Dissecting Saving Dynamics

Measuring Credit, Wealth and Precautionary Effects

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Deutsche Bundesbank DSGE / Macro Workshop

The views expressed are mine
and do not necessarily reflect those of the ECB.

Modelling household heterogeneity

Two (complementary) approaches

1. Simple spender–saver two agent NK models, **TANK**
   Bilbiie (2008), Debortoli and Galí (2017), ...

2. Complex heterogeneous agent NK model, **HANK**
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This paper: 'Middle ground'

- Simple, partial equilibrium model of personal saving rate ...
- ... modelling effects of precautionary saving (uncertainty), ...
- ... estimated on US aggregate time series

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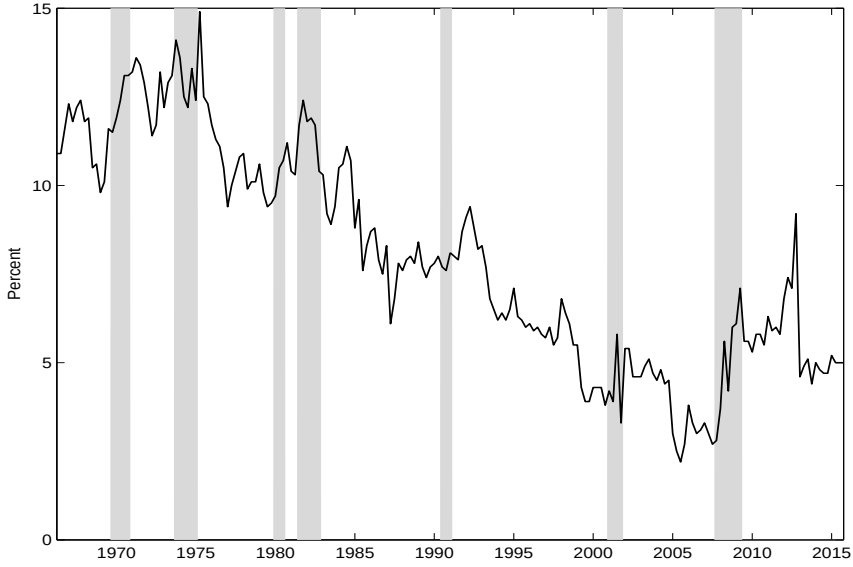
US personal saving rate (s), 1966–2015



Literature on drivers of personal saving s

1. **"Wealth Effects"**
   - Modigliani, Klein, MPS model, ...
     - $s_t = -0.05 m_t$ + other stuff
2. **"Precautionary":** Unemployment risk
   - Carroll (1992), ...
     - Saving rate rises in recessions
     - $\Delta \log C_{t+1}$ strongly related to $\mathbb{E}_t(u_{t+1} - u_t)$
3. **"Credit Availability"**
   - Secular Trend: Parker (2000), Muellbauer (many papers)
   - Cyclical Dynamics: Guerrieri and Lorenzoni (2017), Eggertsson and Krugman (2012), ...
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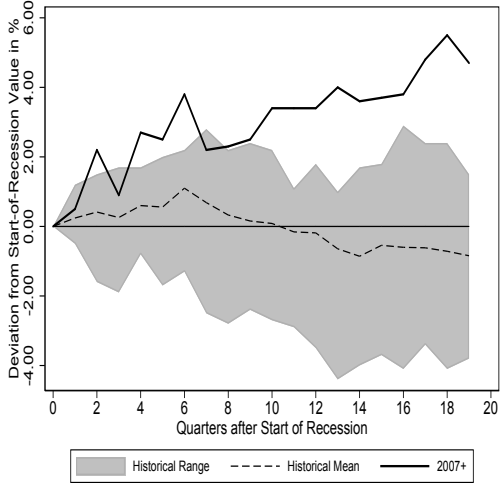
Saving rate in Great Recession, 2007–

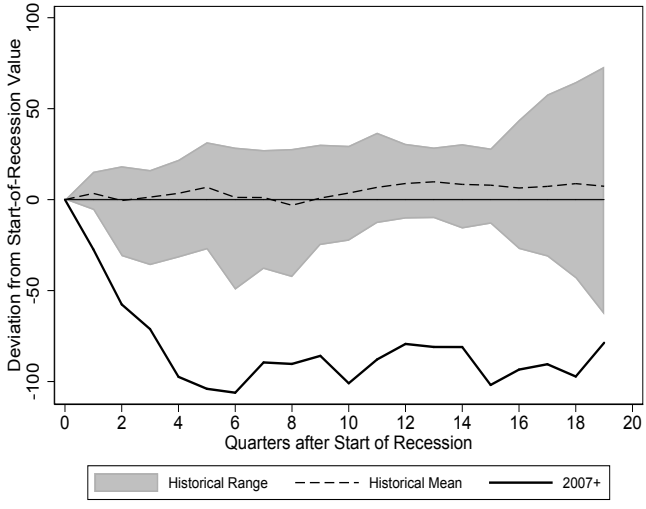
Deviation of saving rate from pre-recession value



