Saving on a Rainy Day, Borrowing for a Rainy Day

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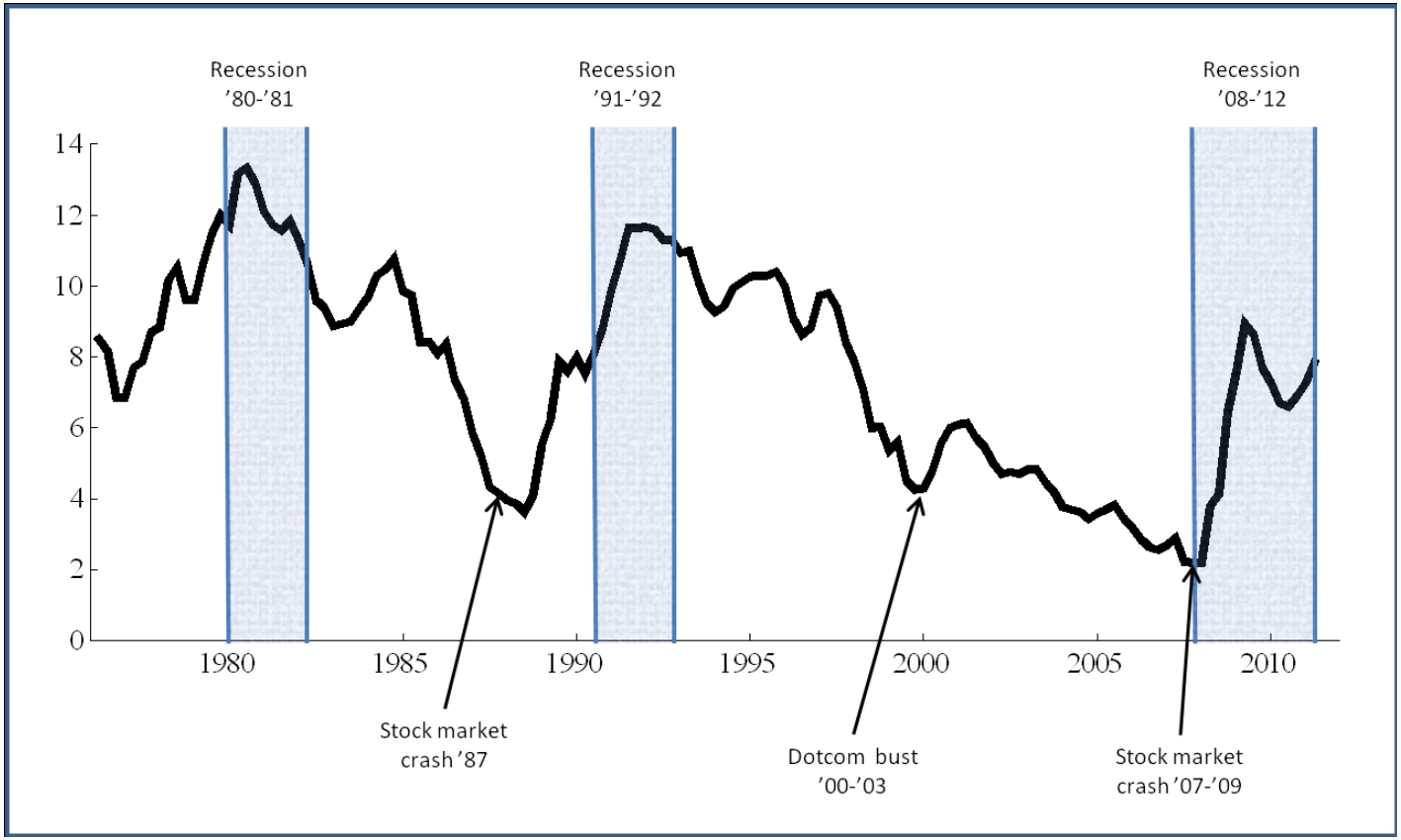
Motivation

- What does a recession imply for different households?
  - Effect on income only part of the story
  - Increased uncertainty (unemployment, asset prices)
  - Contractions in supply of credit
- How do households respond?

Motivation: Savings Rates Over Time



- Spike in saving: consumption not smoothed, fall in borrowing

Motivation

- PIH: consume a permanent income change and annuity value of a transitory income change:
  - Transitory income loss $\longrightarrow$ saving level and rate both fall
  - Permanent income loss $\longrightarrow$ no change in savings level; denominator effect leads to rate rise

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- PIH: consume a permanent income change and annuity value of a transitory income change:
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  - Permanent income loss $\longrightarrow$ no change in savings level; denominator effect leads to rate rise
- Model saving during booms and recessions in a life-cycle model with stable preferences
- Distinguish effects of different types of recession

Motivation: What is a Recession?

