House Prices and Consumer Spending

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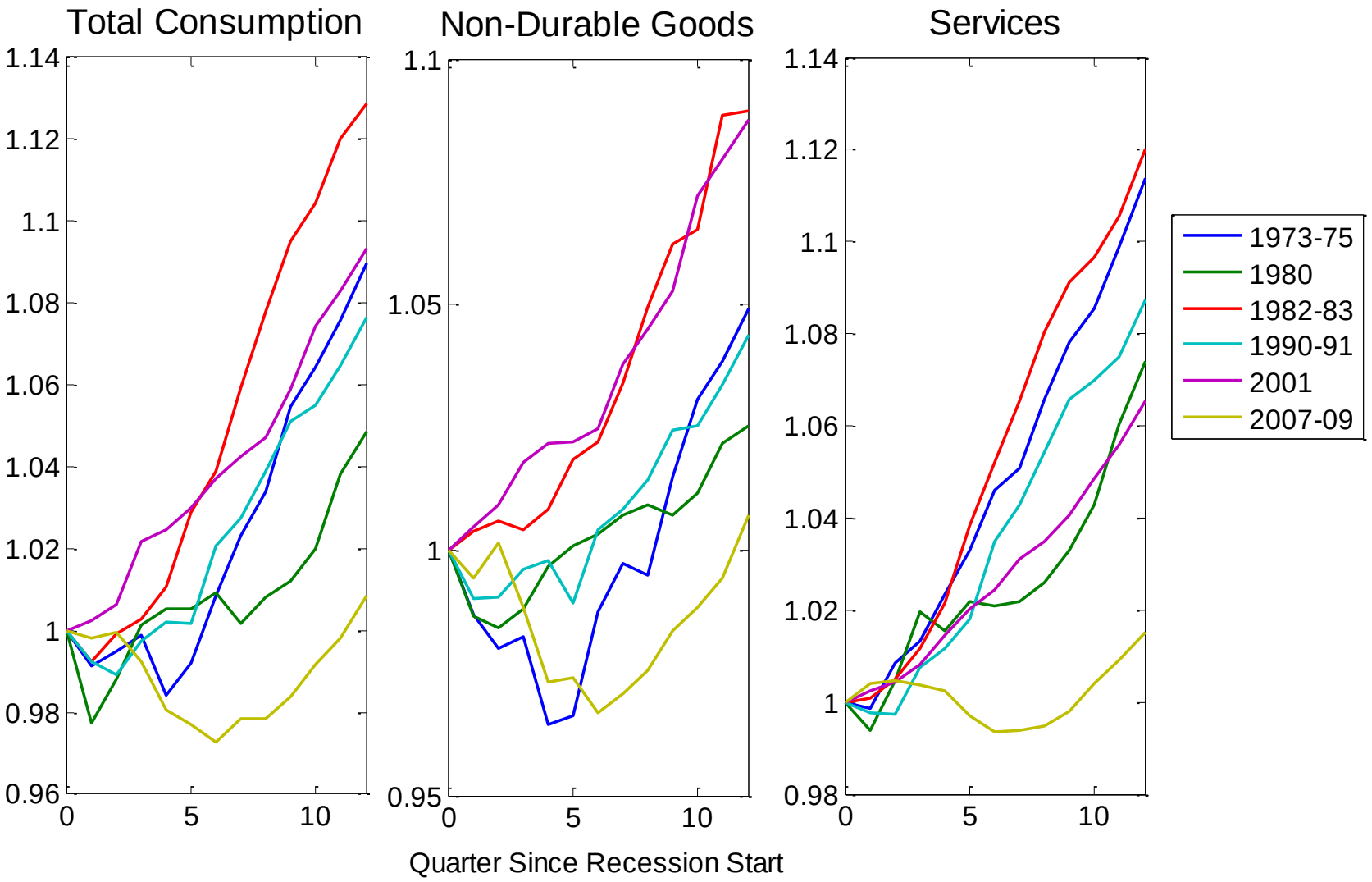
Consumption Decline in Great Recession



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 (≈ 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:

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

- **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
- $\Rightarrow$ 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} = age of household i 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 δ 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 $j_{it} = J$:

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

$\hat{P}_{Xt}$ = 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:

$$V_t(W, s) = \frac{\Psi}{1 - \sigma} \left(\frac{\Gamma(s) + W}{\hat{P}_{Xt}} \right)^{1-\sigma}$$

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 Ψ:

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

Benchmark: Some Numbers

- elasticity of consumption to house prices

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

- 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 (θ) only matter through MPC
- 3 effects cancel out:
  income effect + substitution effect + collateral effect
- 1 effect survives: endowment effect!

Proof

- let $\tilde{H} = PH$:

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

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!