- s rises by ∼4–5 pp
- Bigger & more persistent increase than any postwar recession

But all three indicators also move a lot:

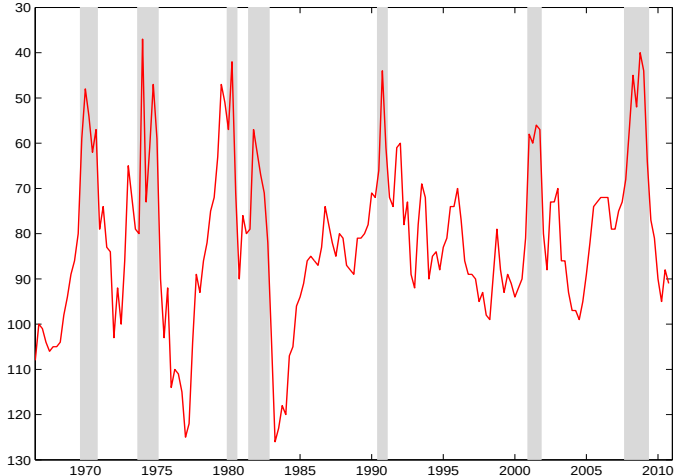
1. Household wealth 2007– ↓ by 100% of income



But all three indicators also move a lot:

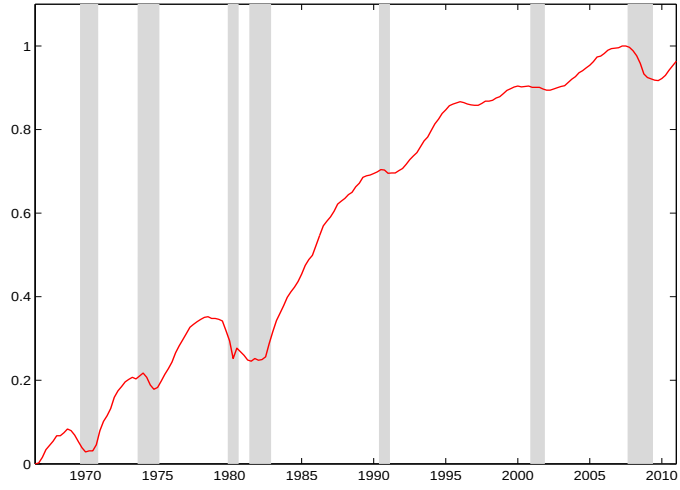
2. Sustained expectations of rising unemployment risk

Thomson Reuters/University of Michigan $\mathbb{E}_t(u_{t+4} - u_t)$



But all three indicators also move a lot:

3. Tighter household credit supply (based on Muellbauer)



Our contribution

Theory

- Simple model with transparent role for all 3 channels
- Qualitative implications of the model
  - "Overshooting" $\Rightarrow$ possible role for fiscal policy

Evidence

- Estimated structural model of saving rate s
- Quantify importance of the 3 channels using aggregate time series

Preview of results

- Model matches actual dynamics of aggregate saving rate
- All three effects present
- Easier borrowing largely explains secular decline in s
- Unemployment risk significant, counter-cyclical
- Order of importance in Great Recession:
  1. Wealth shock
  2. Unemployment risk
  3. Credit tightening

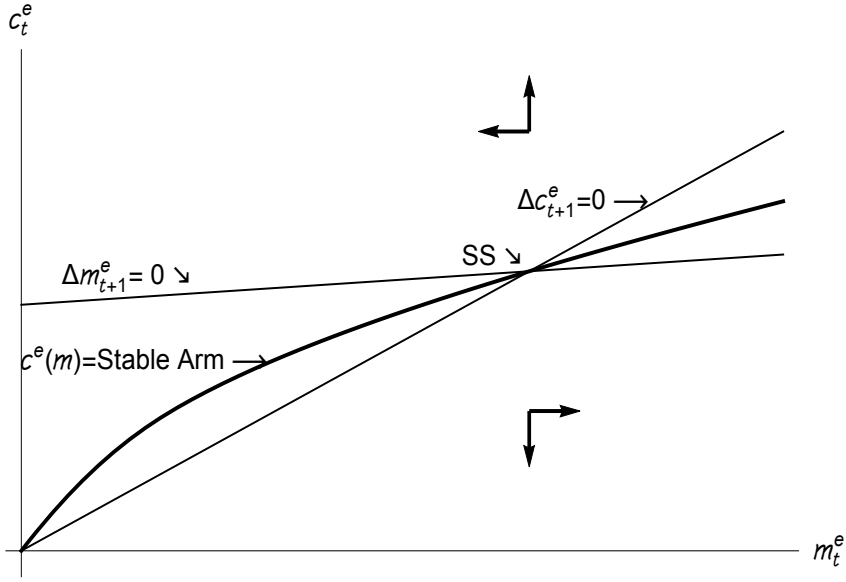
Theory à la Carroll and Toche (2009)