1. **Aggregate shock to income (permanent or transitory)**
2. **Rise in uncertainty**
   - idiosyncratic risk rises in recessions (Carroll, 1992)
   - variance of highly persistent shocks rises (Blundell, Low and Preston, 2011)
3. **Credit crisis**
   - rationing credit raises aggregate saving? Guerrieri and Lorenzoni (2011)
   - Mian and Sufi (2009, 2010): over-indebtedness
4. **Wealth destruction**
   - sharp falls in asset prices - rebuilding balance sheets?
   - Moore and Palumbo (2011); de Nardi et al (2011)

Outline

1. Life-cycle Model of Saving in Recessions
2. Data: Effect of Recessions on Savings Rates
3. Model Inputs and Calibration
4. Simulated Responses to different types of Recession

Life-cycle Model of Saving

- Standard life-cycle dynamic portfolio allocation model
- *Possibility* of recession: 2 state Markov process
  1. Aggregate income shock
  2. Aggregate income shock and idiosyncratic uncertainty higher
  3. Aggregate income shock and credit market tightening.
- *Possibility* of asset crash (whether in a recession or not)

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- *Possibility* of asset crash (whether in a recession or not)
- *Realisation* of a recession can occur with or without a crash
- Explicit aggregation from micro to macro

Life-cycle Model of Saving

$$V_t = \max_{c,q,d} E_t \left[\sum_{j=0}^{T-t} \beta^j \frac{(c_{t+j})^{1-\gamma}}{1-\gamma} \right]$$

$$c_t + q_t - d_t \leq x_t$$

$$x_{t+1} = (1 + r^q_{t+1}) q_t - (1 + r) d_t + y_{t+1}$$

- x_t : cash-on-hand at the start of period
- q_t : holding of a risky asset at end of the period
- d_t : debt owed at end of the period
  ($d_t < 0$ indicates saving in the safe asset)

Life-cycle Model

Recession

- 2 state Markov process:

	Boom $t+1$	Recession $t+1$
Boom t	π	$1-\pi$
Recession t	$1-\rho$	ρ

- Asymmetric process

Life-cycle Model

Stochastic Return Process

- Composite Risky Asset
- Excess returns are iid
- Possibility of a crash in the asset price: a return of $-\phi$
- Probability of a crash is p_R in a recession, p_B in a boom, $p_R > p_B$.

Life-cycle Model

Income Process

Y_{iat} : stochastic labour income for individual i age a in period t:

$$\ln Y_{iat} = \ln Y_{iat}^{P} + \lambda D_t + u_{iat}, \qquad u_{iat} \sim N(0, \sigma_u^2)$$

$$\ln Y_{iat}^{P} = \ln Y_{iat-1}^{P} + f(age) + \theta D_t + \eta_{iat} \qquad \eta_{iat} \sim N(0, \sigma_{\eta,t}^2)$$

λ : transitory effect of a recession

θ : permanent effect of a recession

$$\Delta \ln Y_{iat} = f(age) + \theta D_t + \lambda \Delta D_t + \eta_{iat} + \Delta u_{iat}$$

Life-cycle Model

Variance Shock Recession

- How does the variance of permanent and transitory idiosyncratic shocks (η_{iat} and u_{iat}) evolve over the business cycle?

$$\begin{aligned} \eta_{it} &\sim N(0, \sigma^2_{\eta,B}) && \text{in boom} \\ \eta_{it} &\sim N(0, \sigma^2_{\eta,R}) && \text{in recession} \end{aligned}$$

- Focus on increase in permanent variance in recessions (Blundell, Low, Preston, 2011)

Life-cycle Model

Alternative Credit Constraints

1. Implicit constraint: cannot borrow more than repay with certainty
2. Explicit quantity constraint: cannot borrow more than a certain level

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$$d_{it} < 3Y_{it}$$

4. Flow constraint: cannot increase the stock of debt (have to repay interest):

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- *Credit Supply Shock Recession*: flow constraint comes into place.

Precautionary Borrowing

First-order condition *w.r.t.* d_t

$$u_c(x_t + d_t - q_t) = \beta E_t \left[(1+r) \frac{\partial V_{t+1}}{\partial x_{t+1}} - \frac{\partial V_{t+1}}{\partial d_t} \right]$$

- Borrow in period t because of possibility that need debt in period $t+1$: *borrowing for a rainy day*

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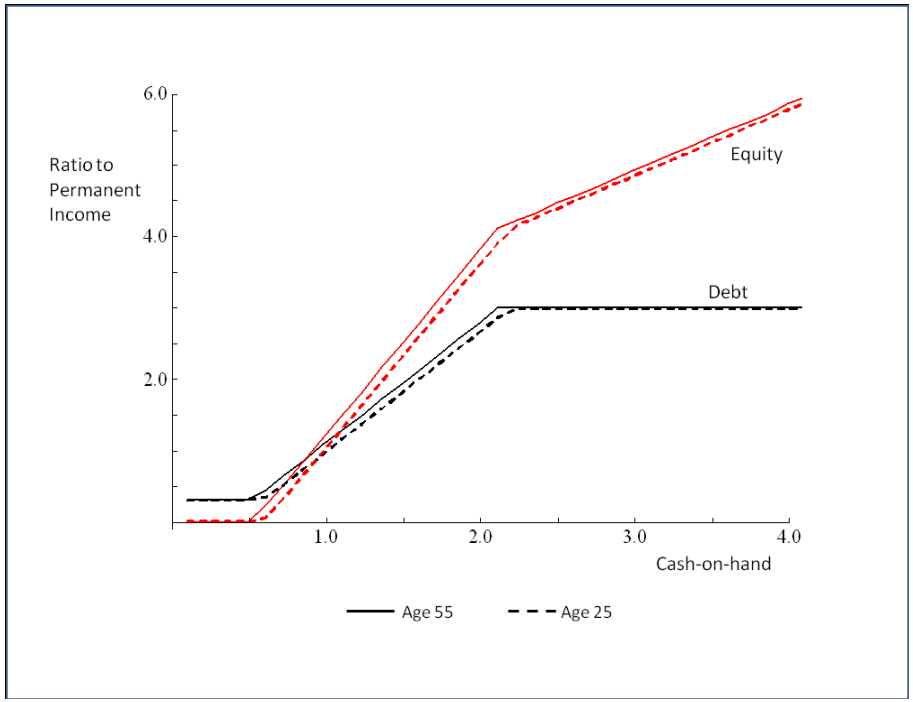
- Borrow in period t because of possibility that need debt in period $t+1$: *borrowing for a rainy day*
- Option value of holding debt: $\frac{\partial V_{t+1}}{\partial d_t} > 0$

