

Dissecting Saving Dynamics

Measuring Credit, Wealth and Precautionary Effects

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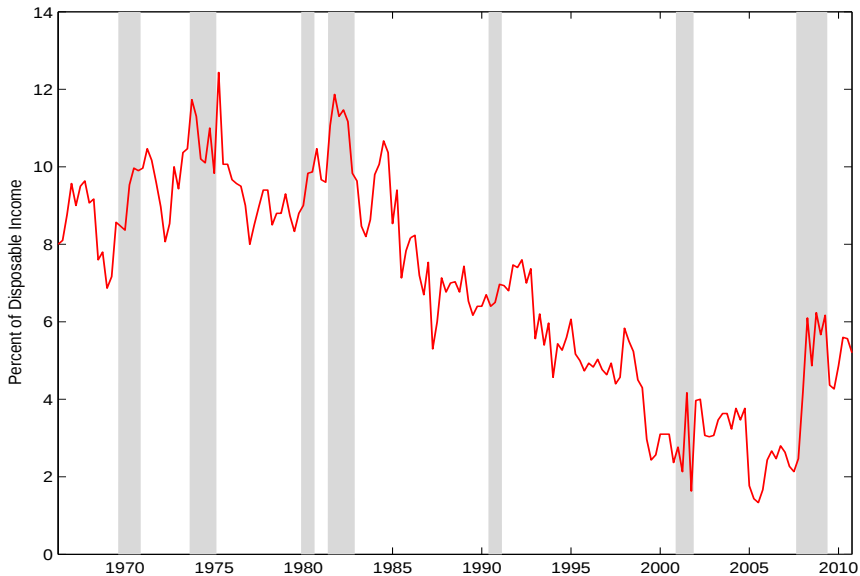
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US Personal Saving Rate (s), 1966–2011



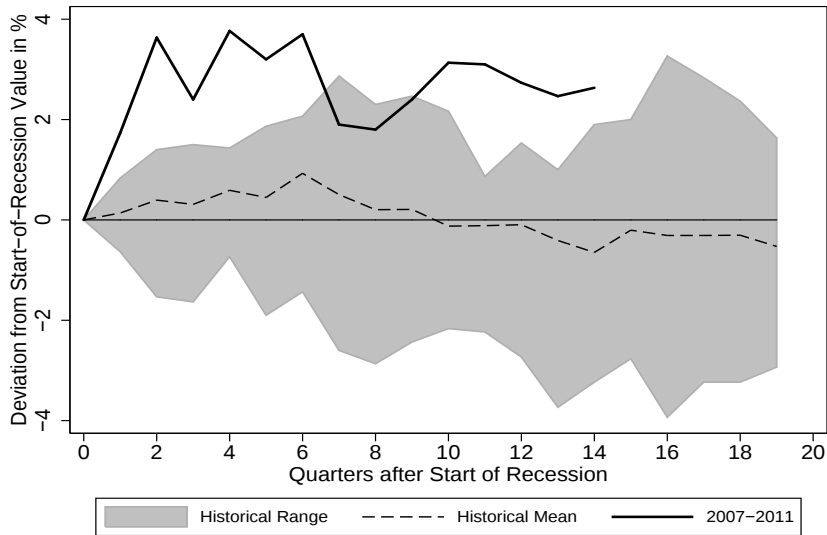
Literature

- ▶ “Wealth Effects”
 - ▶ Modigliani, Klein, MPS model, ...
 - ▶ $s_t = -0.05m_t + \text{other stuff}$
- ▶ “Precautionary”
 - ▶ Carroll (1992)
 - ▶ Saving rate rises in recessions
 - ▶ $\Delta \log C_{t+1}$ strongly related to $\mathbb{E}_t(u_{t+1} - u_t)$
- ▶ “Credit Availability”
 - ▶ Secular Trend:
 - ▶ Parker (2000), Dynan and Kohn (2007), Muellbauer (many papers)
 - ▶ Cyclical Dynamics:
 - ▶ Guerrieri and Lorenzoni (2011), Eggertsson and Krugman (2011), Hall (2011)

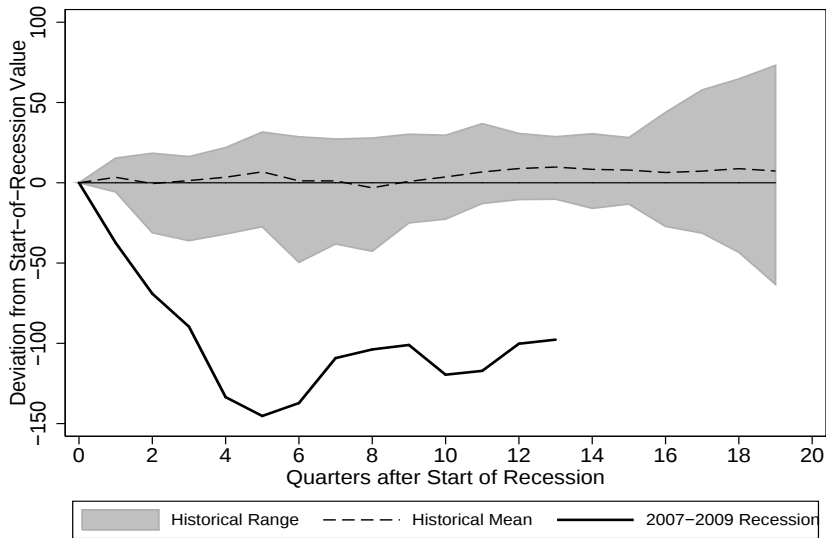
Great Recession 2007–2009

- ▶ s rises by $\sim 4\text{--}5$ pp
- ▶ Bigger & more persistent increase than any postwar recession
- ▶ But all three indicators also move a lot:
 - ▶ Credit conditions tighten
 - ▶ Unemployment Expectations rise
 - ▶ Wealth falls