- CRRA utility, labor supply ℓ, agg wage W, emp status ξ:

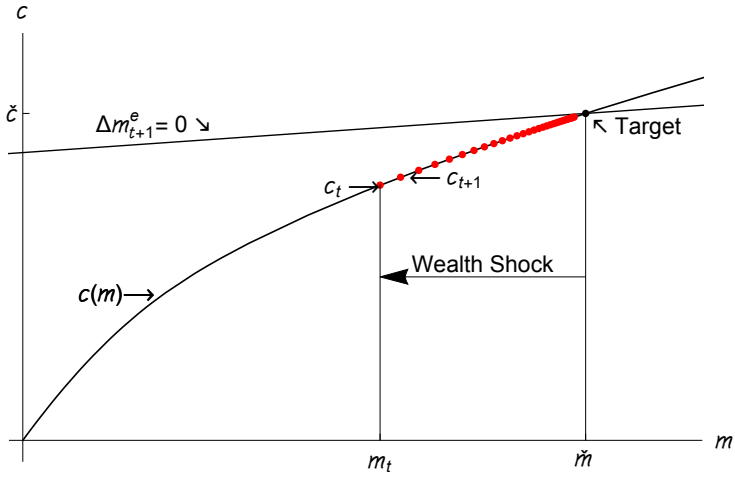
$$\begin{aligned} \mathrm{v}(\boldsymbol{m}_t) &= \max_{\boldsymbol{c}_t} \ \mathrm{u}(\boldsymbol{c}_t) + \beta \mathbb{E}_t\left[\mathrm{v}(\boldsymbol{m}_{t+1})\right] \\ &\text{s.t.} \\ \boldsymbol{m}_{t+1} &= (\boldsymbol{m}_t - \boldsymbol{c}_t)\mathrm{R} + \ell_{t+1}\mathrm{W}_{t+1}\xi_{t+1} \end{aligned}$$

- $\xi_{t+1} \in \{\xi^u, \xi^e\}$ where $\xi^u < \xi^e$
- Unemployment risk (prob of becoming unemployed): $\mho$
- Tractability: unemployment shocks are permanent [if $\xi_t = \xi^u$ then $\xi_{t+1} = \xi^u$]
- ℓ and W grow at constant rate
- Target wealth $\check{m}$ exists and is stable:
  - Consumption chosen so that $m_t \to \check{m}$