- $\Rightarrow dC(W,s)/dP = dC(W,s)/dW \cdot dW/dP$

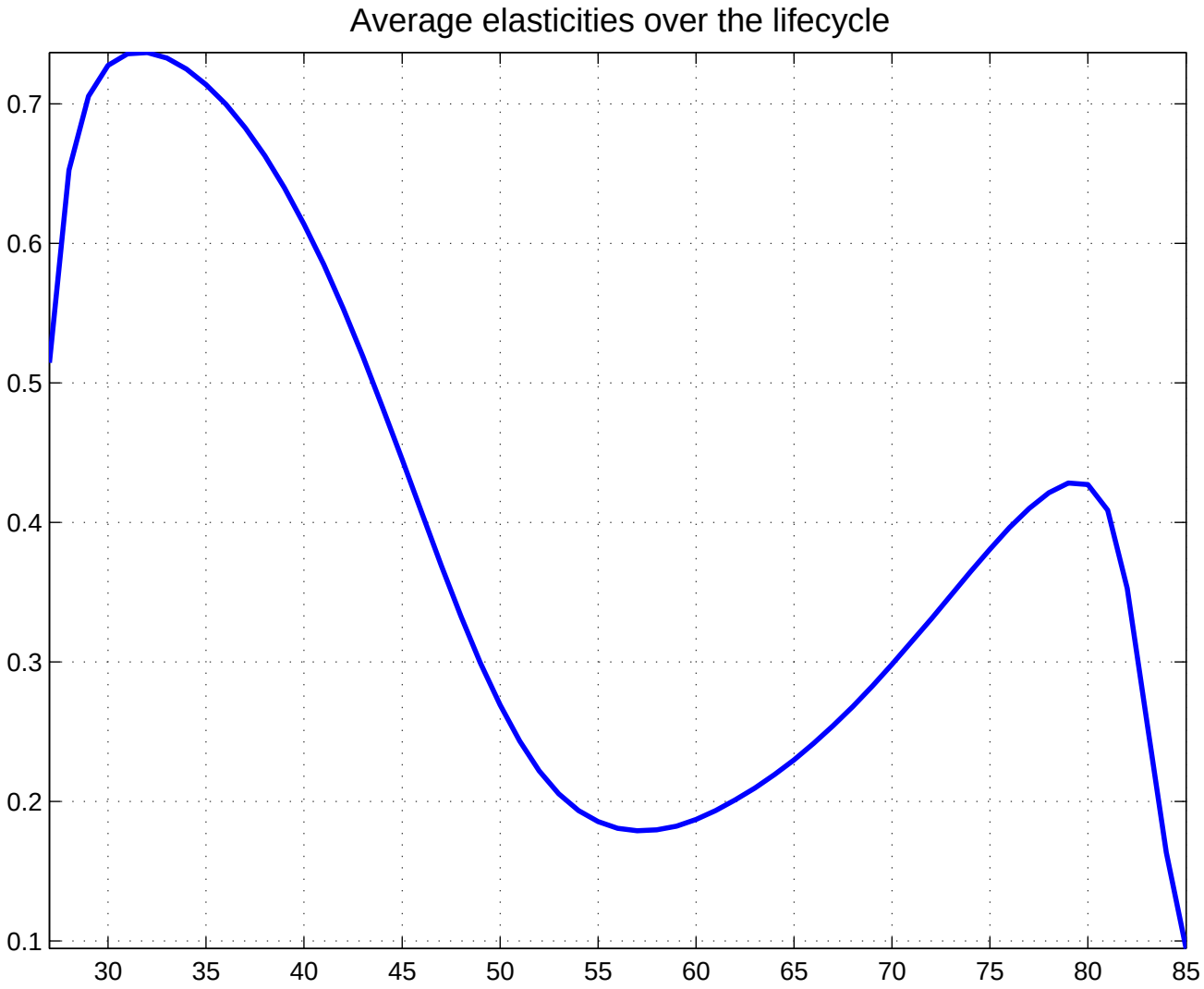
Calibration

- 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

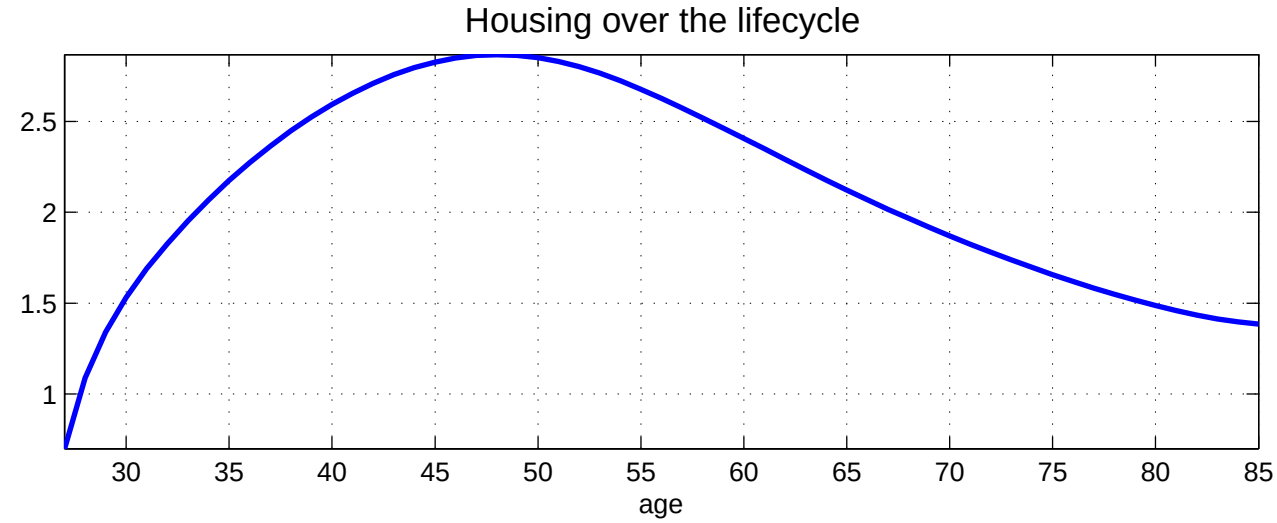
$$PH/Y = 2.56 \qquad A/Y = -0.30$$

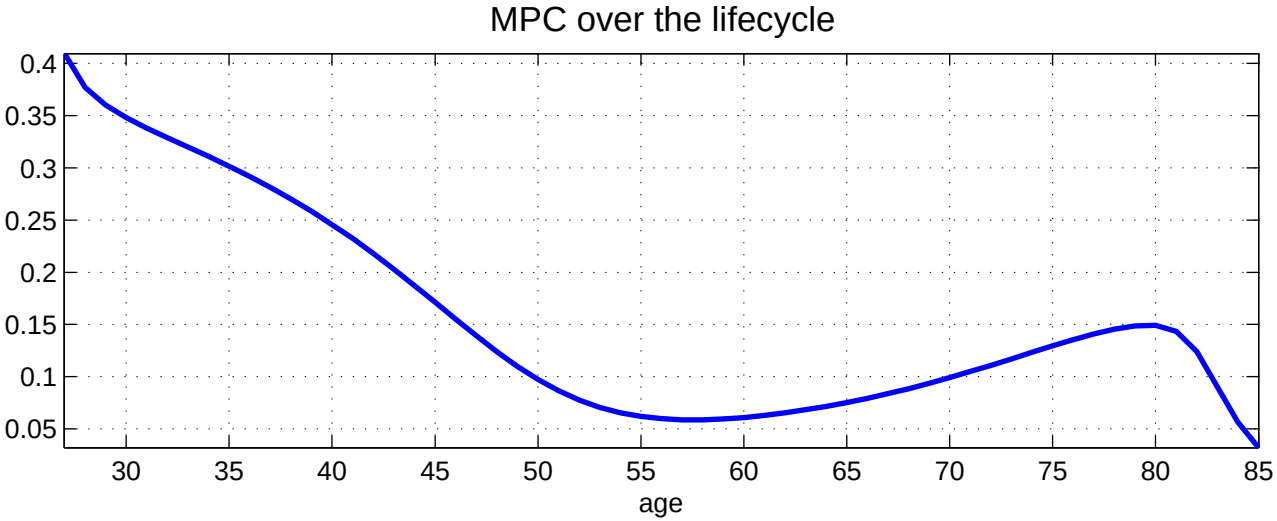
from Survey of Consumer Finances 2001

Elasticities over the Life Cycle

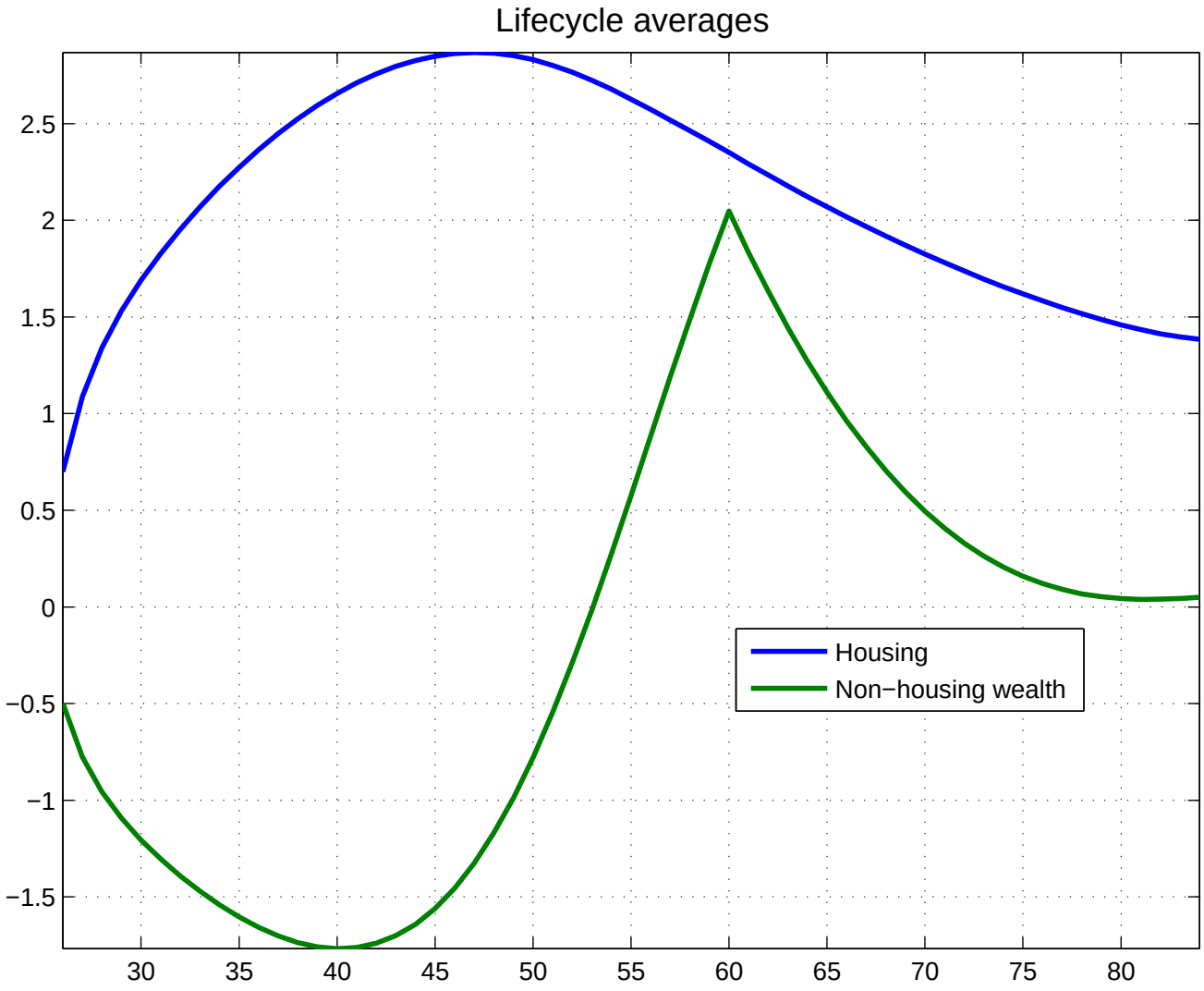


Understanding the Life Cycle

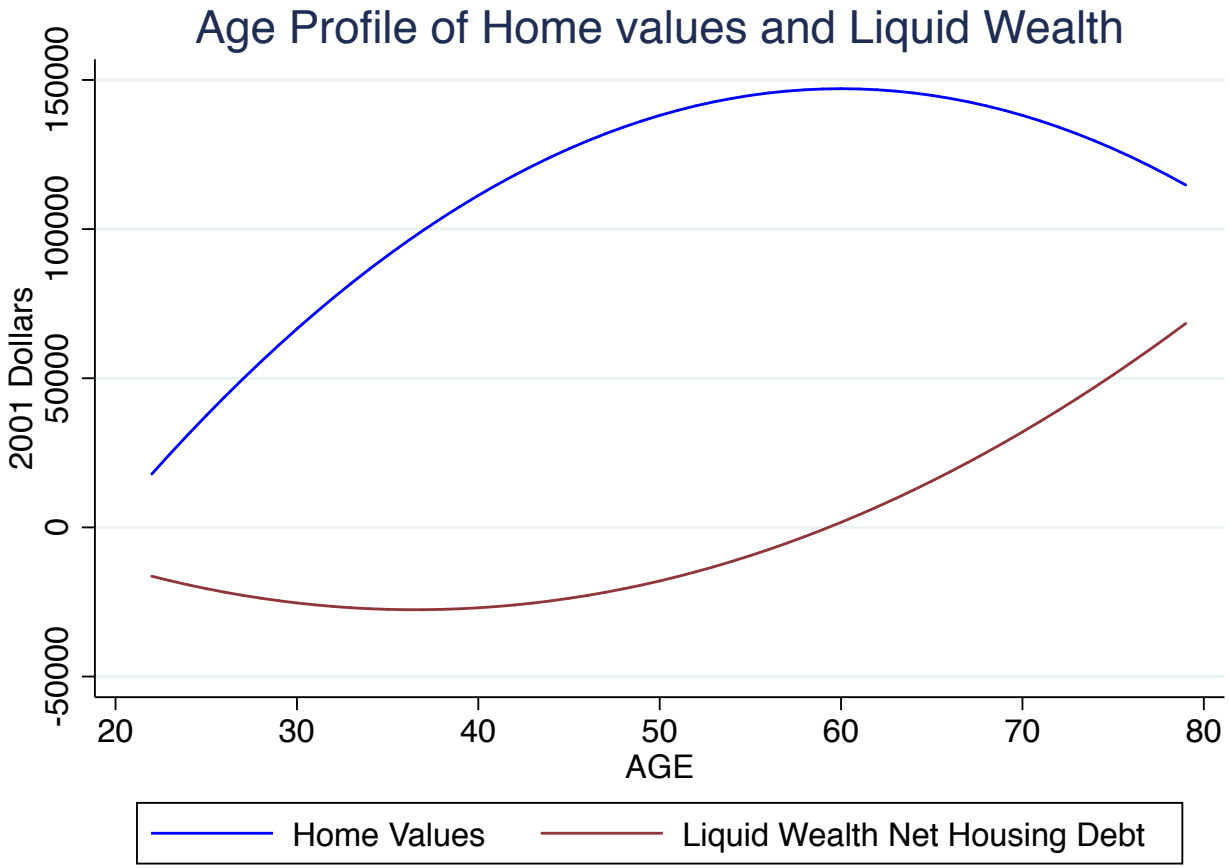