Personal Saving Rate 2007– ↑

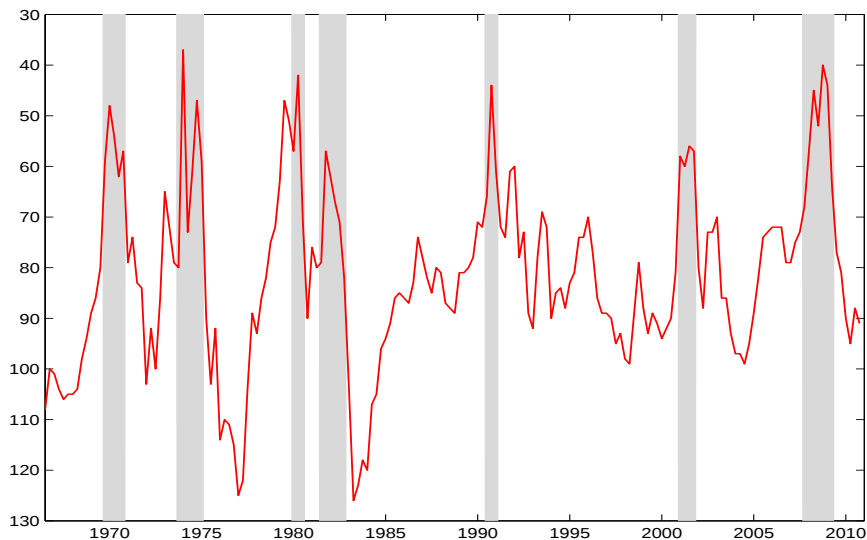


Household Wealth 2007– ↓ by 150% of Income

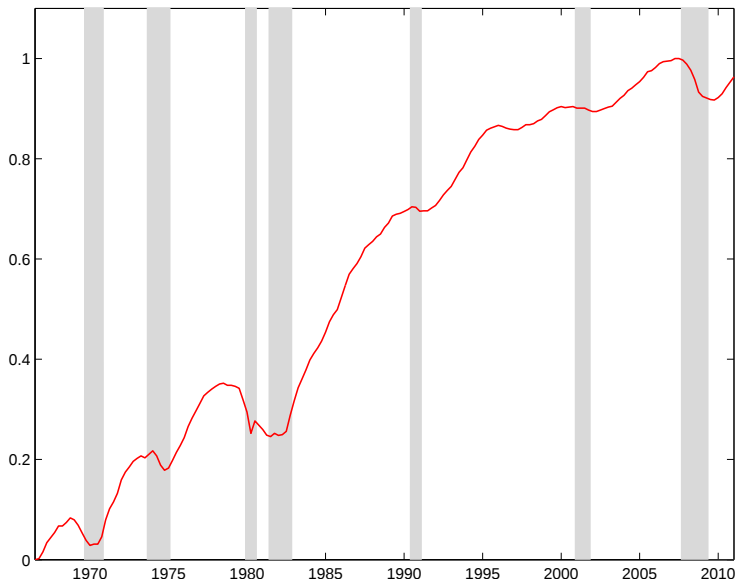


Sustained Expectations of Rising Unemp Risk

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



Tighter HH Credit Supply (Based on Muellbauer)



Our Contributions

► Theory

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

► Evidence

- Quantify importance of the 3 channels
- Two estimated models of s
 - **Reduced-form**—OLS
 - **Structural**—Nonlinear least squares

Why Do We Care?

- ▶ *Quantify* role of credit, wealth and uncertainty
- ▶ Useful for in-sample and out-of-sample analysis
- ▶ Strength of recovery/dynamics of GDP

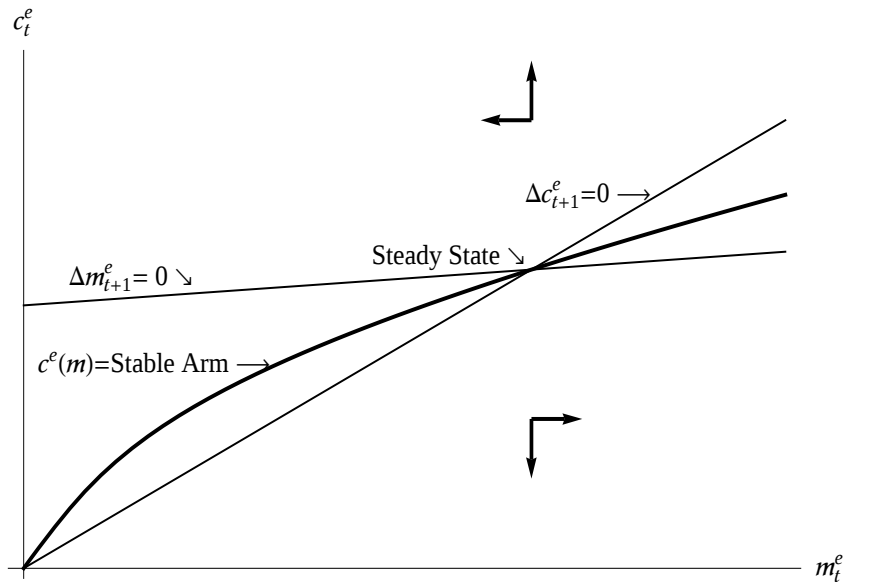
Theory à la Carroll and Toche (2009)