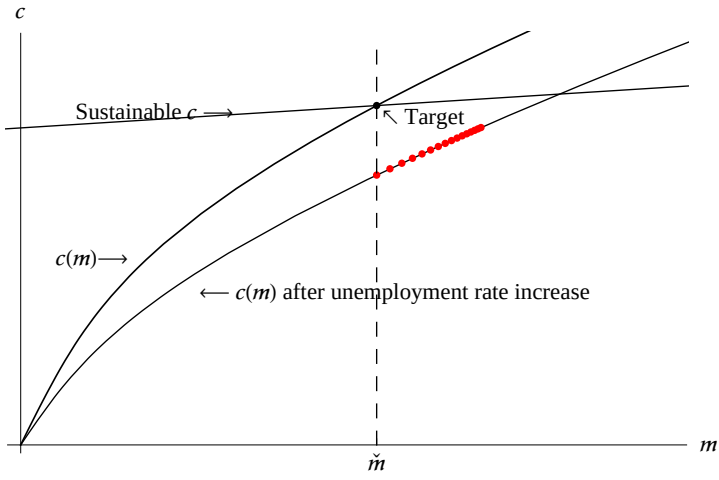
Consumption function



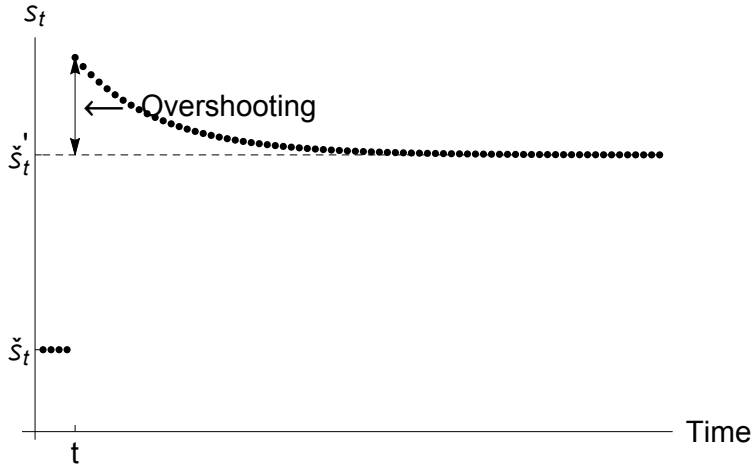
Consumption after a wealth shock



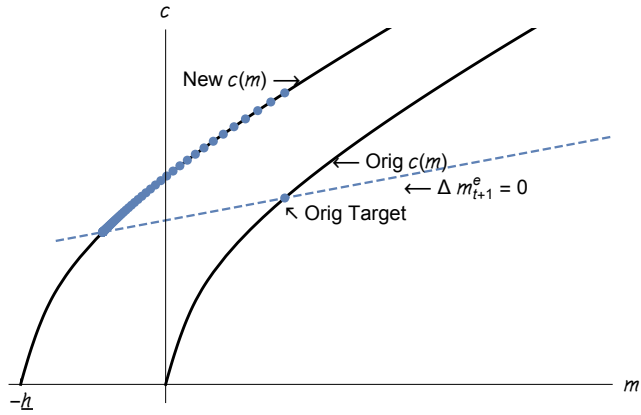
Permanent rise in unemployment risk $\mho$



Saving rate after permanent rise in υ



Credit easing/financial innovation & deregulation



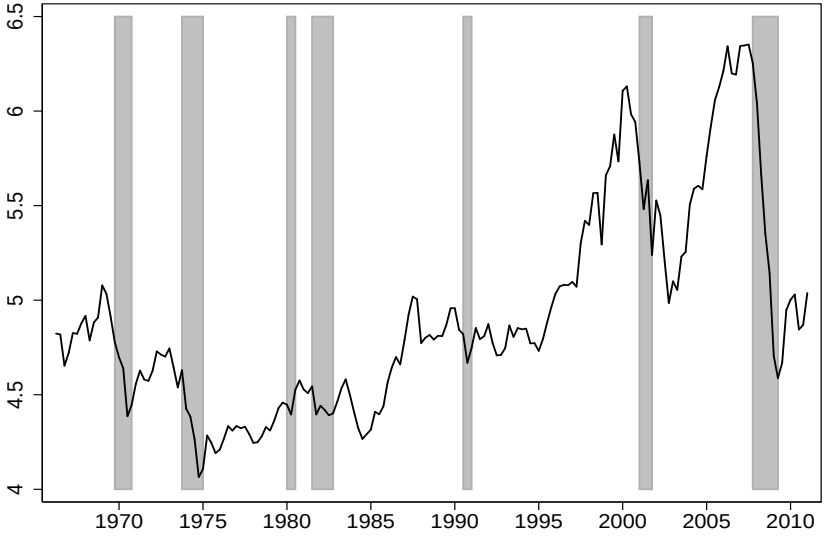
Expansion of borrowing limit $\underline{h}$

$\check{m}$ is close to linear in credit conditions

Data & sources

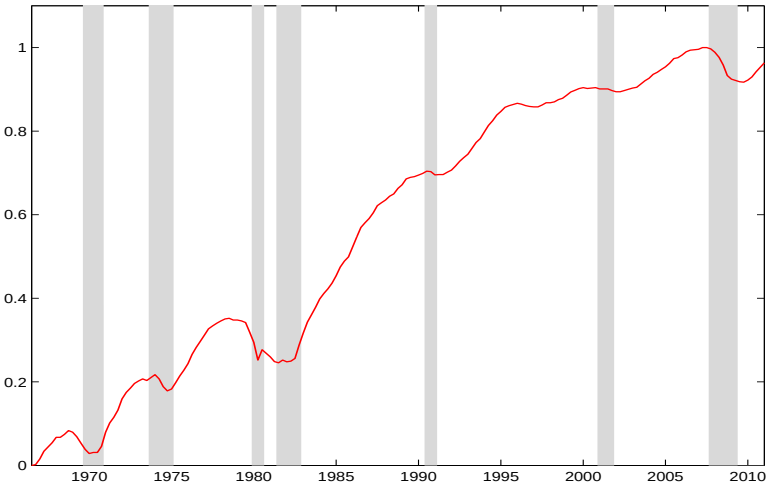
- Quarterly 1966Q2–2011Q4
- Saving rate: BEA NIPA
- Net worth: US Financial Accounts (Flow of Funds), Fed
- Credit conditions: "Credit Easing Accumulated," CEA
  - Senior Loan Officer Opinion Survey (SLOOS), Fed
  - Question on banks' willingness to provide consumer installment loans—Loan supply
- Unemployment risk: using Thomson Reuters/UMichigan unempl expectations