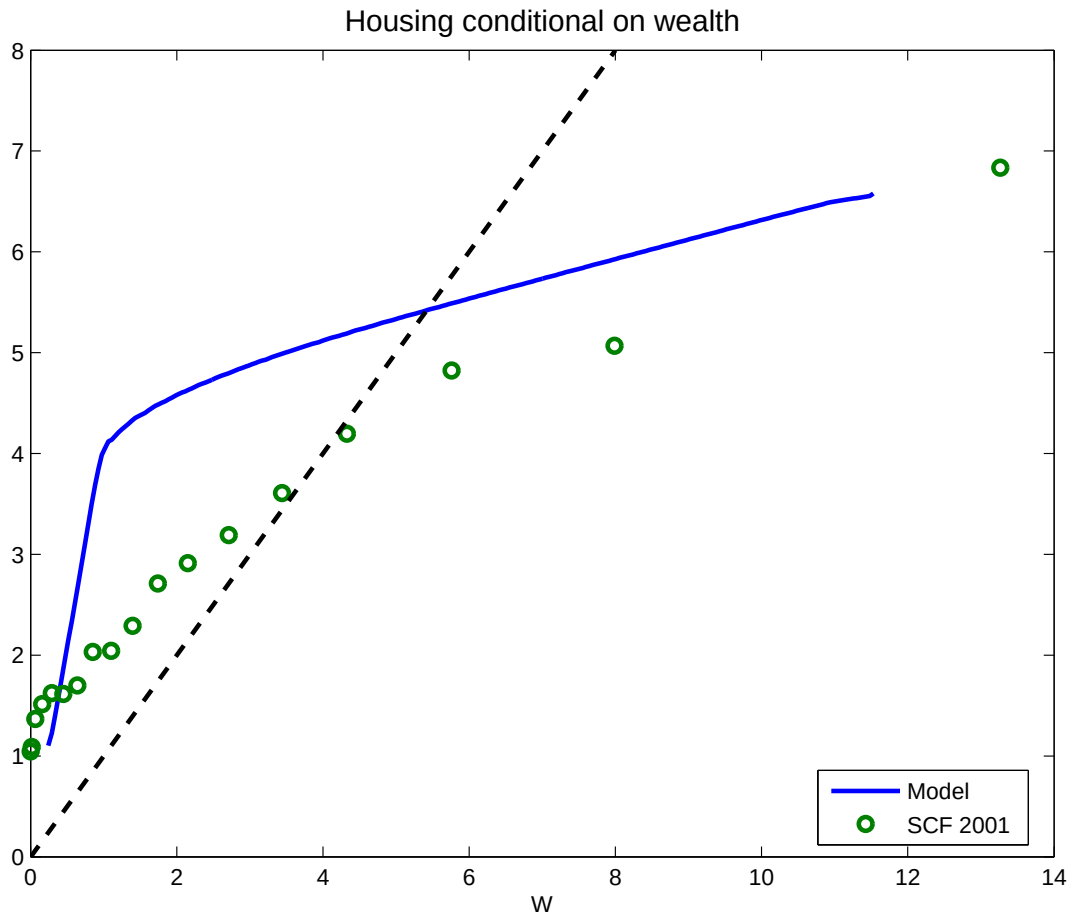
Housing and Net Liquid Wealth over the Life Cycle



Data: Housing and Net Liquid Wealth over Life Cycle



Housing and net worth



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

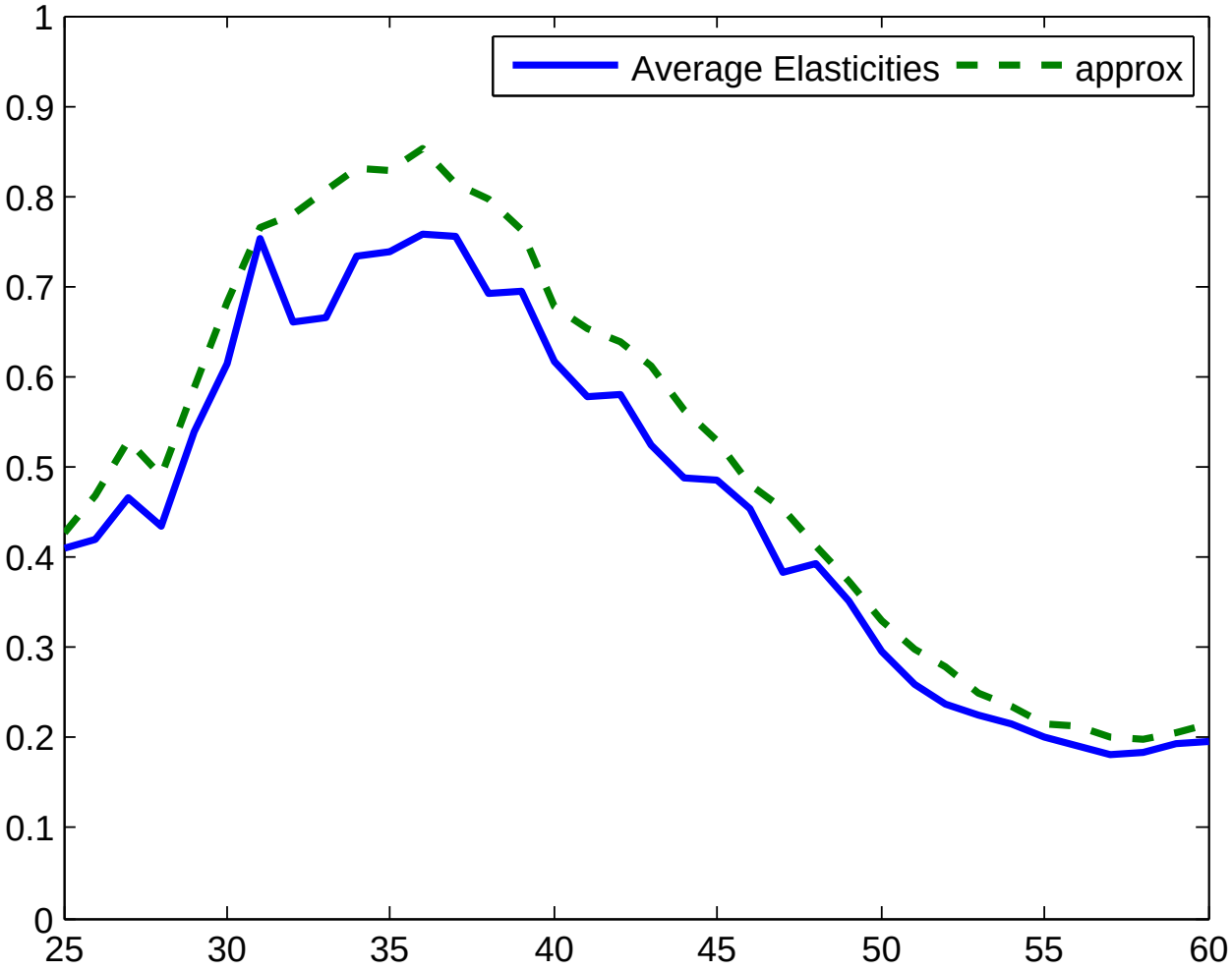
Adjustment Costs

- with liquid housing wealth housing adjusts too much
- $\rightarrow$ introduce adjustment costs
- fixed cost of trading housing proportional to house value