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

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

- ▶ $\xi_{t+1} \in \{\xi^u, \xi^e\}$ where $\xi^u < \xi^e$
- ▶ ℓ and W grow at constant rate
- ▶ Tractability: unemployment shocks are **permanent**
 - ▶ If $\xi_t = \xi^u$ then $\xi_{t+1} = \xi^u$
- ▶ **Target wealth** $\check{m}$ exists and is stable:
 - ▶ Consumption chosen so that $m_t \rightarrow \check{m}$

Consumption Function

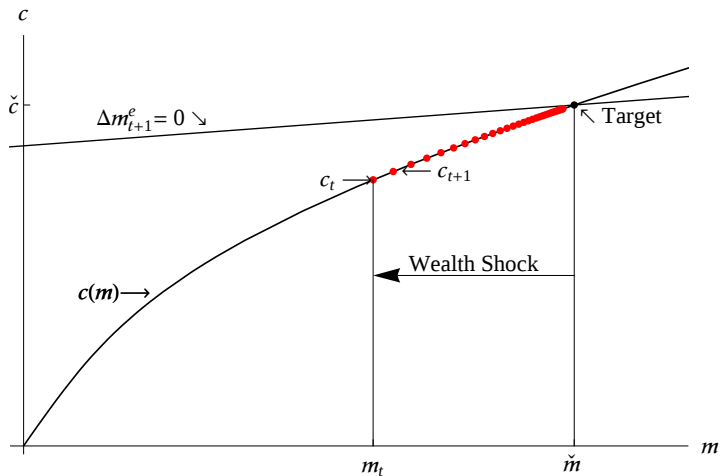


Target Wealth $\check{m}$

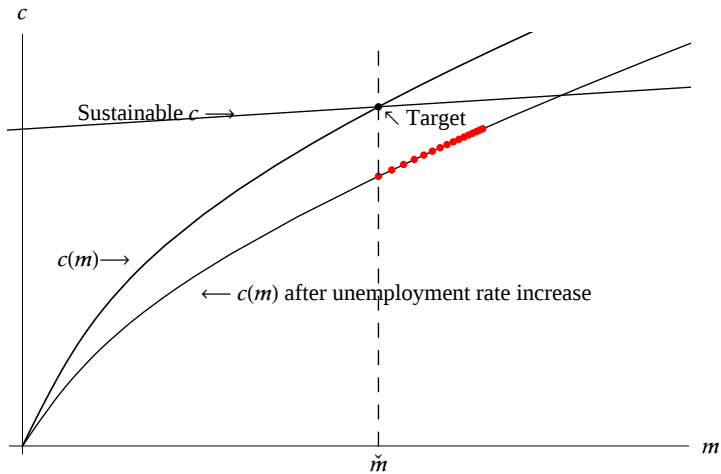
Closed-form solution for target wealth depends on unemployment risk $\bar{U}$ and generosity of unemployment insurance ξ^u :

$$\check{m} = f(\underbrace{\bar{U}}_{(+)}, \underbrace{\xi^u}_{(-)}, \text{preferences}, \dots)$$

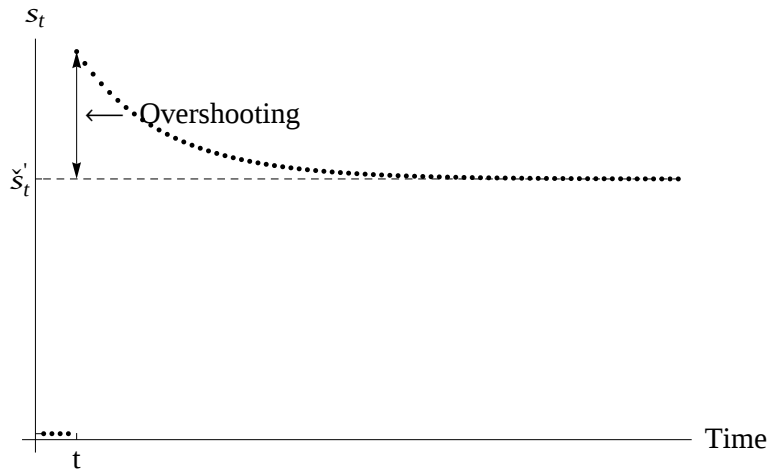
Consumption After a Wealth Shock



Permanent Rise in $\bar{U}$



Saving Rate After a Permanent Rise in $\bar{u}$

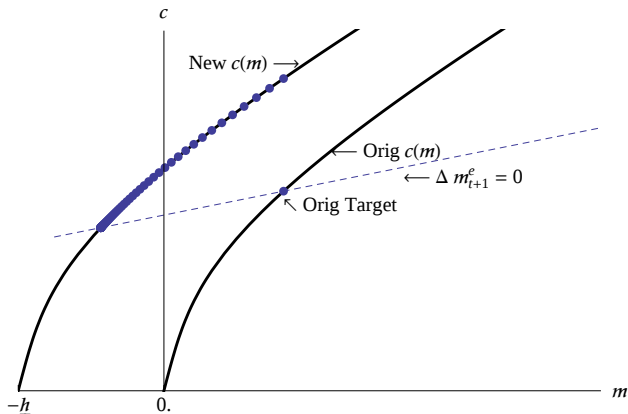


Overshooting and Fiscal Policy

DSGE models:

- ▶ Frictions, frictions everywhere; but missing here
- ▶ If Δc imposes 'external' costs
 - ▶ Sticky prices/wages
 - ▶ Capital (or Investment) adjustment costs
 - ▶ Other reasons for 'pecuniary externalities'
- ▶ $\Rightarrow$ 'stimulus' payments, fiscal policy may reduce cost of cycle
- ▶ Justification for 'automatic stabilizers'?