Net worth (ratio to disposable income) m



Credit Easing Accumulated (CEA) (à la Muellbauer)

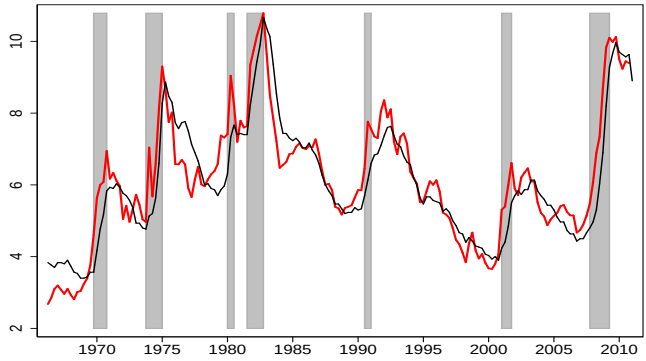
Accumulated responses, weighted with debt–income ratio, to:
"Please indicate your bank's willingness to make consumer installment loans now as opposed to three months ago."



$\mho_t$ implied by Michigan unemployment expectations

- Regress: $\Delta_4 u_{t+4} = \alpha_0 + \alpha_1 UExp_t$
- U risk: $\mho_t = u_t + \Delta_4 \hat{u}_{t+4}$
- $\Delta_4 u_{t+4} \equiv u_{t+4} - u_t$, $\Delta_4 \hat{u}_{t+4} \equiv$ fitted values
- $\mho_t$ tracks but precedes actual U

UExp: "How about people out of work during the coming 12 months—do you think that there will be more unemployment than now, about the same, or less?"



Structural estimation—Nonlinear least squares

Minimize distance between model-implied s_t^{theor} and actual s_t^{meas}:

$$\hat{\Theta} = \arg\min \frac{1}{T} \sum_{t=1}^{T} \left(s_t^{\text{meas}} - s_t^{\text{theor}}(\Theta; m_t - \check{m}(\cdot)) \right)^2$$

- Parameters: $\Theta = \{\beta, \theta_{\text{CEA}}, \bar{\theta}_{\mho}, \theta_u\}$; β: discount factor
- Target wealth $\check{m} = \check{m}(\underline{h}_t, \mho_t)$
  - Depends negatively on credit supply CEA and positively on unemp risk $\mho$
- Shifter of target wealth: $\underline{h}_t = \theta_{\text{CEA}} \text{CEA}_t$
- Unemployment risk: $\mho_t = \bar{\theta}_{\mho} + \theta_u \mathbb{E}_t u_{t+4}$

Structural estimation—Asymptotics

Delta method standard errors

$$T^{1/2}\left(\hat{\Theta}-\Theta\right) \rightarrow_d \mathcal{N}\left(0, \sigma^2 \times \left(\lim_{T\rightarrow\infty} \mathbb{E}(\mathbf{F}'\mathbf{F}/T)\right)^{-1}\right),$$

where the variance matrix can consistently be estimated with:

$$\hat{\sigma}^2 \times \left(\hat{\mathbf{F}}'\hat{\mathbf{F}}/T\right)^{-1}$$

- Var of residuals $\hat{\sigma}^2 = \frac{1}{T}\sum_{t=1}^{T}\left(s_t^{\text{meas}} - s_t^{\text{theor}}(\Theta; z_t)\right)^2$
- Gradient of saving rate function $\hat{\mathbf{F}} = \nabla_{\Theta'} s_t^{\text{theor}}\left(\hat{\Theta}; z_t\right)$, evaluated at optimal $\hat{\Theta}$ (calculated numerically)
- Data $z_t = \left\{m_t, \text{CEA}_t, \mathbb{E}_t u_{t+4}\right\}$