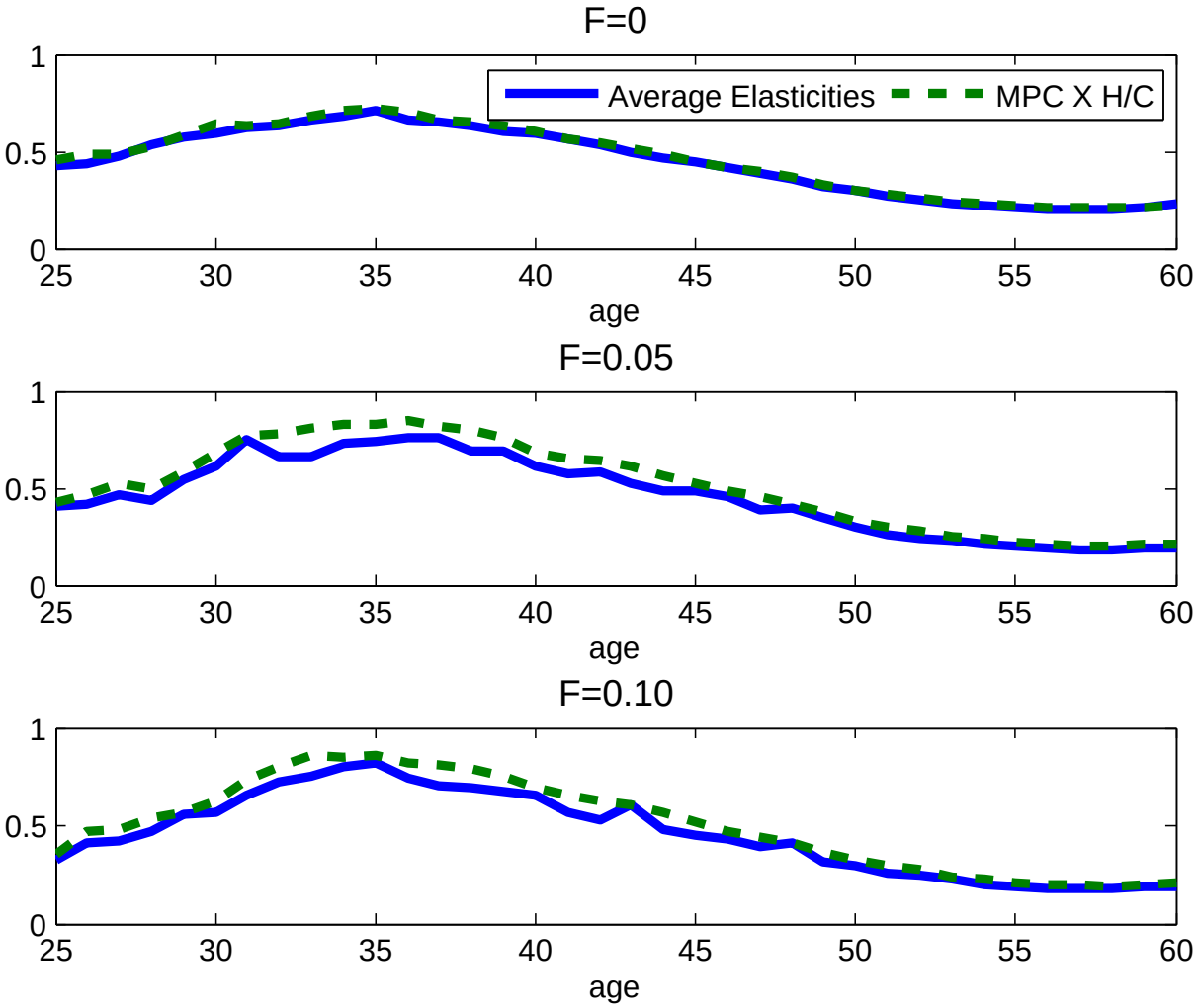
$$\kappa_{it} = F \cdot P_t H_{it-1} \mathbb{1}_{H_{it} \neq H_{it-1}}$$