Credit Easing/Financial Innovation & Deregulation

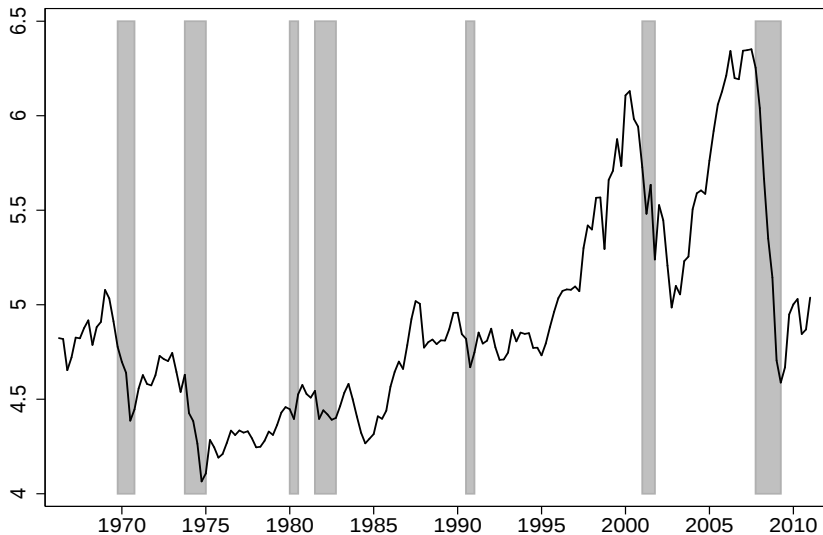


$\tilde{m}$ is close to linear in credit conditions

Data & Sources

- ▶ Quarterly 1966Q2–2011Q1
- ▶ **Saving rate:** BEA NIPA
- ▶ **Net worth:** Flow of Funds Accounts, Fed
 - ▶ (Model m corresponds to $1 +$ ratio of Net worth to disposable income)
- ▶ **Credit conditions:** “Credit Easing Accumulated,” CEA
 - ▶ Senior Loan Officer Opinion Survey (SLOOS), Fed
 - ▶ Banks’ **willingness** to provide consumer installment loans
- ▶ **Unemployment risk:** using Thomson Reuters/UMichigan unemployment expectations

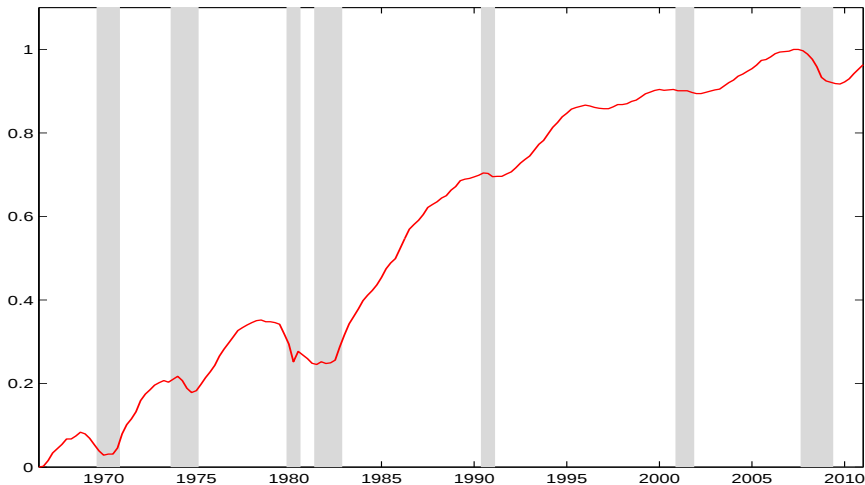
Net Worth (Ratio to Quarterly Disp Income)



Credit Easing Accumulated (CEA) (à la Muellbauer)

Accumulated responses, weighted with debt-income ratio, to:

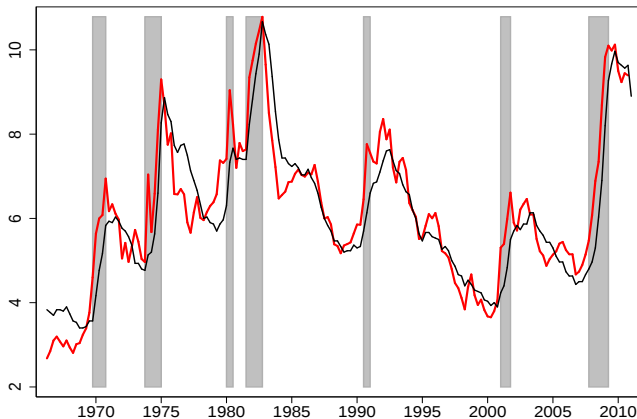
“Please indicate your **bank's willingness to make consumer installment loans** now as opposed to three months ago.”



$\mathcal{U}_t$ Implied by Michigan U Expectations

- ▶ Regress: $\Delta_4 u_{t+4} = \alpha_0 + \alpha_1 UExp_t$
- ▶ U risk: $\mathcal{U}_t = u_t + \Delta_4 \hat{u}_{t+4}$
- ▶ $\Delta_4 u_{t+4} \equiv u_{t+4} - u_t$, $\Delta_4 \hat{u}_{t+4} \equiv$ fitted values
- ▶ $\mathcal{U}_t$ 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?”