Structural estimates

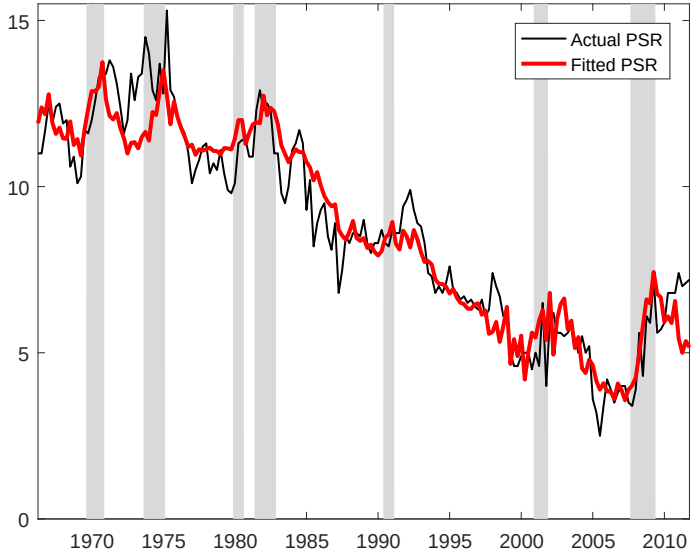
$$s_t = s\big(\{m_t, \text{CEA}_t, \mathbb{E}_t u_{t+4}\}; \Theta\big),$$
$$\underline{h}_t = \theta_{\text{CEA}} \text{CEA}_t,\ \mho_t = \bar{\theta}_{\mho} + \theta_u \mathbb{E}_t u_{t+4}$$

Parameter	Description	Value
Calibrated Parameters		
r	Interest Rate	0.04/4
ΔW	Wage Growth	0.01/4
ρ	Relative Risk Aversion	2
Estimated Parameters $\Theta = \{\beta, \theta_{\text{CEA}}, \bar{\theta}_{\mho}, \theta_u\}$		
β	Discount Factor	$1 - 0.0065^{***}$
		(0.0005)
θ_{CEA}	Scaling of CEA_t to $\underline{h}_t$	8.8943^{***}
		(0.8403)
$\bar{\theta}_{\mho}$	Scaling of $\mathbb{E}_t u_{t+4}$ to $\mho_t$	$1.2079 \times 10^{-4***}$
		(0.2757×10^{-4})
θ_u	Scaling of $\mathbb{E}_t u_{t+4}$ to $\mho_t$	$2.6764 \times 10^{-4***}$
		(0.6490×10^{-4})
$\bar{R}^2$		0.906
DW stat		0.780

Structural estimates: Interpretation of parameters

- **Discount factor** $\beta = 1 - 0.0065$ or 0.974 at annual frequency [standard]
- **Credit availability** $\underline{h}_t$ varies b/w 0 and $8.89/4 \approx 2.2 \Rightarrow$
  Credit availability $\uparrow$ by 220% of DI due to fin deregulation 1966–2007 (peak)
- **Unemployment risk** $\mho_t$
  - Ranges b/w 1.25×10^{-4} and 1.5×10^{-4} per quarter
  - $\Rightarrow$ 3 % prob to become permanently unemployed per life cycle (50 years)
  - $\mho_t$ is highly counter-cyclical
  - 20 % $\uparrow$ in $\mho_t \Rightarrow$ 1 pp $\uparrow$ saving rate (regular recession)
    Similar response to richer models [eg Carroll, Slacalek, Tokuoka, and White (2017)]

Actual and fitted saving rate

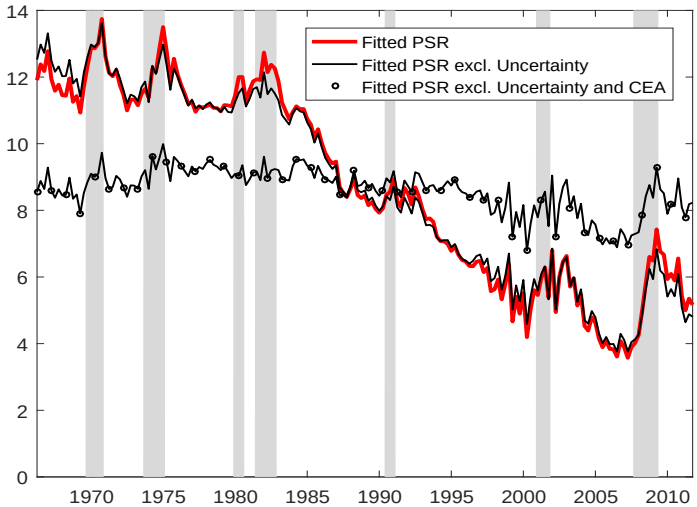


Structural model vs. linear, reduced form model

Actual and Explained Change of the Saving Rate: 2006/07–2009/10

	Model Decomposition		
Variable	Structural	Reduced Form	Actual Δs_t
m_t	1.3	$-0.89 \times -1.19 = 1.1$	
CEA_t	0.6	$-7.91 \times -0.12 = 1.0$	
$\mathbb{E}_t u_{t+4}$	0.7	$0.20 \times 4.6 = 0.9$	
Explained/Actual Δs_t	2.6	3.0	2.6