  ... but $\frac{\partial V_{t+1}}{\partial x_{t+1}}$ higher because of presence of constraint in $t+1$
- Both precautionary borrowing and precautionary saving motives are present:
  - consumption in t could be lower or higher

Solution Without Flow Credit Constraint



- Two motives for borrowing.
- As cash-on-hand rises: desire to leverage and buy risky asset
- Contrast with single asset model

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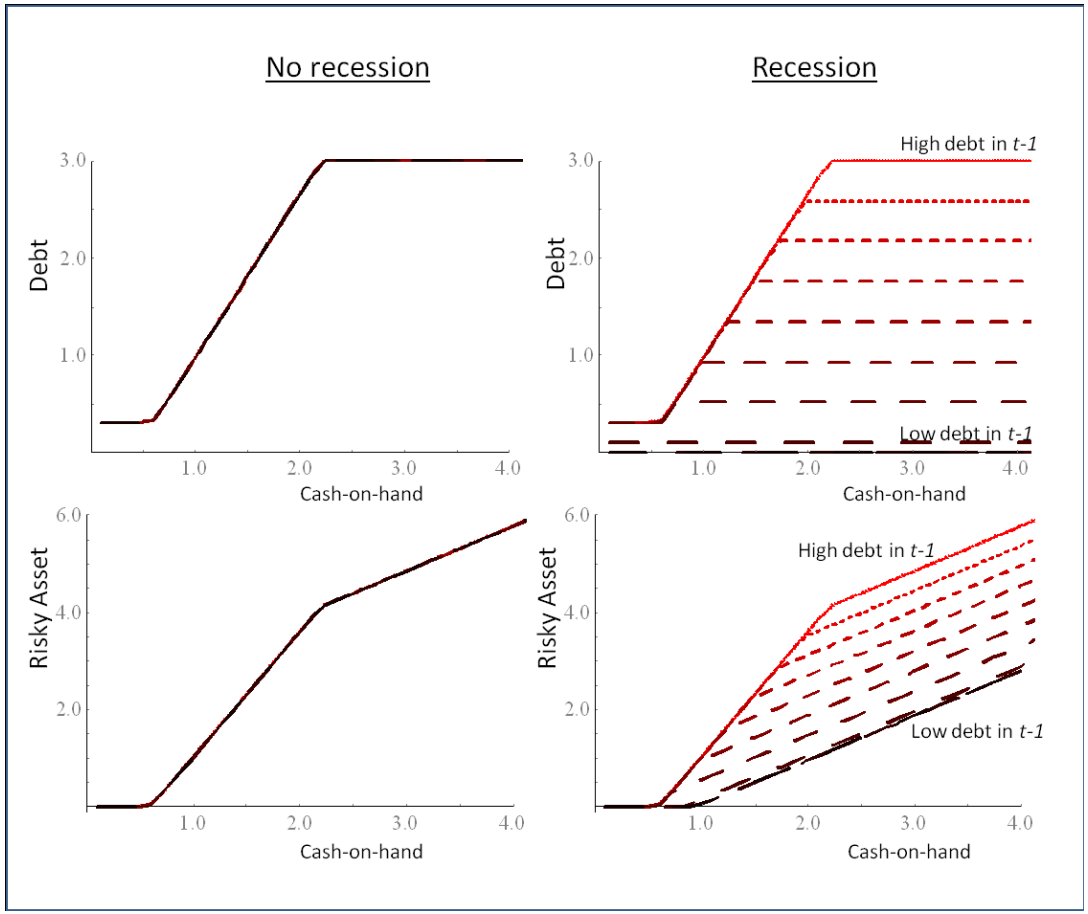


- High x : constraint reduces equity investment (increases consumption)

Data

- UK micro data (FES) 1976-2010: consumption, income etc
- Recessions: 1980-1981, 1990-1991, 2008-2009
- Micro data: observe individual behaviour
- Synthetic cohort analysis
- Observe young/ middle aged/ old in each recession

Estimates

Saving Rates at Onset: what fraction of cohort income is saved

	Savings Rate	*ΔSavings Rate*
Recession*	**0.0390** (.0093)	
Recession Onset	0.0108 (.012)	0.0115 (.0131)
Recession Onset + 1	**0.030** (.012)	**0.0224** (.0131)
Recession Onset + 2	**0.051** (.014)	**0.0211** (.0148)
Recession Onset + 3	0.0118 (.014)	**-0.0365** (.0148)
F-Test (p-value)	4.24 (0.004)	3.24 (0.0166)

- Same across age groups and across recessions

Simulations

- Show calibration
- Show baseline life-cylce profiles:
  consumption, savings, net worth, leverage
- Simulate behaviour in alternative recessions:
  - Recession occurs and lasts 2 periods:
    1. Fall in permanent income
    2. Fall in permanent income and variance increase
    3. Credit market constraint tightens in recession
  - Asset price crash occurs at start of the recession
- Effects on different cohorts depending on age at onset (25,40,55)