- 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 θ

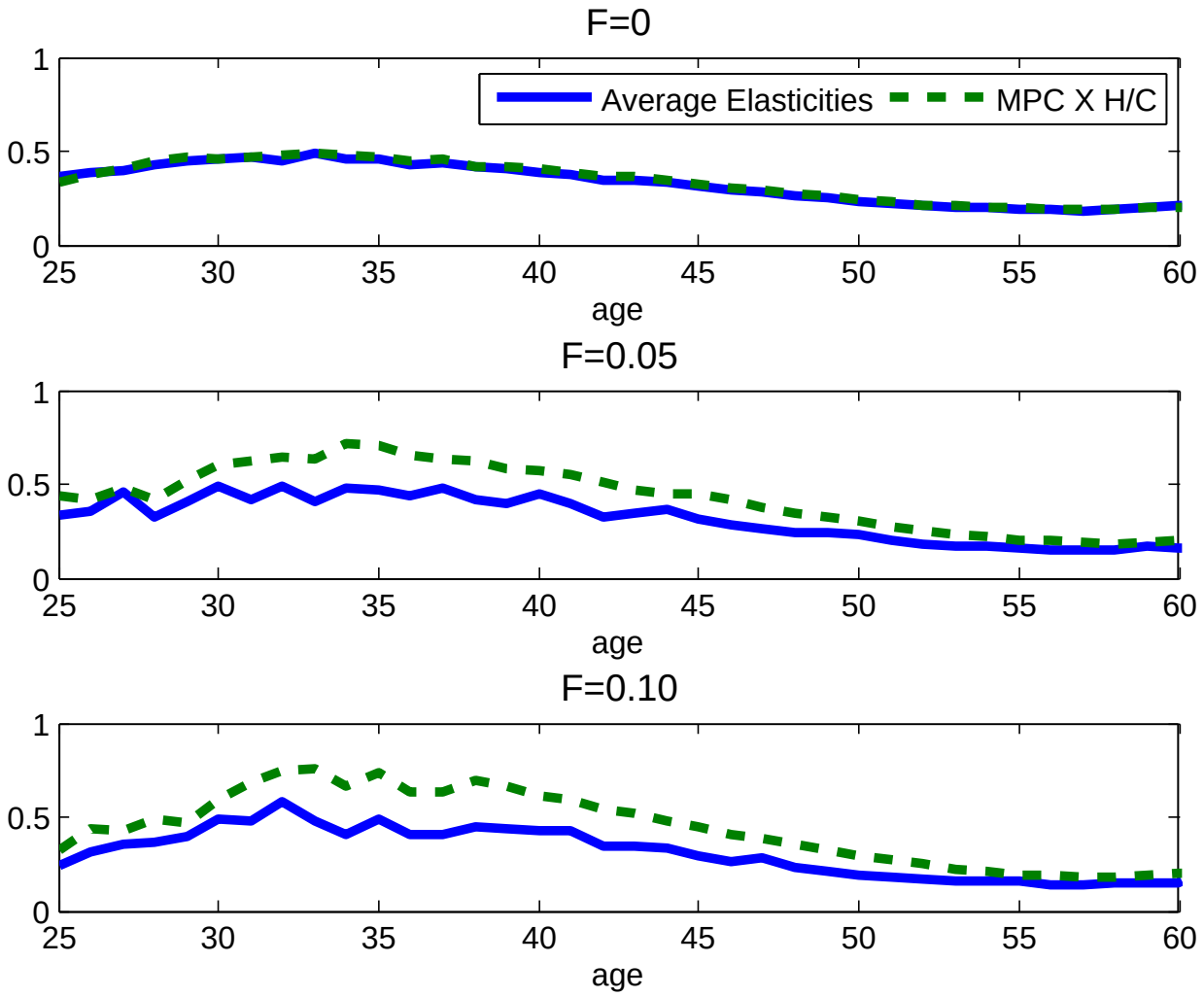
Elasticities over the Life Cycle



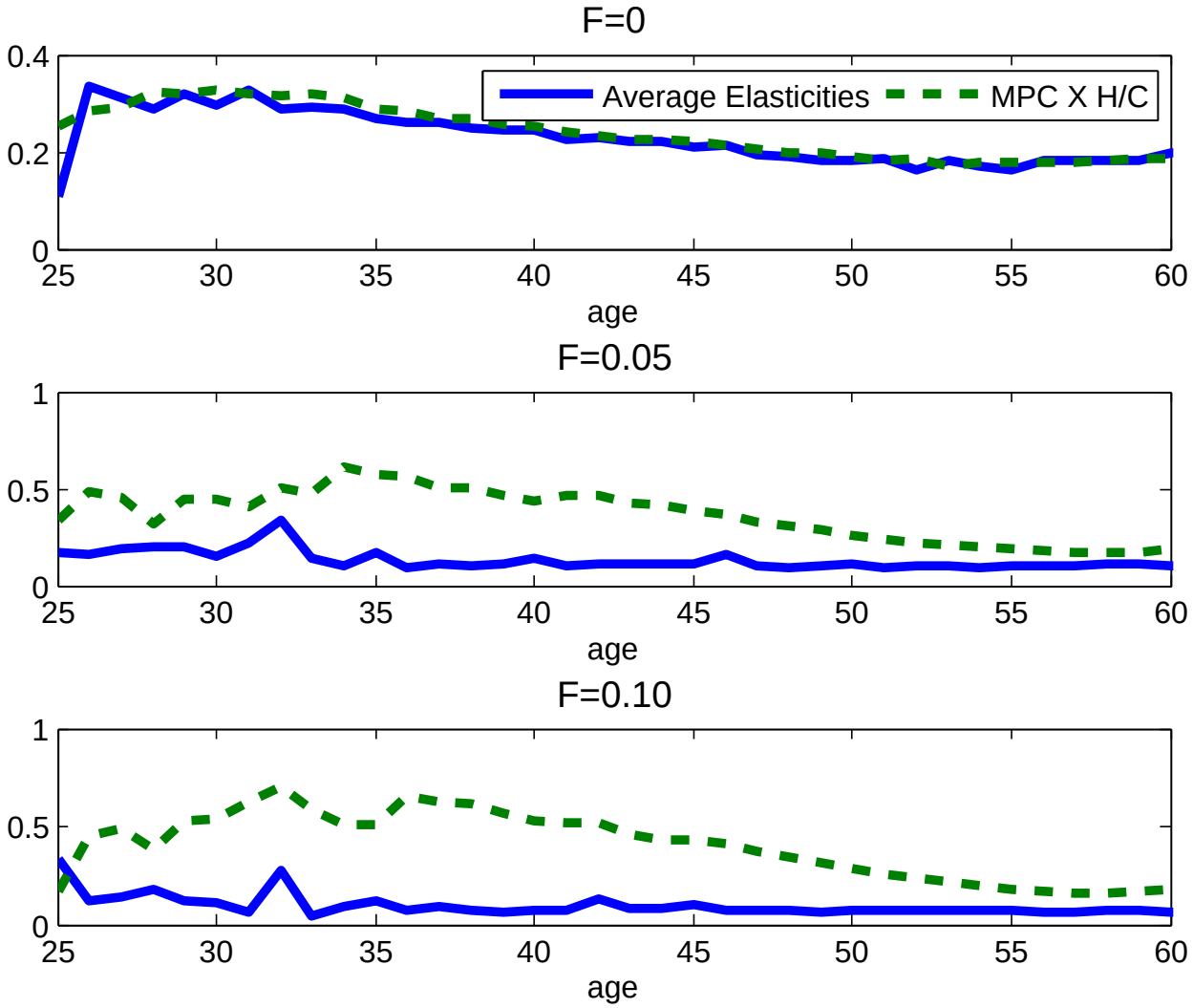
Simple Formula Accuracy: $\theta = 0.25$