Decomposition of fitted saving rate s

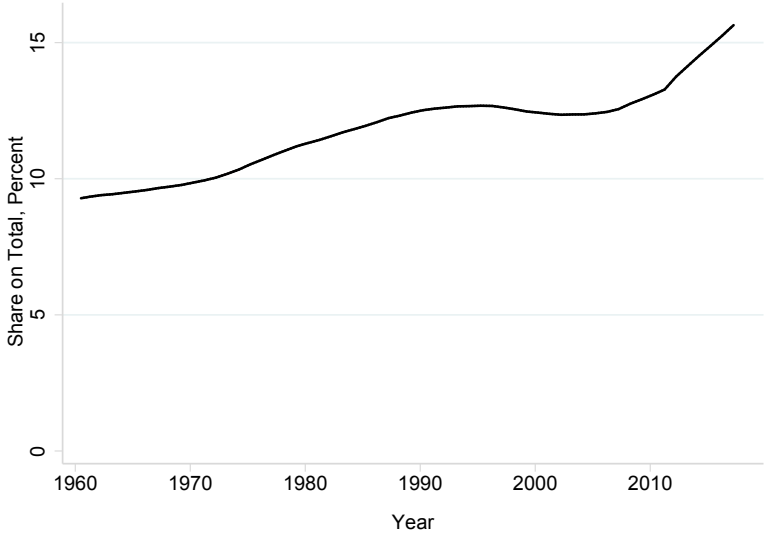


- CEA essential to capture trend in s
- m, $\mho$: business-cycle changes in s
- Implied MPCW ≈ 0.015 [Lower range of typical estimates, 0.02–0.07]

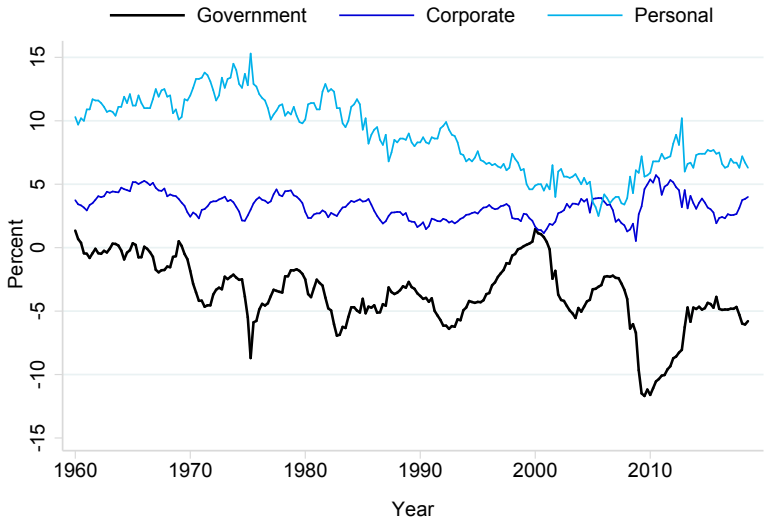
Competitor models of saving

- Quadratic utility / linearized models: No role for effects of uncertainty
- Demographics: Aging implies increasing saving rate [counterfactual]
- Increasing inequality: Top income / wealth not related to s

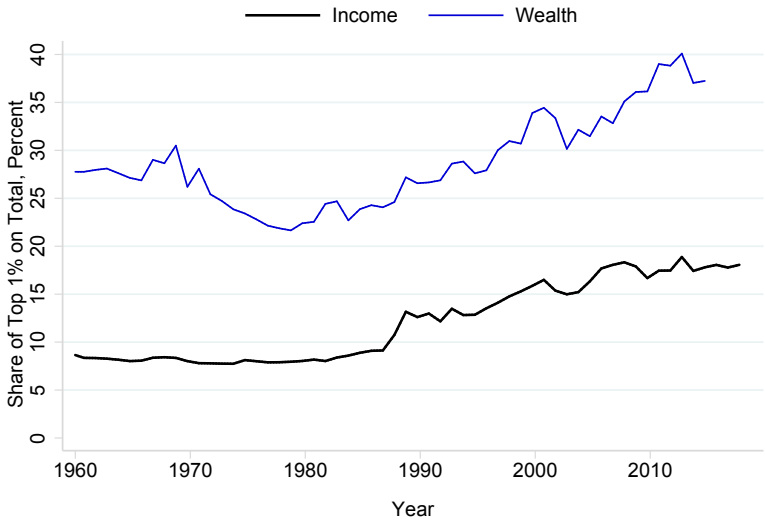
Robustness: Saving rate and share of 65+ years