Inputs into the Model: Income Process

The Effect of Recessions on Income Growth

Constant	**0.0294** (.0072)	**0.0293** (.0073)
Age	0.010 (.007)	0.0098 (.0067)
Age^2	**-0.00015** (.00007)	**-0.00015** (.00007)
Permanent: θ	**-0.0317** (.0127)	**-0.0311** (.0154)
Transitory:λ		-0.00097 (.0150)

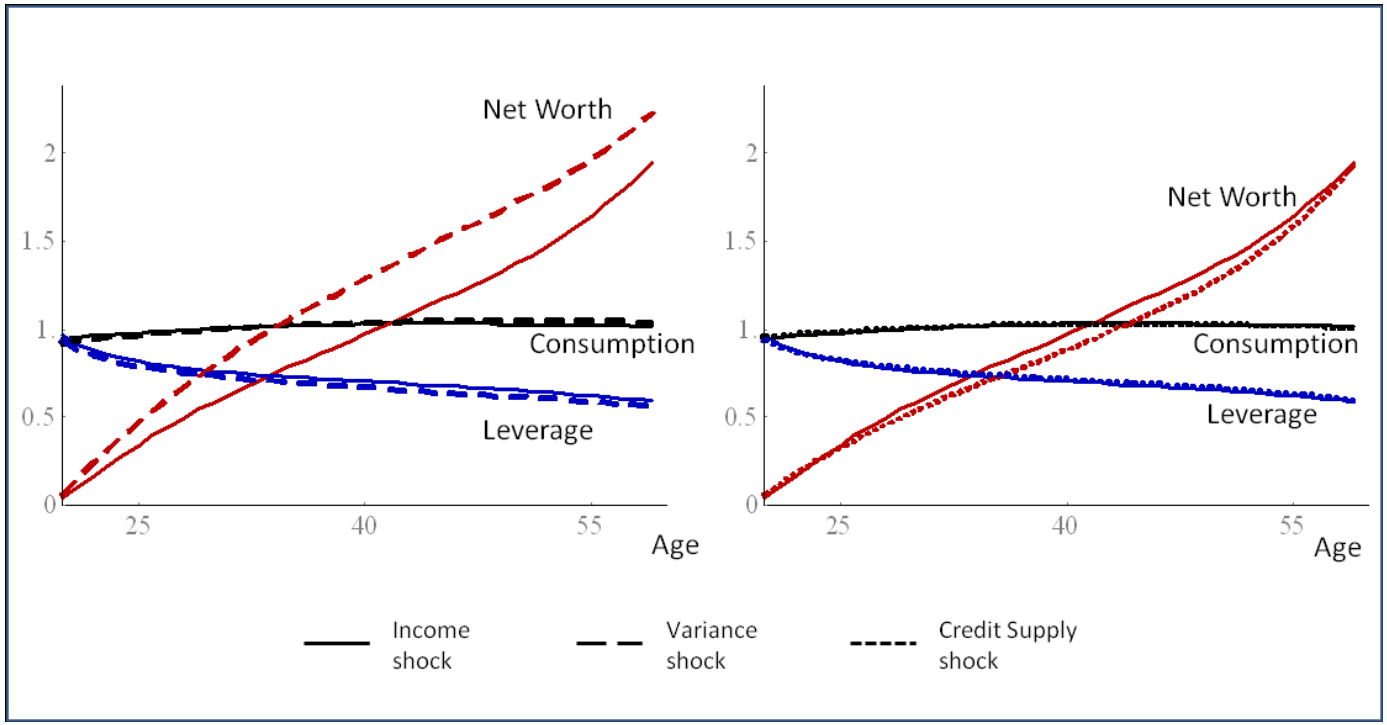
- Permanet effect only: consistent with lack of consumption smoothing.
- Effect same across age and across recessions.

Calibration Parameter Values

$\delta = 0.07$	discount rate
$\gamma = 2.0$	coefficient of relative risk aversion
$\sigma_{n,B} = 0.1$	permanent shock in boom
$\sigma_{n,R} = 0.15$	permanent shock in recession
$p_B = 0.02$	probability of a crash in boom
$p_R = 0.04$	probability of a crash in recession
$\phi = 15\%$	size of crash in risky asset
$\sigma_\varepsilon = 0.076$	standard deviation of return on risky asset
$\mu = 0.035$	mean return on risky asset
$r = 0.02$	interest rate
$g = 0.02$	corporate earnings growth rate