Simple Formula Accuracy: $\theta = 0.5$



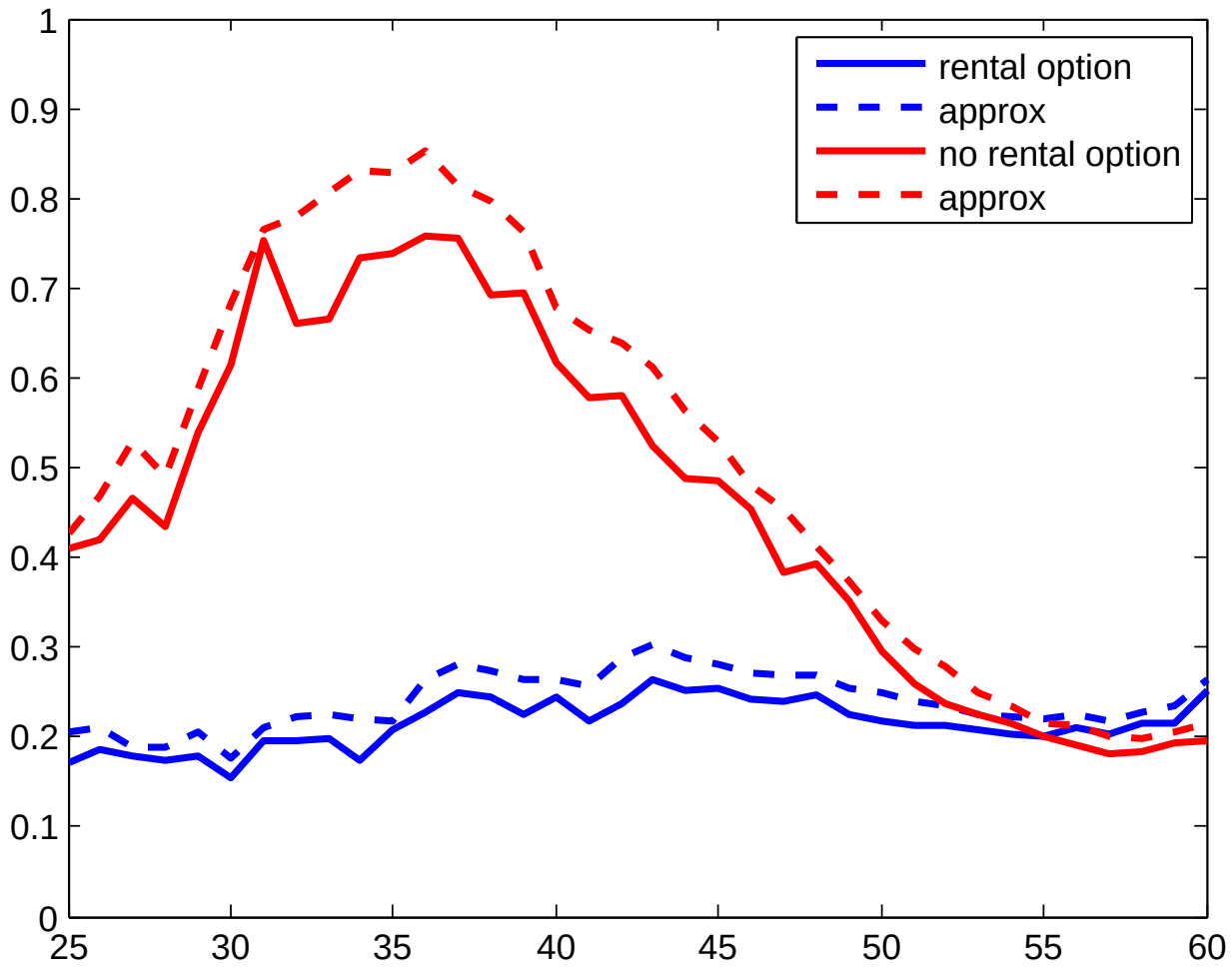
Simple Formula Accuracy: $\theta = 1$



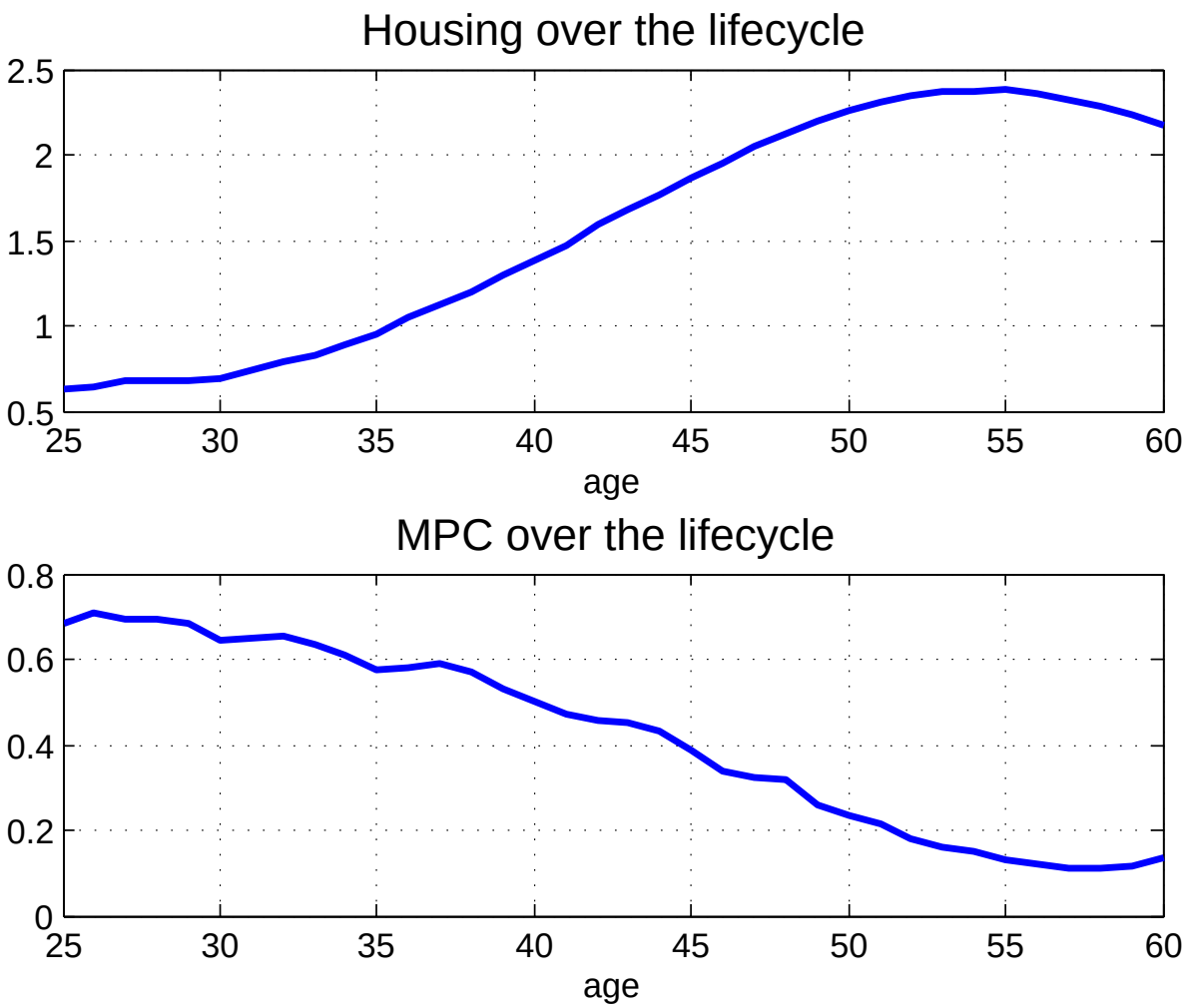
Rental Option

- so far everybody is homeowner...
- while US homeownership rate is roughly 2/3
- $\rightarrow$ 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)

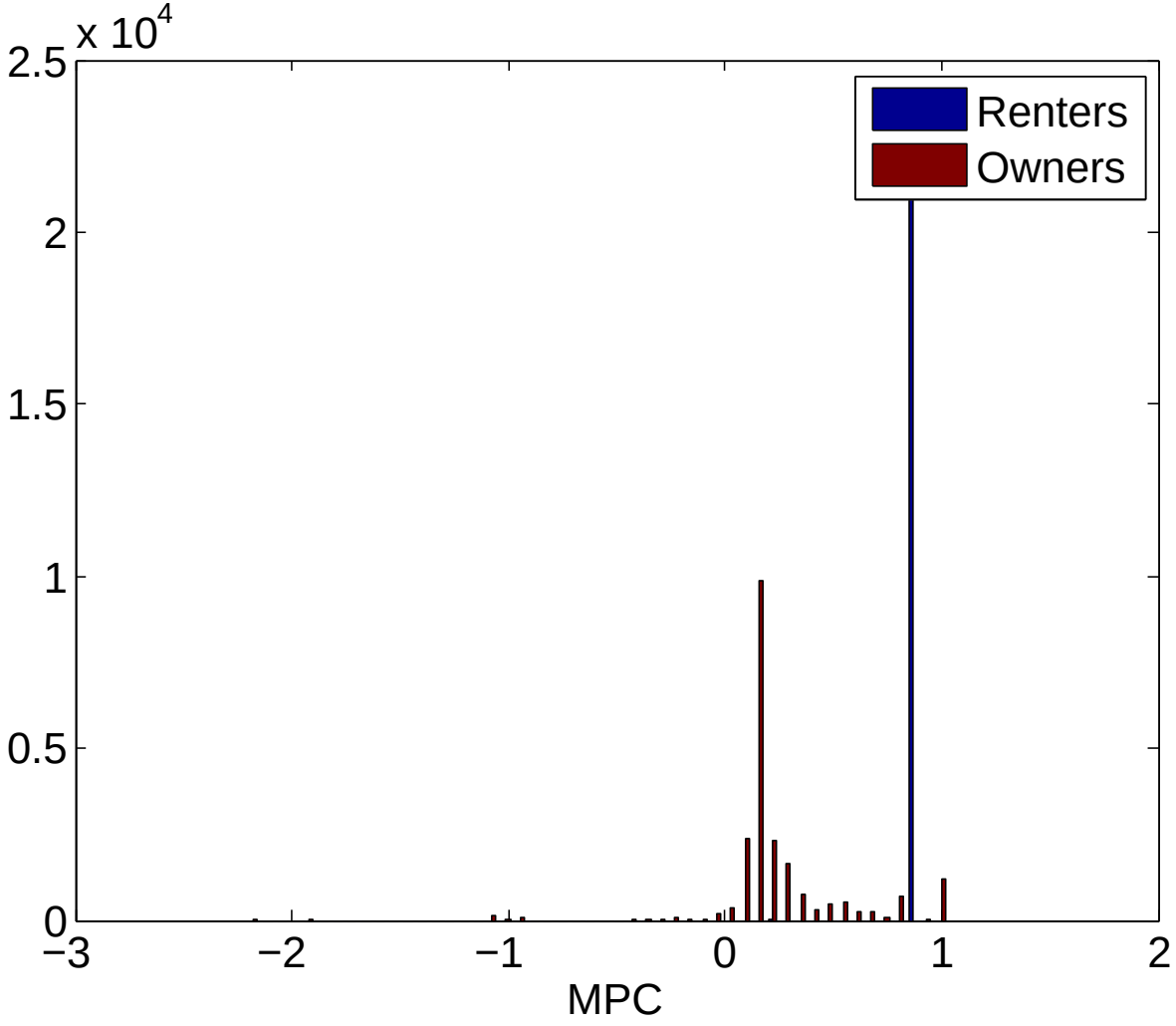
Elasticities over the Life Cycle



Understanding the Life Cycle



MPC Distribution: Renters vs Owners



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
- $\rightarrow$ 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:

$$\Delta c_{i,t} = \sum_m \beta_m * month + \beta_x X_{i,t} + \beta_{rebate} rebate_{i,t} + u_{i,t}$$

- timing of rebate exogenous, but size is not $\rightarrow$ instrument for $rebate_{i,t}$ using indicator for received rebate (estimate with 2sls IV regression)