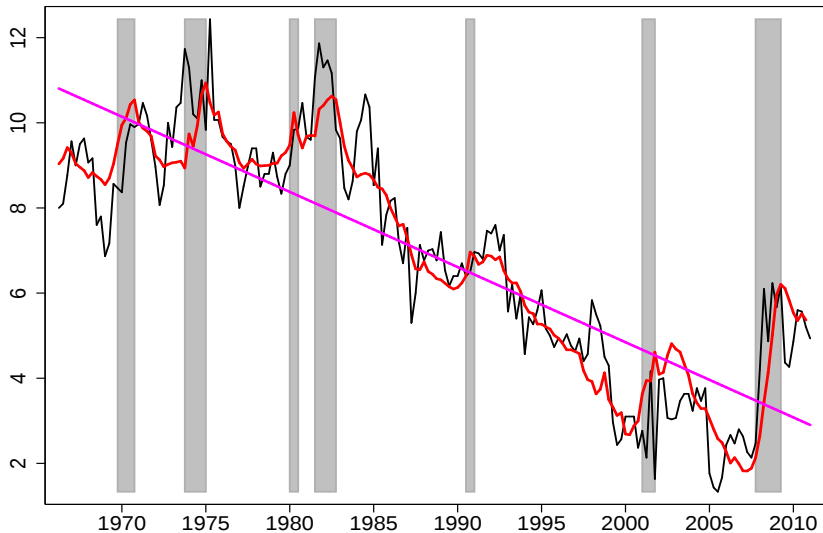


Reduced-Form Regressions

$$s_t = \gamma_0 + \gamma_m m_t + \gamma_{CEA} CEA_t + \gamma_{Eu} \mathbb{E}_t u_{t+4} + \gamma_t t + \gamma_{uC} (\mathbb{E}_t u_{t+4} \times CEA_t) + \varepsilon_t$$

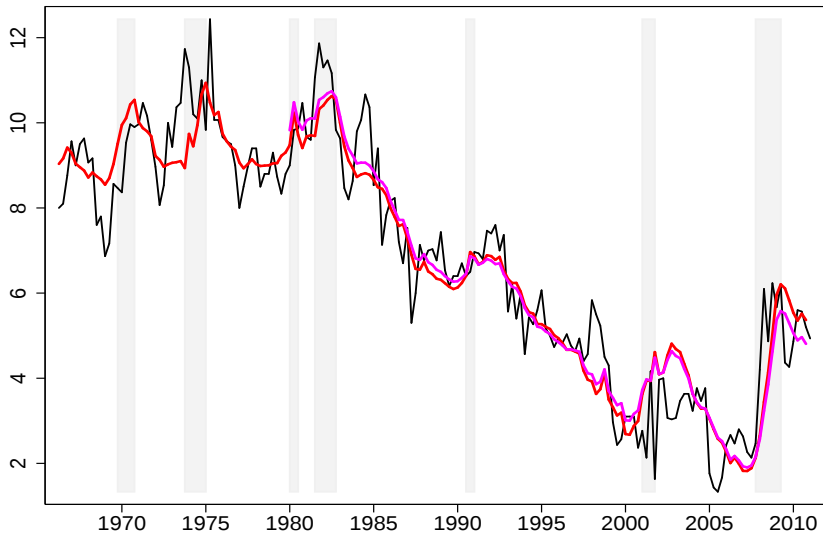
Model	Time	Wealth	CEA	Un Risk	All 3	Baseline	Interact
γ_0	11.95*** (0.61)	25.20*** (1.73)	9.32*** (0.57)	8.24*** (0.42)	14.90*** (2.56)	15.23*** (2.16)	15.55*** (2.56)
γ_m		-2.61*** (0.32)			-1.12*** (0.42)	-1.18*** (0.35)	-1.37*** (0.46)
γ_{CEA}			-14.14*** (1.74)		-5.47*** (1.94)	-6.12*** (0.57)	-4.60*** (1.72)
γ_{Eu}				0.67*** (0.05)	0.32*** (0.12)	0.29*** (0.08)	0.38*** (0.11)
γ_t	-0.04*** (0.00)	-0.03*** (0.00)	0.04*** (0.01)	-0.05*** (0.00)	-0.00 (0.01)		0.00 (0.01)
γ_{uC}							-0.32** (0.16)
$\bar{R}^2$	0.70	0.85	0.82	0.88	0.89	0.90	0.90
F stat p val	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DW stat	0.30	0.69	0.50	0.86	0.94	0.93	0.98