Baseline

No realised recession or crash



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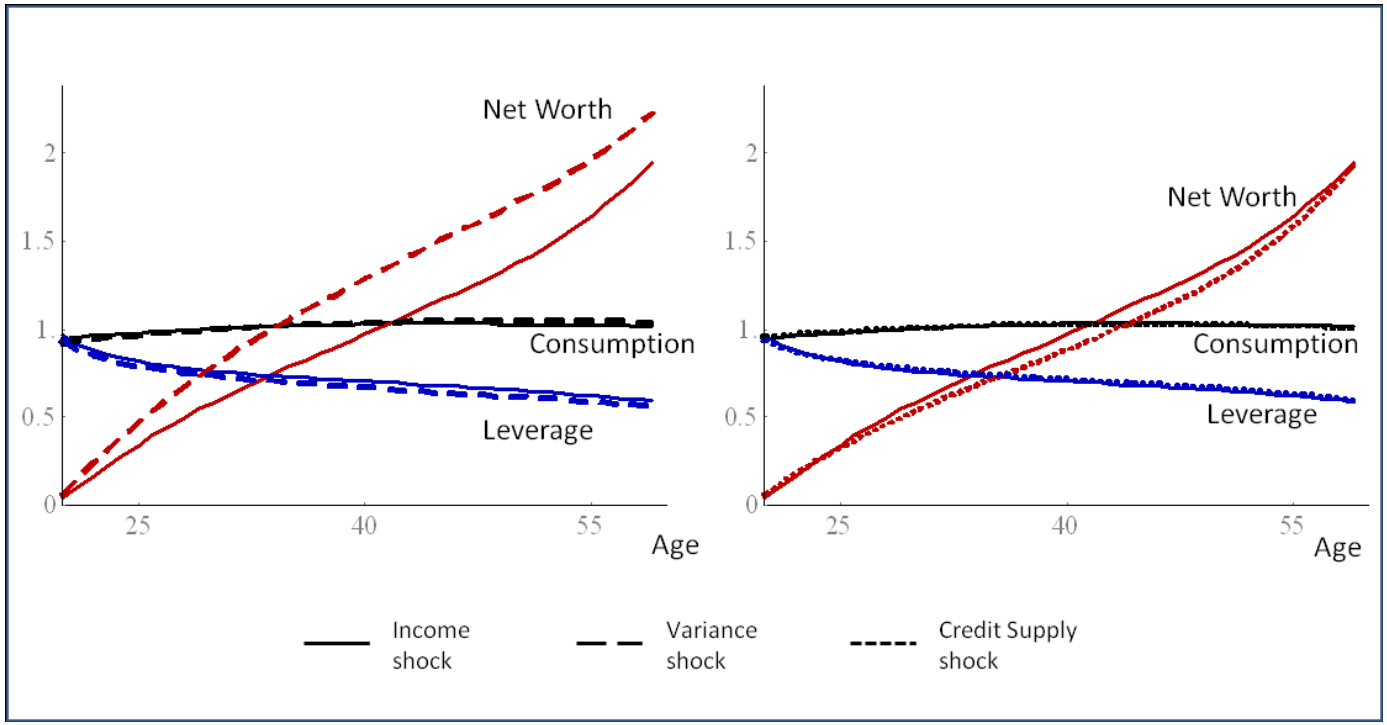