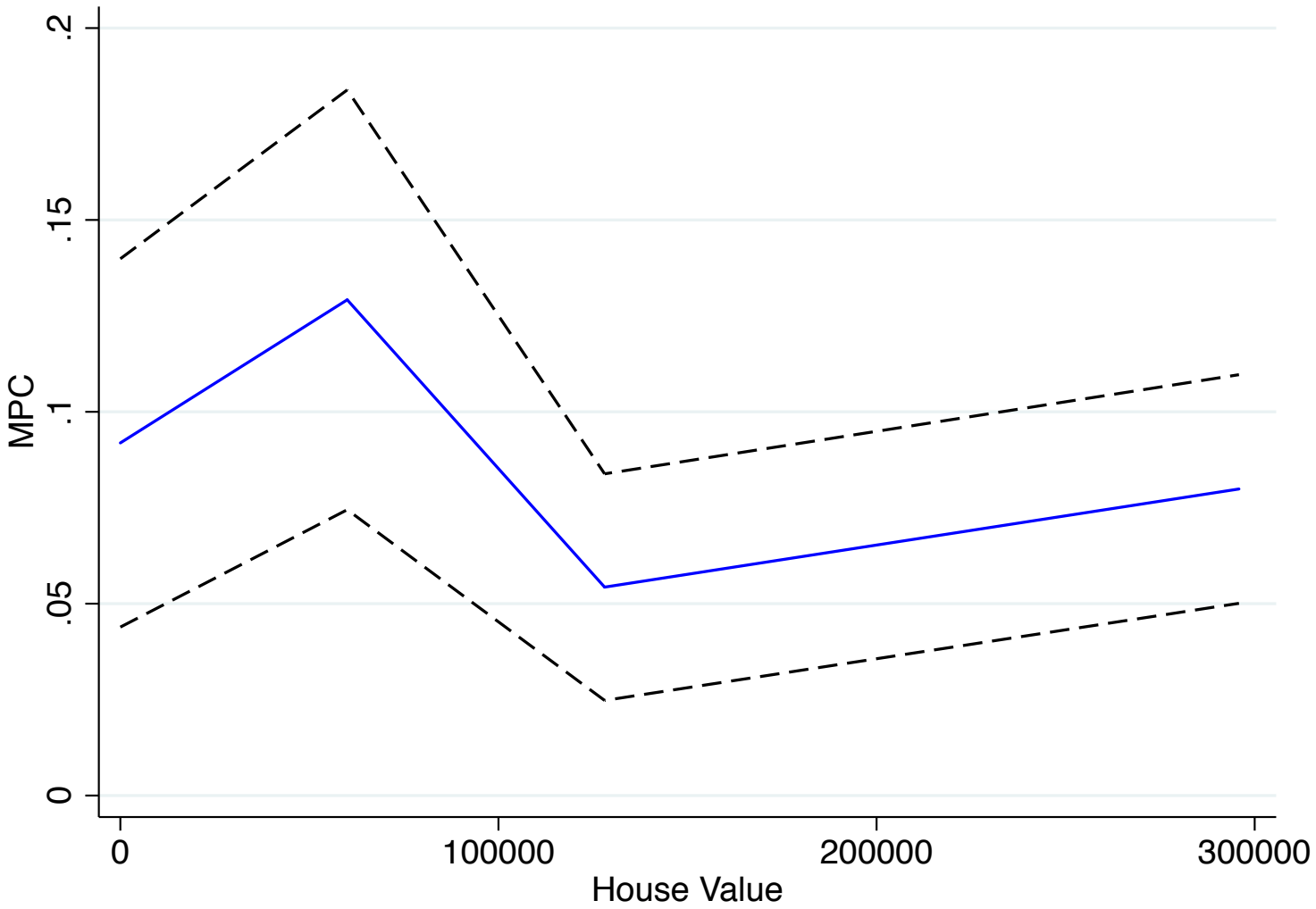
Adjusting for Housing

- we want to estimate

$$MPC \cdot (1-\delta)PH/C$$

- JPS (2001) find average MPC $\approx .2 - .3$
- depending on consumption data $(1-\delta)PH/C \approx 2-3$
- back-of-the-envelope: elasticity $\approx .4 - .9$
- 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



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

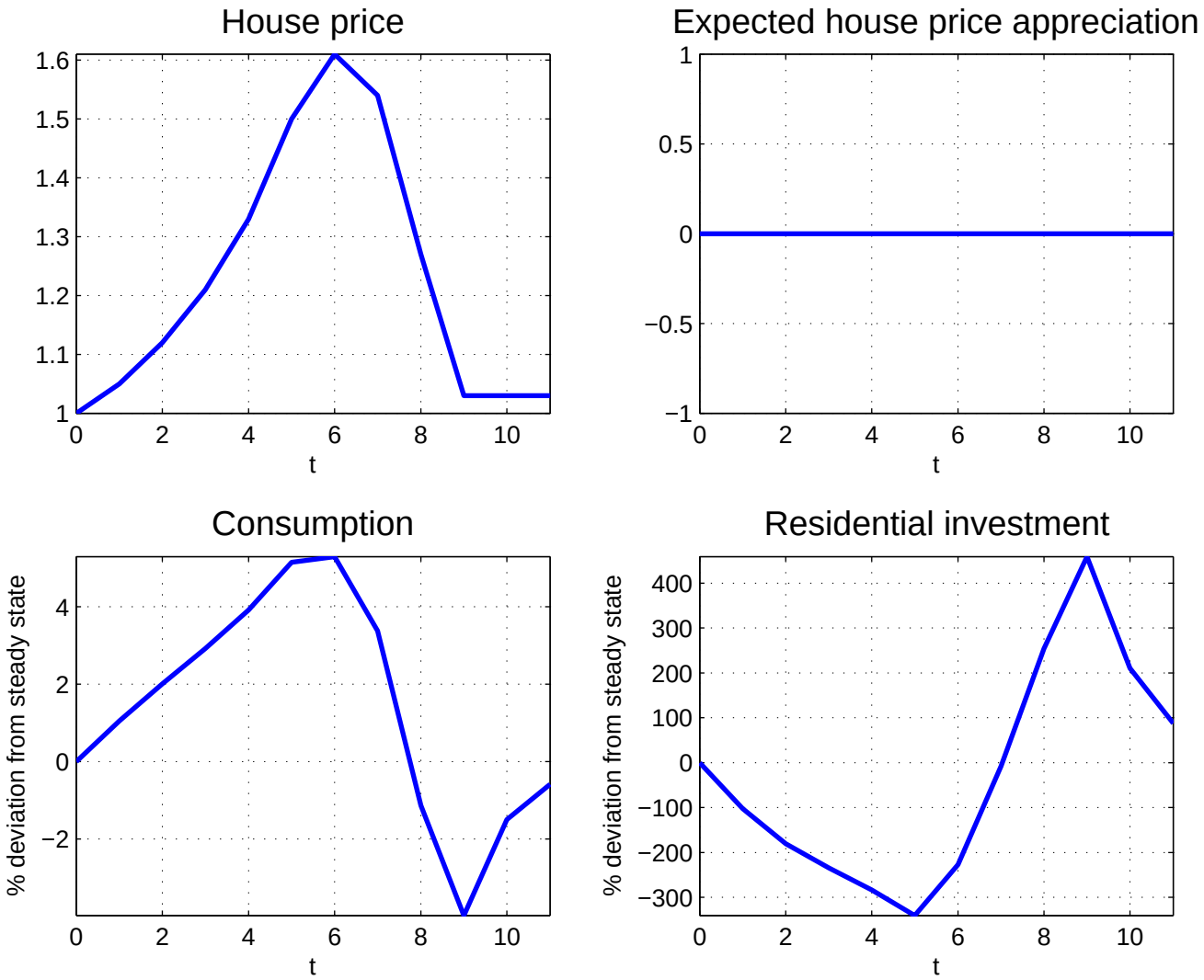
$$E_t\left[P_{t+j}\right] = P_t \exp\left\{g_t \frac{1-\lambda^j}{1-\lambda}\right\} \text{ for } j = 1, 2, \ldots$$

  with $\lambda = .5$

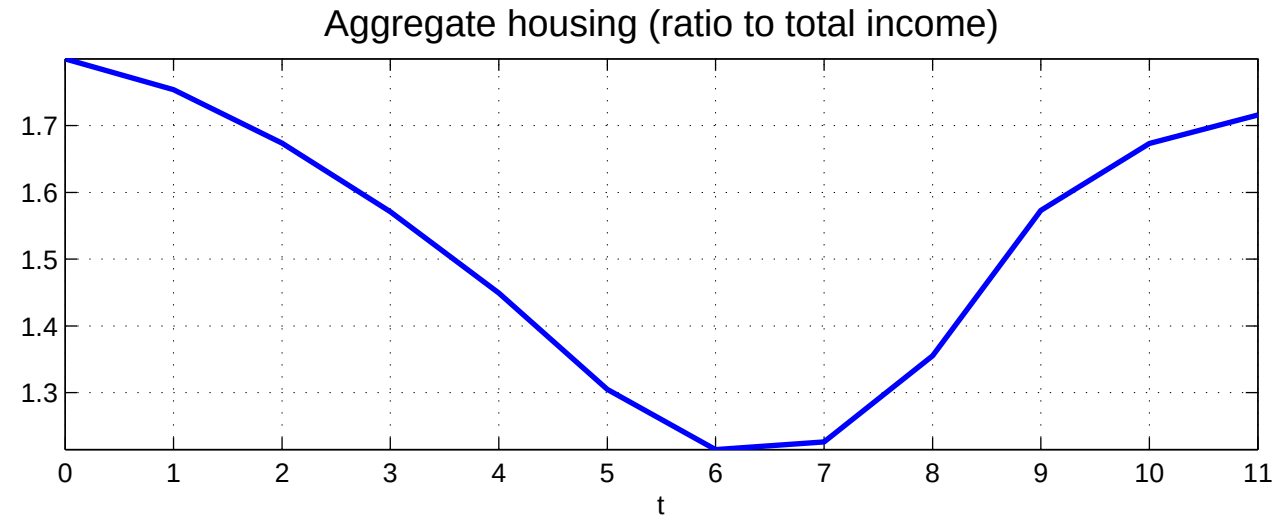
- objective: choose $\{g_t\}$ to obtain realistic implications for housing demand
- residential investment is

