid Wealth Net Housing Debt
Housing and net worth

Housing conditional on wealth

Model
SCF 2001
Baseline: Take Out

- Implication 1:
  aggregate elasticity is large = 0.37
  (working life: 0.41)

- Implication 2:
  aggregate elasticity affected by household debt distribution

- Implication 3:
  the young are the ones with higher elasticities because are more levered
Adjustment Costs

- with liquid housing wealth housing adjusts too much
- → introduce adjustment costs
- fixed cost of trading housing proportional to house value
  \[ \kappa_{it} = F \cdot P_t H_{it-1} \mathbb{1}_{H_{it}\neq H_{it-1}} \]
- adjustment cost \( F = .05 \)
- average elasticity still high = 0.47 (working life)
- previous formula does not hold analytically anymore
- still a good approximation for small/realistic values of \( \theta \)
Simple Formula Accuracy: $\theta = 0.25$
Simple Formula Accuracy: $\theta = 0.5$

![Graphs showing average elasticities for different values of F (0, 0.05, 0.10) against age. The graphs illustrate changes in average elasticities and MPC X H/C for varying levels of F.]
Simple Formula Accuracy: $\theta = 1$

![Graphs showing average elasticities for different values of F and age.](image-url)
Rental Option

• so far everybody is homeowner...

• while US homeownership rate is roughly 2/3

• → introduce the option to rent

• flow cost of renting to match the homeownership rate

• rent/price ratio is constant

• aggregate elasticity drops to .22 (working life)
Elasticities over the Life Cycle

The graph shows the elasticities over the life cycle with different options:

- **Rental Option**
- **Approximation**
- **No Rental Option**
- **Approximation**
Understanding the Life Cycle

Housing over the lifecycle

MPC over the lifecycle
MPC Distribution: Renters vs Owners

![MPC Distribution Graph](image-url)
Full Model: Take Out

- implication 1: aggregate elasticity is sizeable = 0.22
- implication 2: aggregate elasticity still affected by household debt level and distribution
- implication 3: older have higher elasticities because young rent
- implication 4: rental option matters a lot, adjustment cost not
Data on MPC

- our sufficient statistic gives a good approximation
- → look at MPC in the data to calculate implied elasticities
- three possible approaches:
  1. follow Johnson, Parker and Souleles (2006) to exploit random timing of rebate checks
  2. follow Blundell, Pistaferri and Preston (2008) to estimate MPC to temporary shocks using PSID data
  3. use mint.com data by imposing some income process (thanks to Scott Baker)
JPS approach

- JPS exploit the random timing of the rebate in 2001
- rebate timing based on last 2 digits of SSN
- rebate timing combined with CEX consumption data
- basic regression:
  \[
  \Delta c_{i,t} = \sum_m \beta_m \cdot \text{month} + \beta_X X_{i,t} + \beta_{\text{rebate}} \text{rebate}_{i,t} + u_{i,t}
  \]
- timing of rebate exogenous, but size is not → instrument for \( \text{rebate}_{i,t} \) using indicator for received rebate (estimate with 2sls IV regression)
Adjusting for Housing

- we want to estimate
  \[ MPC \cdot (1 - \delta) \frac{PH}{C} \]

- JPS (2001) find average MPC \( \approx 0.2 - 0.3 \)

- depending on consumption data \( (1 - \delta) \frac{PH}{C} \approx 2 - 3 \)

- back-of-the-envelope: elasticity \( \approx 0.4 - 0.9 \)

- however heterogeneity in MPC and housing \( \rightarrow \) correlation may be important!

- \( \Rightarrow \) we want to estimate how MPC vary with housing

- rolling regression with reasonable window of housing
MPC and Housing

![Graph showing the relationship between MPC and house value.](image-url)
Bubble experiment

• set \( \{P_t\} \) equal to real home price index from Shiller (2015)

• at each time \( t \) consumers form expectations about future prices as follows

\[
E_t [P_{t+j}] = P_t \exp \left\{ g_t \frac{1 - \lambda^j}{1 - \lambda} \right\} \quad \text{for } j = 1, 2, \ldots
\]

with \( \lambda = .5 \)

• objective: choose \( \{g_t\} \) to obtain realistic implications for housing demand

• residential investment is

\[
I_t = H_t - (1 - \delta) H_{t-1}
\]
Without \( g \) shocks

- **House price**
- **Expected house price appreciation**
- **Consumption**
- **Residential investment**
Without $g$ shocks: housing, debt

**Aggregate housing (ratio to total income)**

**Aggregate household debt (ratio to total income)**
With $g$ shocks

- **House price**
- **Expected house price appreciation**
- **Consumption**
- **Residential investment**

Graphs showing the impact of $g$ shocks on various economic indicators over time ($t$).
With $g$ shocks: housing, debt

Aggregate housing (ratio to total income)

Aggregate household debt (ratio to total income)
Final Remarks

• we explore models with incomplete markets to think about the response of consumption to changes in house prices

• with liquid housing, this response $= MPC \cdot (1 - \delta)H$

• this formula works approximately well when we introduce adjustment costs and rental option

• the model (and the data) deliver large elasticities in line with the empirical literature

• to match residential investment we need future appreciation, which affect consumption decision