- Variance shock: consumption growth faster, more accumulation, less leverage

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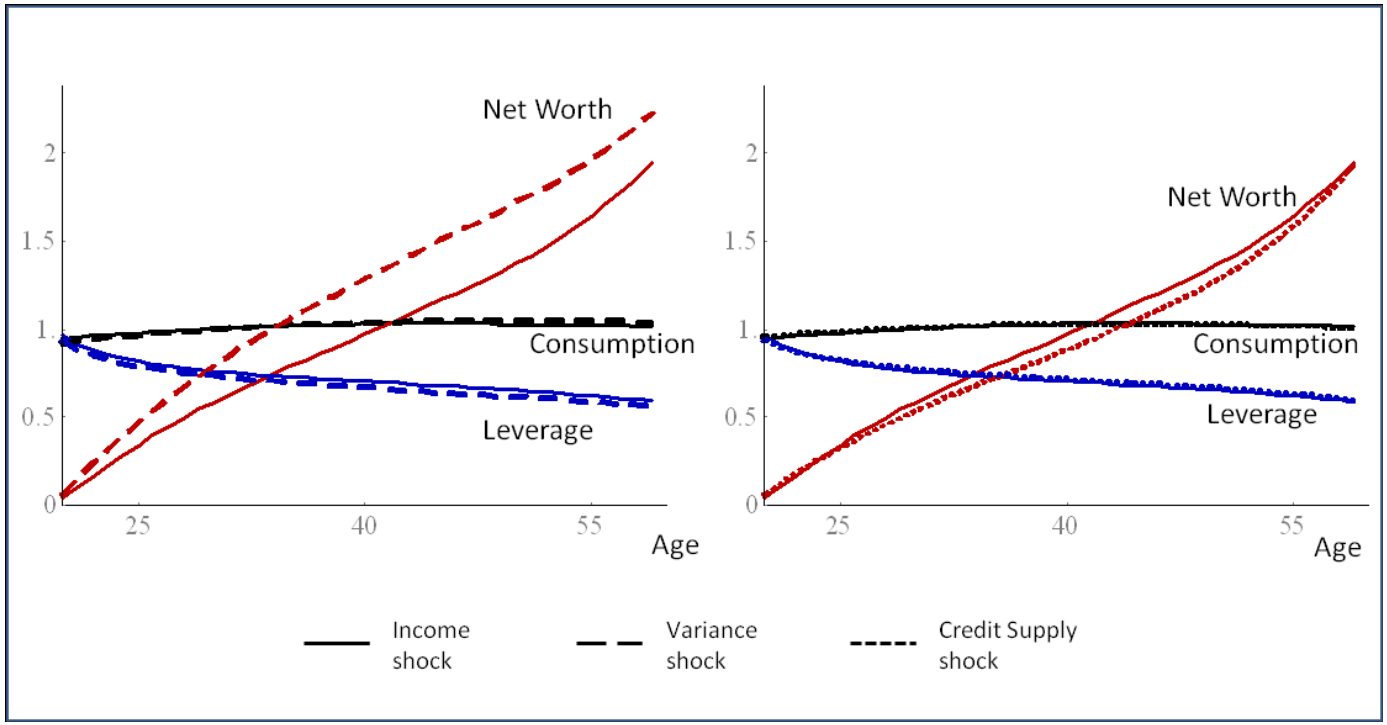
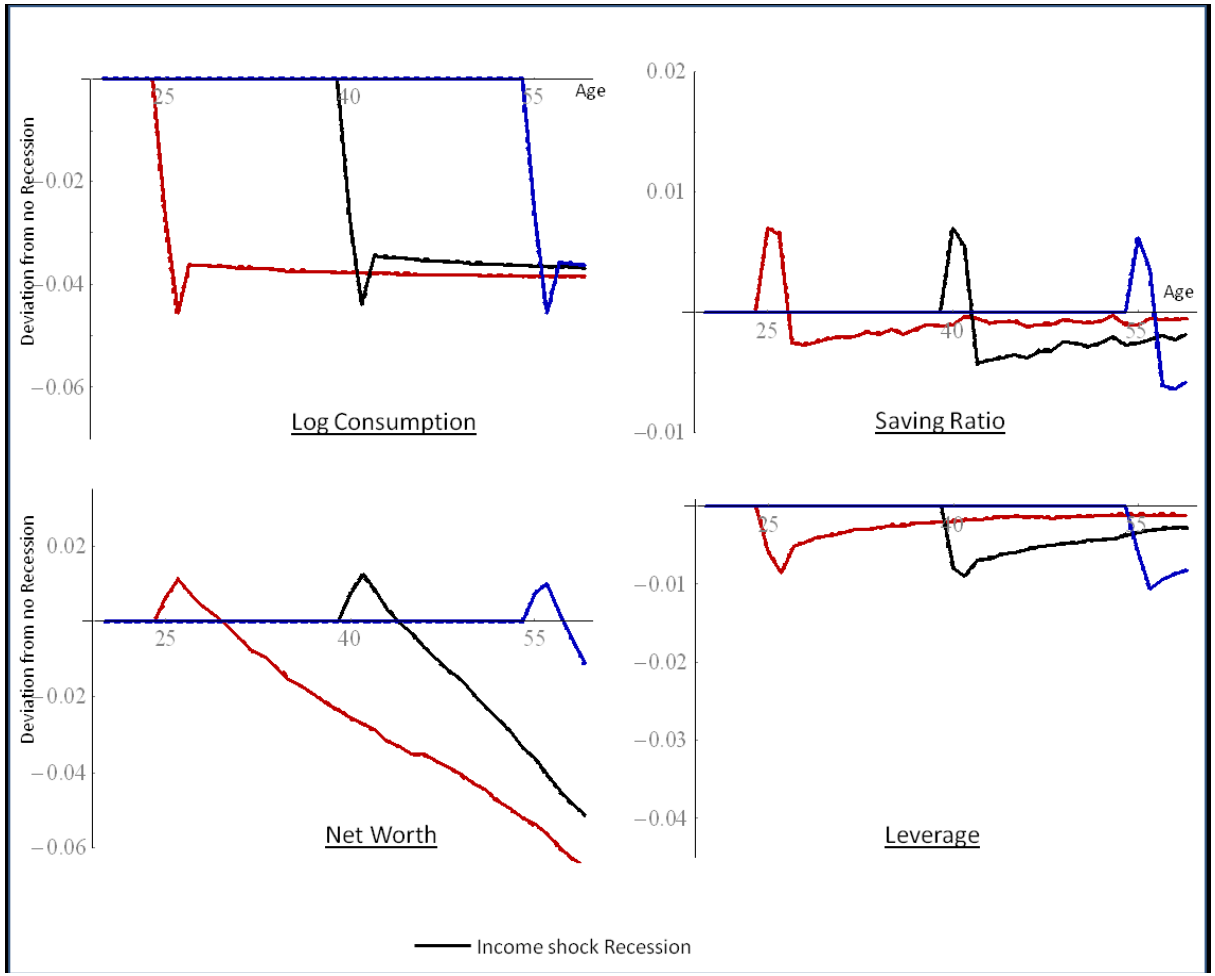