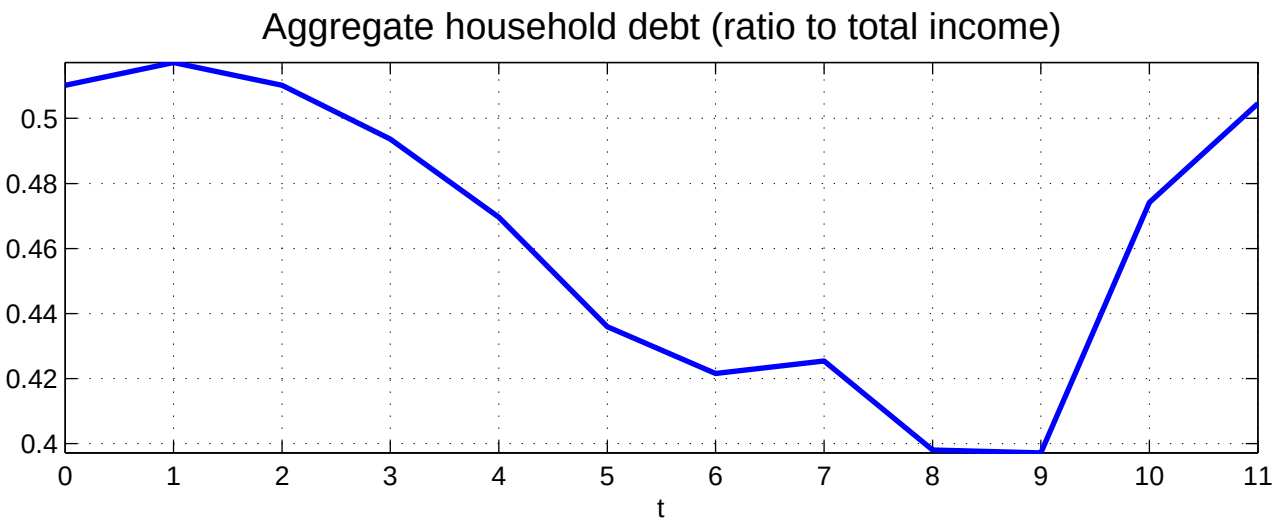
$$I_t = H_t - (1-\delta) H_{t-1}$$

Without g shocks

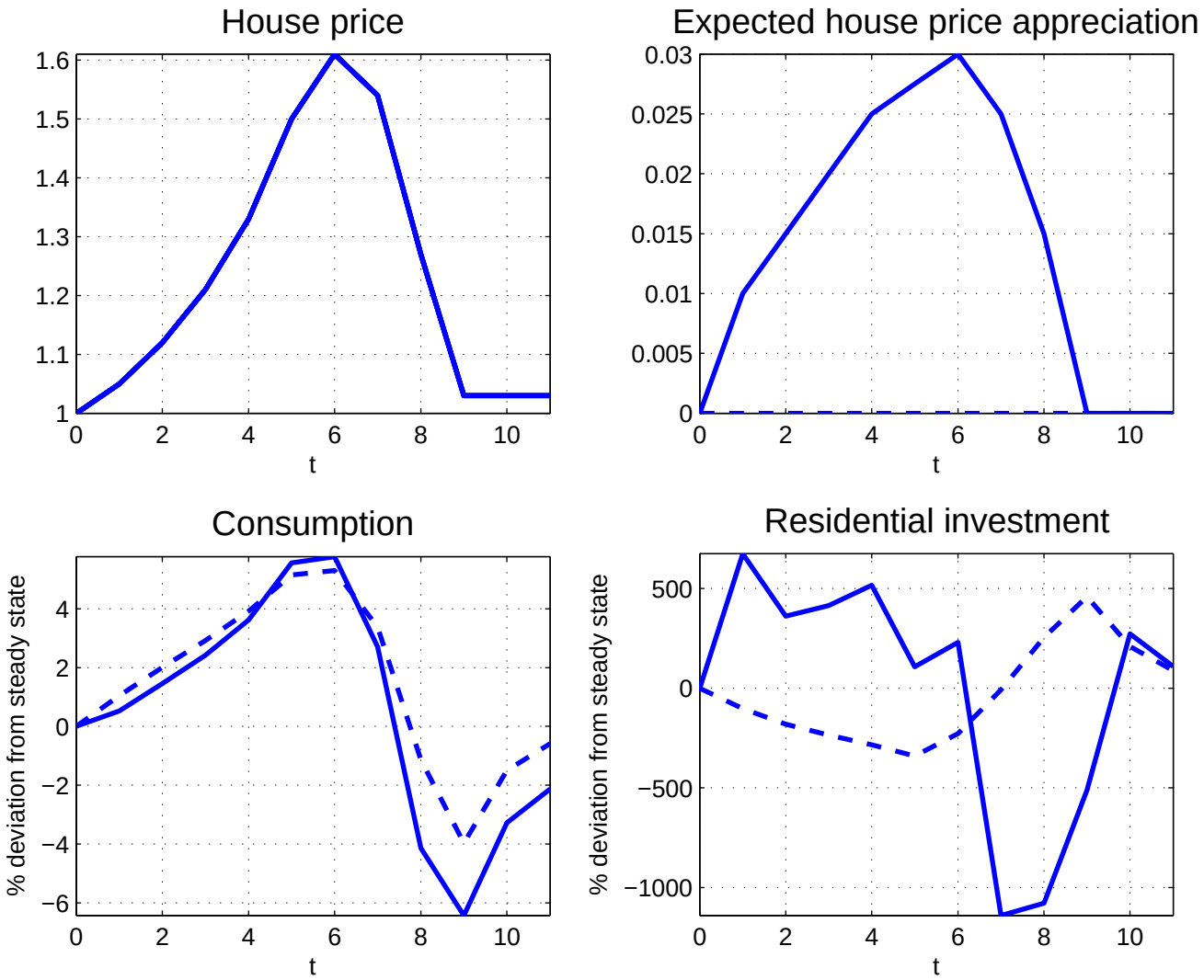


Without *g* shocks: housing, debt

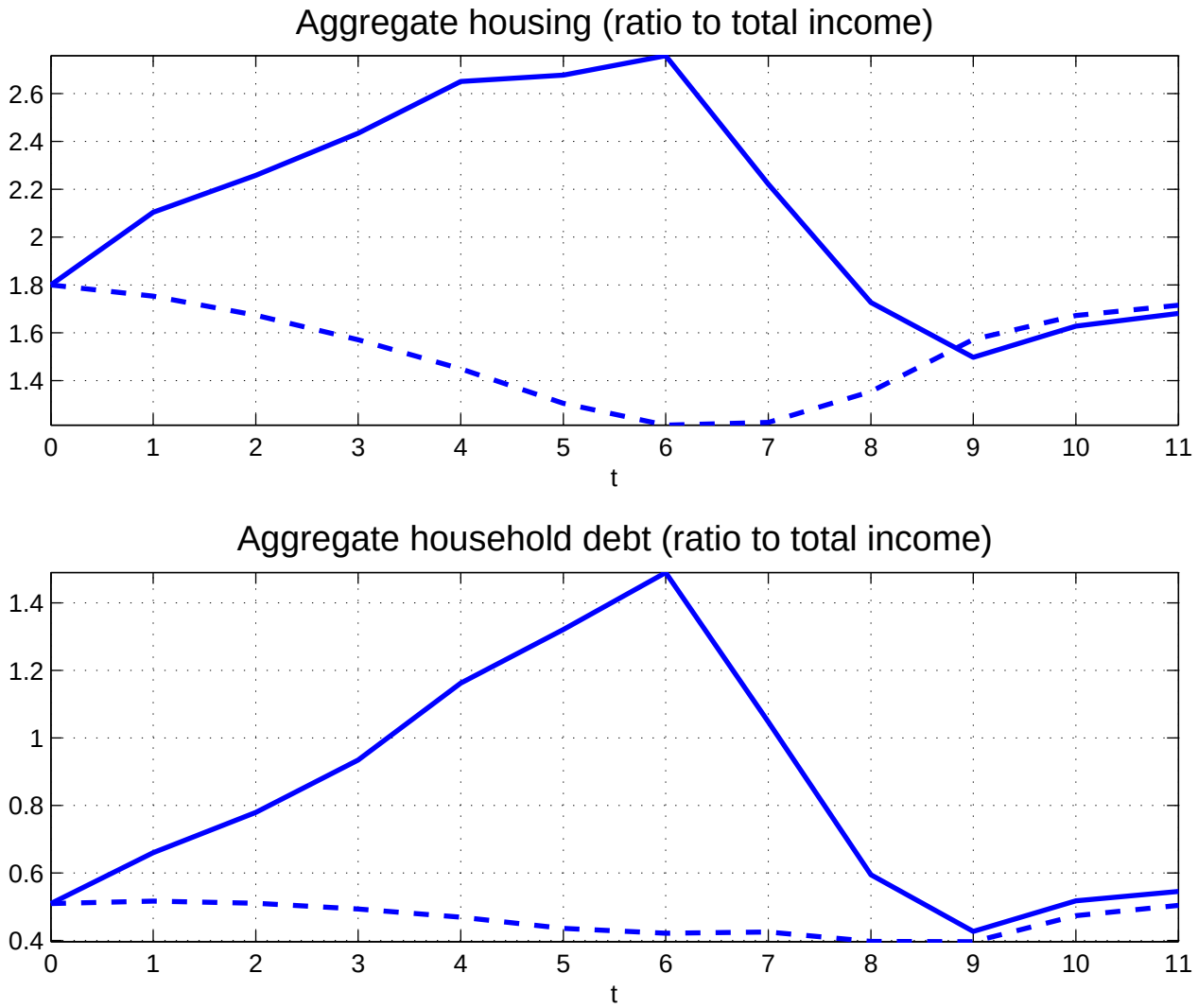




With g shocks



With *g* shocks: housing, debt



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