Fit: Baseline vs Time Trend

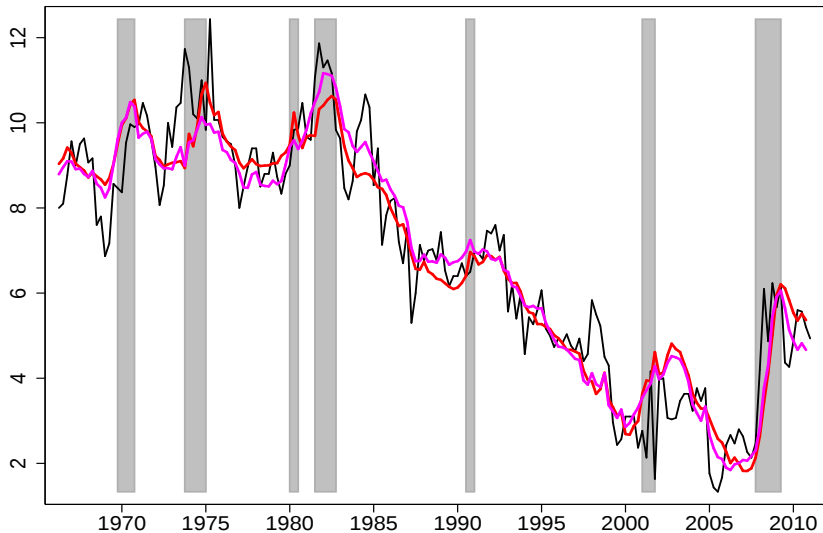


Model	Baseline	Uncert	s_{t-1}	Debt	Full Controls	Post-80	IV
γ_m	-1.18*** (0.35)	-1.21*** (0.36)	-0.31 (0.22)	-0.80** (0.36)	-1.30*** (0.31)	-1.50 (1.25)	-2.02*** (0.49)
γ_{CEA}	-6.12*** (0.57)	-5.97*** (0.65)	-2.87*** (0.53)	-5.40*** (0.73)	-6.24*** (0.63)	-5.00** (2.00)	-5.85*** (1.17)
γ_{Eu}	0.29*** (0.08)	0.28*** (0.09)	0.14*** (0.05)	0.34*** (0.07)	0.12 (0.09)	0.30** (0.14)	0.08 (0.13)
γ_σ		0.26 (0.47)					
γ_s			0.57*** (0.07)				
γ_d				-1.91 (1.16)			
γ_r					0.13*** (0.04)		
γ_{GS}					-0.12 (0.08)		
γ_{CS}					-0.31** (0.14)		
$\gamma_{0post80}$						-1.48 (7.90)	
$\gamma_{mpost80}$						0.56 (1.29)	
$\gamma_{CEApost80}$						-2.35 (2.13)	

Fit: Baseline vs Post-1980



Fit: Baseline vs Full Controls



Reduced-Form Regressions—Summary

The three factors explain saving well:

1. Credit conditions
2. Wealth
3. Unemployment risk

Structural Estimation—Nonlinear Least Squares

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

$$\hat{\Theta} = \arg \min \sum_{t=1}^T \left(s_t^{\text{meas}} - s_t^{\text{theor}} \left(\Theta; m_t - \check{m}(\bar{m}(\text{CEA}_t), \mathcal{U}(\mathbb{E}_t u_{t+4})) \right) \right)^2,$$

where

- ▶ $\Theta = \{\beta, \bar{\theta}_m, \theta_{\text{CEA}}, \bar{\theta}_{\mathcal{U}}, \theta_u\}$
- ▶ $\bar{m}_t = \bar{\theta}_m + \theta_{\text{CEA}} \text{CEA}_t$
- ▶ $\mathcal{U}_t = \bar{\theta}_{\mathcal{U}} + \theta_u \mathbb{E}_t u_{t+4}$
- ▶ β : discount factor

Structural Estimation—Asymptotics

Delta Method

$$T^{1/2}(\hat{\Theta} - \Theta) \rightarrow_d \mathcal{N}(0, D^{-1}ED'^{-1}),$$

where

- ▶ $D = \mathbb{E} \frac{\partial q_t(\Theta)}{\partial \Theta'}$
- ▶ $E = \text{var}(q_t(\Theta))$
- ▶ Scores $q_t(\Theta) = (s_t^{\text{meas}} - s_t^{\text{theor}}(\Theta)) \frac{\partial s_t^{\text{theor}}(\Theta)}{\partial \Theta'}$

Structural Estimates

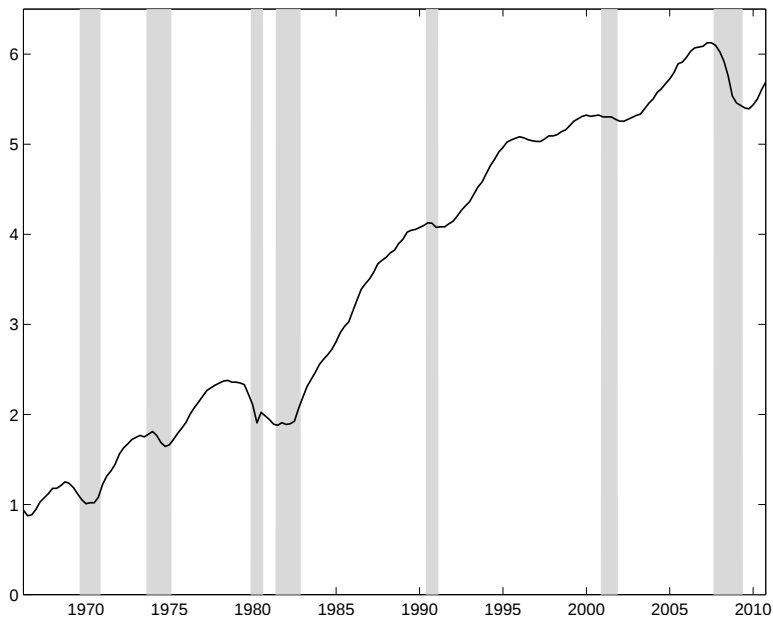
$$s_t^{\text{theor}} = s_t^{\text{theor}}(\Theta; m_t - \check{m}(\bar{m}_t, \mathcal{U}_t)),$$