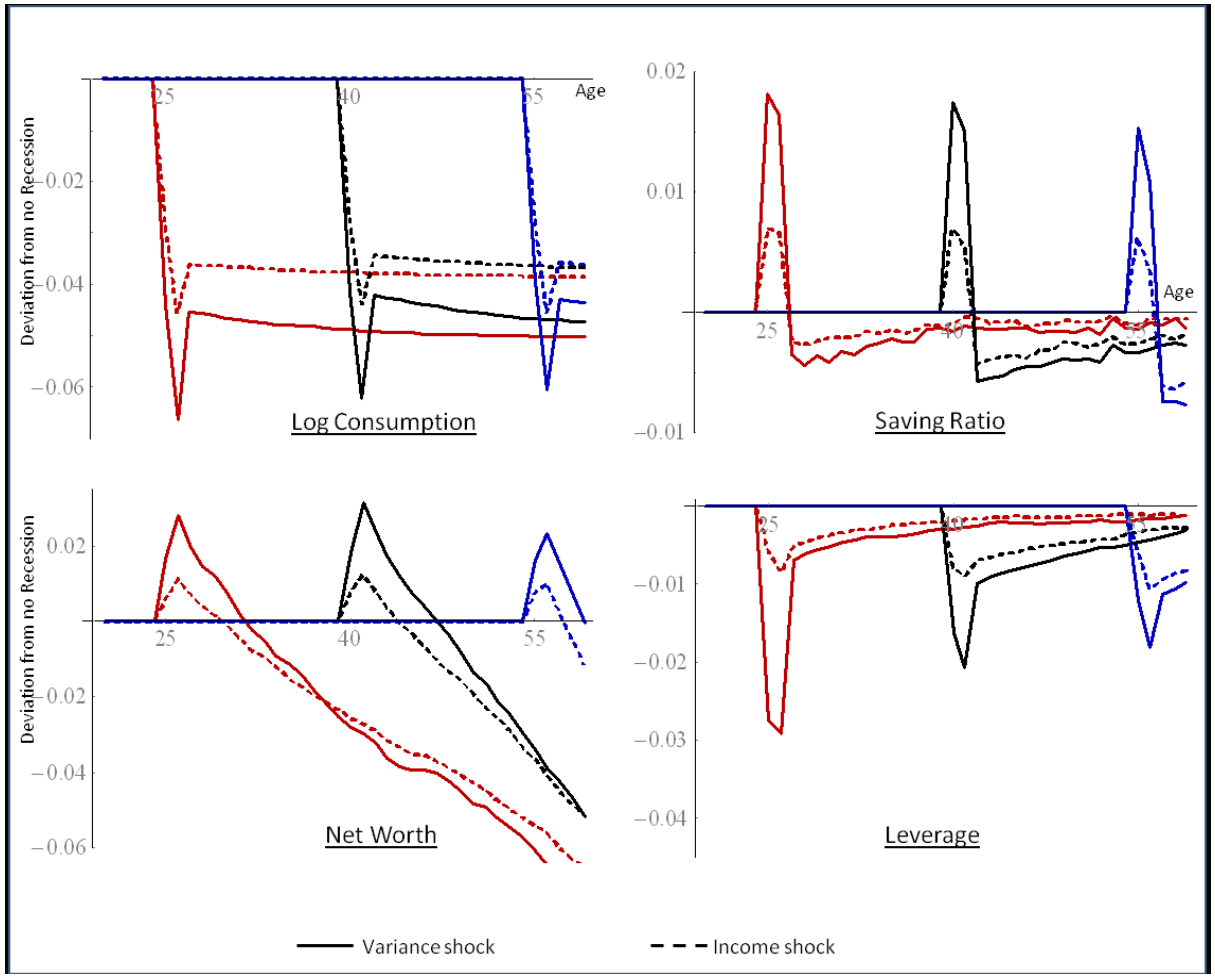
- Variance shock: consumption growth faster, more accumulation, less leverage
- Credit supply shock: consumption growth slower, less accumulation, more leverage:
  - *precautionary borrowing* offsetting *precautionary saving*

Simulations: Income Shock Recession



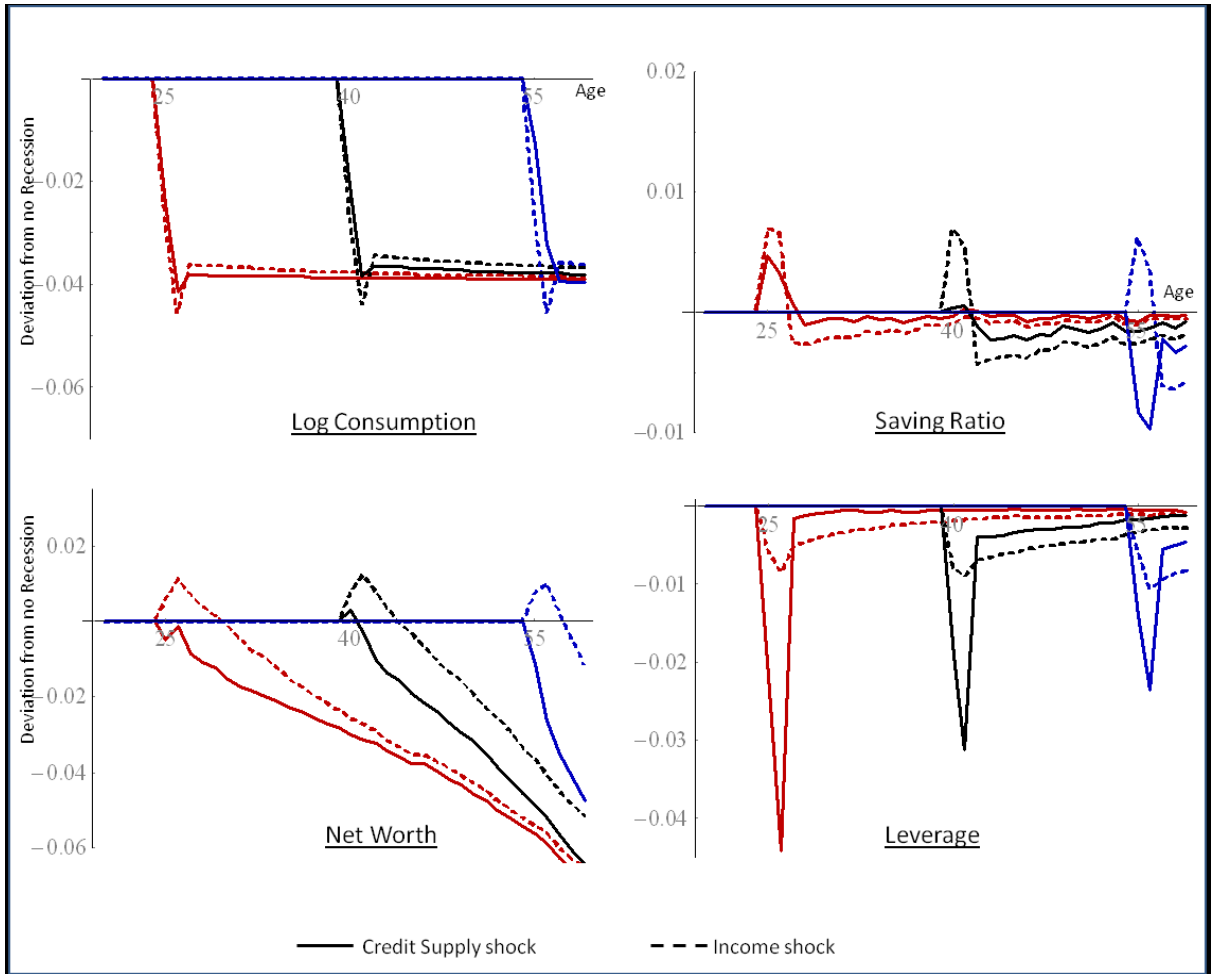
- Overshooting of consumption and saving (at all ages)
- Uncertainty about duration of recession