Robustness: Government, corporate, personal saving rate



Robustness: Top 1 percent income and wealth share



Summary and conclusions

- Estimate simple model with precautionary saving
- Model matches actual aggregate saving rate dynamics
- All three effects present
- Easier borrowing largely explains secular decline in s
- Order of importance in Great Recession:
  1. Wealth shock
  2. Unemployment risk
  3. Credit tightening

To Do: Need to combine aggregate time series w/ household heterogeneity

References

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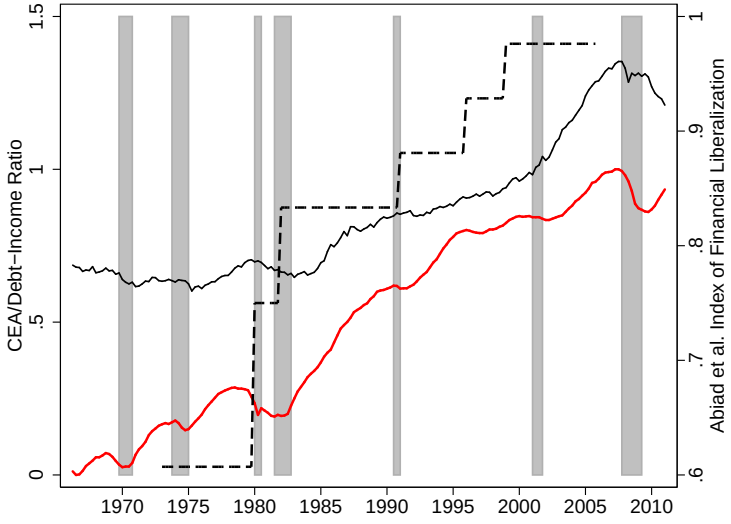
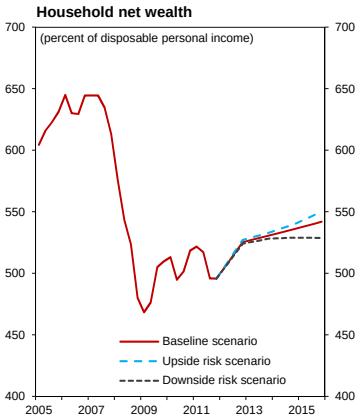
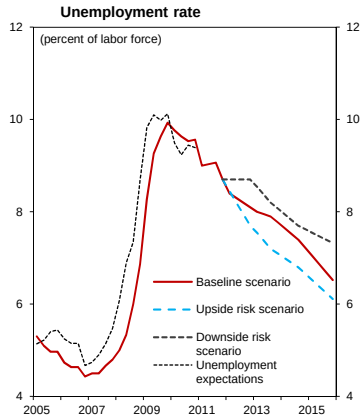
Background Slides

Alternative Measures of Credit Availability



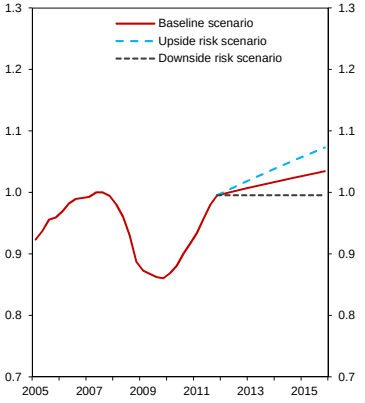
Assumptions/Scenarios for Out-of-Sample Forecasts



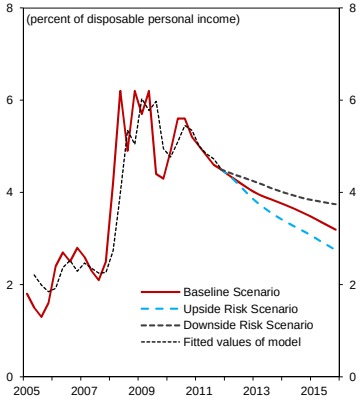


Assumptions/Scenarios for Out-of-Sample Forecasts

Credit conditions



Household saving rate



Actual and Target Wealth