$$\bar{m}_t = \bar{\theta}_m + \theta_{\text{CEA}} \text{CEA}_t,$$

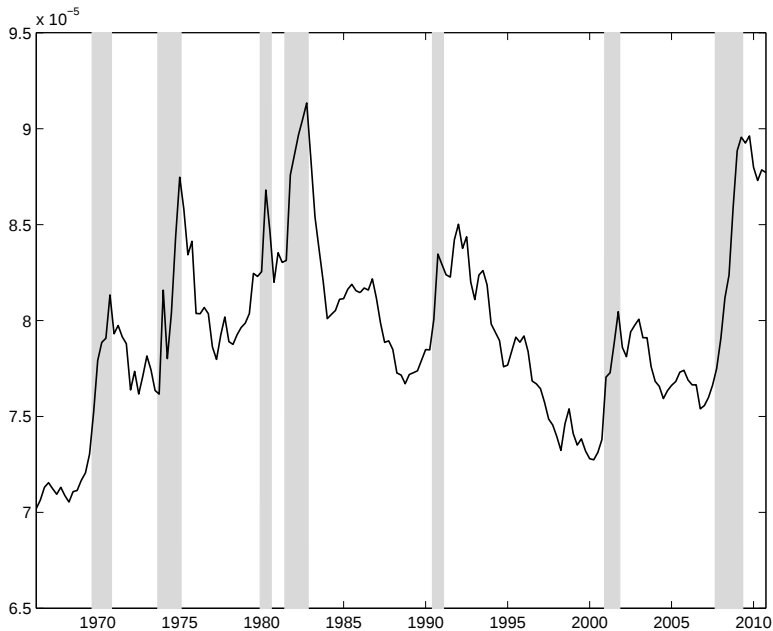
$$\mathcal{U}_t = \bar{\theta}_{\mathcal{U}} + \theta_u \mathbb{E}_t u_{t+4}.$$

Parameter	Description	Value
Calibrated Parameters		
r	Interest Rate	0.04/4
ΔW	Wage Growth	0.01/4
ρ	Relative Risk Aversion	2
Estimated Parameters $\Theta = \{\beta, \bar{\theta}_m, \theta_{\text{CEA}}, \bar{\theta}_{\mathcal{U}}, \theta_u\}$		
β	Discount Rate	$1 - 0.0064^{***}$ (0.0018)
$\bar{\theta}_m$	Scaling of $\bar{m}_t$	0.0072 (0.0206)
θ_{CEA}	Scaling of $\bar{m}_t$	5.2215^{***} (0.1396)
$\bar{\theta}_{\mathcal{U}}$	Scaling of $\mathcal{U}_t$	5.3758×10^{-5} (8.4334×10^{-5})
θ_u	Scaling of $\mathcal{U}_t$	0.0363 (0.1227)
$\bar{R}^2$		0.821
DW stat		0.950

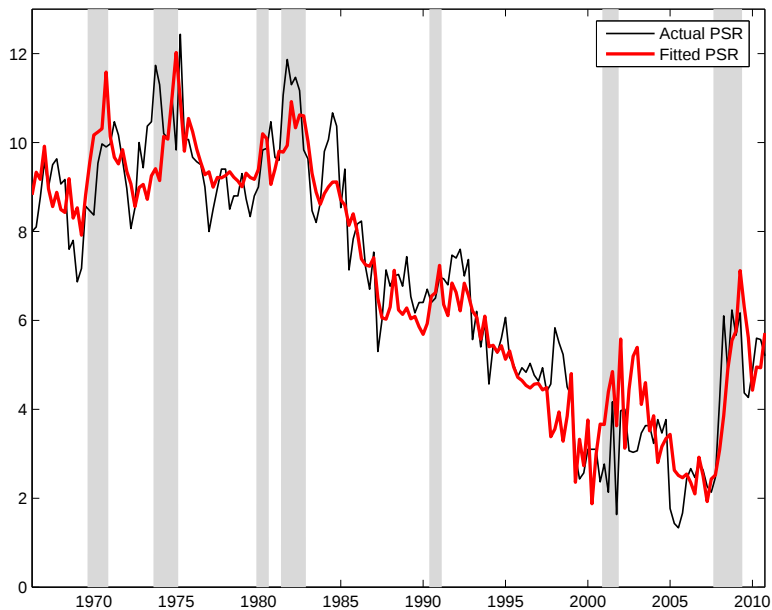
Estimated Extent of Credit Constraints $\bar{m}_t$ (Frac of DI)