Simulations: Variance Shock Recession



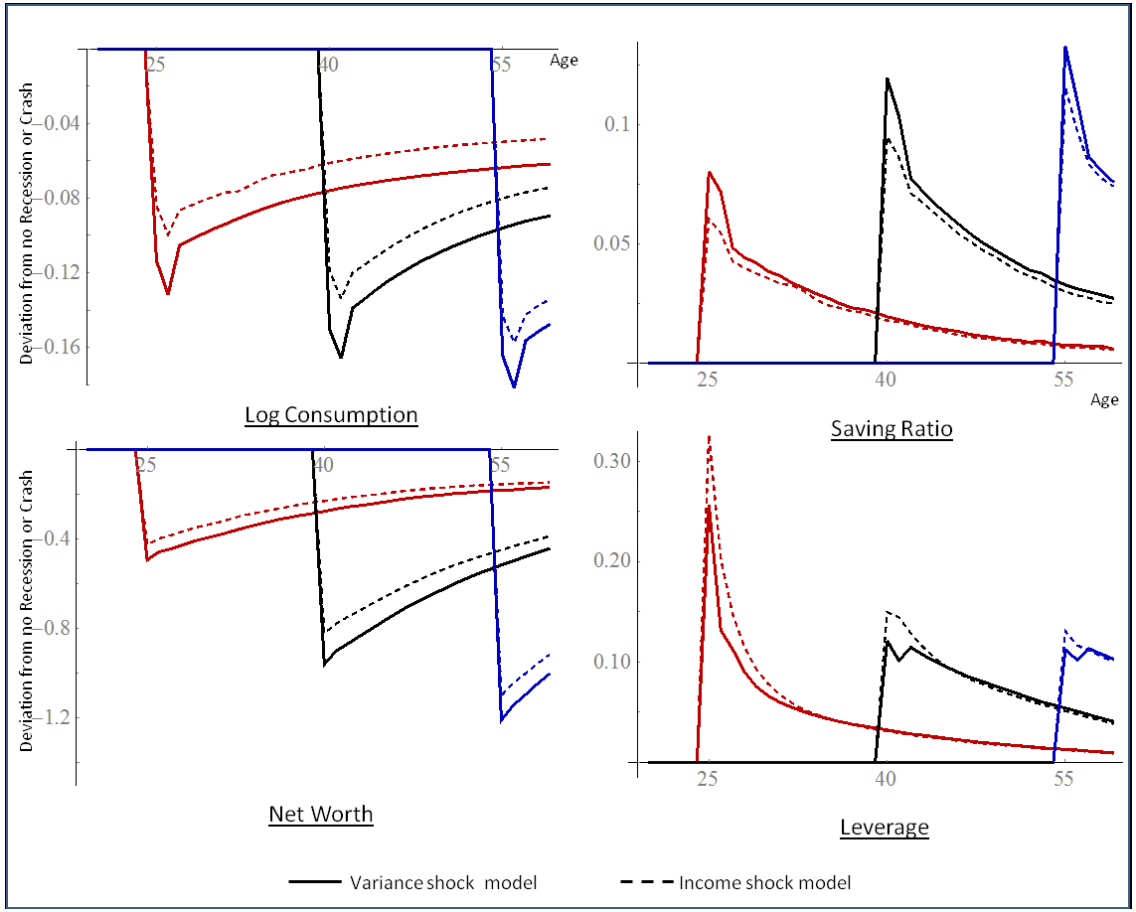
- Greater overshooting of consumption and saving (at all ages)
- Sharp deleveraging.
- Over half of saving spike explained.

Simulations: Credit Supply Shock Recession



- Consumption falls less because of precautionary borrowing motive
- Saving spike *lower* than income shock recession.
- Saving *falls* in recession for the old

Simulations: Asset Market Crash in a Recession



- Direct wealth loss - large because of leveraged positions
- Savings rate high, and remains high, especially for old
- Debt remains and deleveraging needed - reduction is gradual

Conclusions

- Data: saving rates are greater on a rainy day
  - spikes up after onset of recession, then falls back after 2 years
  - across recessions and across age groups
- Recession modelled as:
  - permanent fall in income
  - increased uncertainty
  - constraint on flow credit
  - alongside asset market crash

Conclusions

- Recession as a permanent fall in income has some effect on savings rate (a quarter of the observed rise)
- Contraction in supply of new credit
  - Ex ante: generates *borrowing for a rainy day*
  - Ex post:
    - ★ only a small increase in savings rate for the young in recessions
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- Asset price fall matters especially for older households
  - High savings rate persists, slow to unwind leveraged positions.

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- Asset price fall matters especially for older households
  - High savings rate persists, slow to unwind leveraged positions.
- Preferred explanation:
  - Permanent fall in income and rise in uncertainty:
    - ★ generates rise in savings in recessions and then fall at end of recession
    - ★ generates observed patterns across life-cycle