Estimated Permanent Unemployment Risk $\mathcal{U}_t$

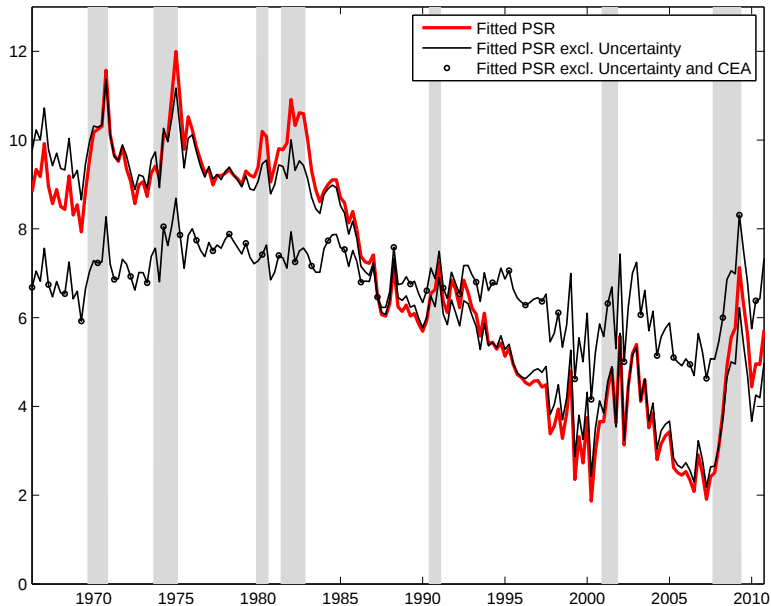


Fit of the Structural Model

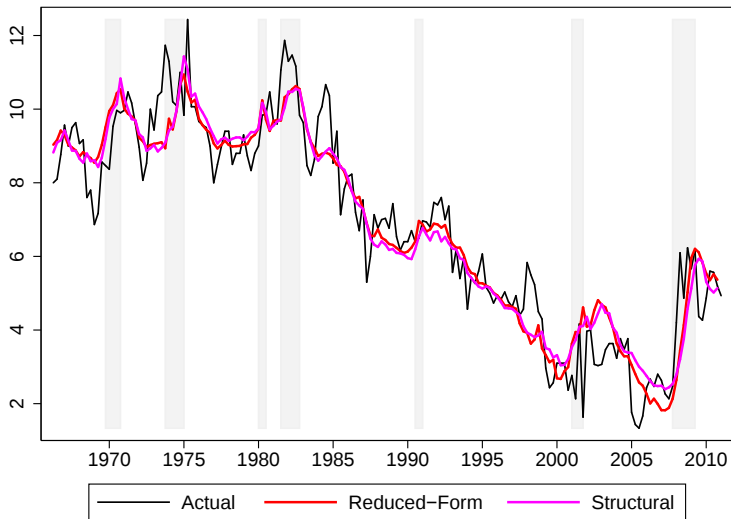


Decomposition of Fitted PSR

Fix $\bar{U}_t$ and $\bar{CEA}_t$ at their sample means, back out the implied s_t



Fit: Structural Model vs Reduced-Form



Reduced-Form Regressions on Model Data

$$s_t^{\text{theor}} = \gamma_0 + \gamma_m m_t + \gamma_{\text{CEA}} \text{CEA}_t + \gamma_{Eu} \mathbb{E}_t u_{t+4} + \gamma_t t + \gamma_{uC} (\mathbb{E}_t u_{t+4} \times \text{CEA}_t) + \varepsilon_t$$

Model	Time	Wealth	CEA	Un Risk	All 3	Baseline	Interact
γ_0	11.96*** (0.50)	21.44*** (1.11)	9.35*** (0.41)	8.42*** (0.16)	12.24*** (0.60)	12.51*** (0.53)	12.49*** (0.55)
γ_m		-2.33*** (0.25)			-0.79*** (0.12)	-0.85*** (0.10)	-0.94*** (0.11)
γ_{CEA}			-13.82*** (1.12)		-5.85*** (0.59)	-6.49*** (0.14)	-5.33*** (0.47)
γ_{Eu}				0.63*** (0.02)	0.33*** (0.04)	0.30*** (0.02)	0.37*** (0.03)
γ_t	-0.04*** (0.00)	-0.03*** (0.00)	0.04*** (0.01)	-0.05*** (0.00)	-0.00 (0.00)		0.00 (0.00)
γ_{uC}							-0.19*** (0.04)
$\bar{R}^2$	0.80	0.93	0.93	0.98	0.99	0.99	0.99
F stat p val	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DW stat	0.05	0.22	0.09	0.39	0.72	0.71	0.99

Reduced-Form Regressions on Actual Data

$$s_t^{\text{meas}} = \gamma_0 + \gamma_m m_t + \gamma_{\text{CEA}} \text{CEA}_t + \gamma_{Eu} \mathbb{E}_t u_{t+4} + \gamma_t t + \gamma_{uC} (\mathbb{E}_t u_{t+4} \times \text{CEA}_t) + \varepsilon_t$$

Model	Time	Wealth	CEA	Un Risk	All 3	Baseline	Interact
γ_0	11.95*** (0.61)	25.20*** (1.73)	9.32*** (0.57)	8.24*** (0.42)	14.90*** (2.56)	15.23*** (2.16)	15.55*** (2.56)
γ_m		-2.61*** (0.32)			-1.12*** (0.42)	-1.18*** (0.35)	-1.37*** (0.46)
γ_{CEA}			-14.14*** (1.74)		-5.47*** (1.94)	-6.12*** (0.57)	-4.60*** (1.72)
γ_{Eu}				0.67*** (0.05)	0.32*** (0.12)	0.29*** (0.08)	0.38*** (0.11)
γ_t	-0.04*** (0.00)	-0.03*** (0.00)	0.04*** (0.01)	-0.05*** (0.00)	-0.00 (0.01)		0.00 (0.01)
γ_{uC}							-0.32** (0.16)
$\bar{R}^2$	0.70	0.85	0.82	0.88	0.89	0.90	0.90
F stat p val	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DW stat	0.30	0.69	0.50	0.86	0.94	0.93	0.98

Structural Estimation—Summary

- ▶ Model fits well. . .
- ▶ . . . almost as well as reduced form
(Mincer–Zarnowitz puts weight 0.45 on structural model)
- ▶ Substantial role for **time-varying precautionary saving**
- ▶ CEA matters for low frequency,
wealth for business-cycle frequency

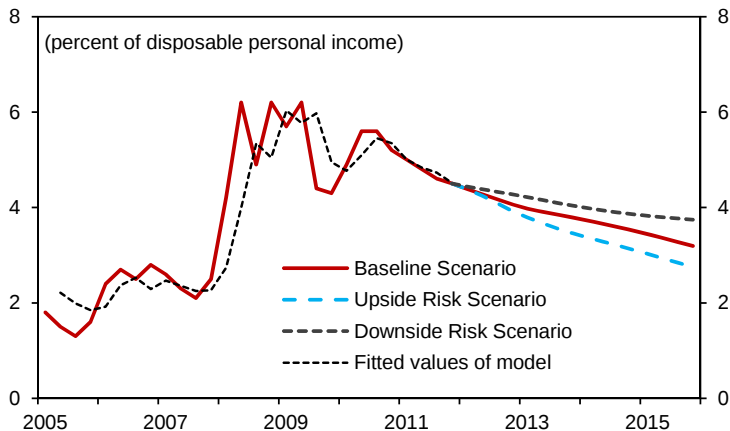
PSR Forecasts—In Sample

Great Recession 2007–2010

Variable	Reduced-Form Model	Structural Model	Actual Δs_t
$\gamma_m \times \Delta m_t$	$-1.18 \times -1.39 = 1.64$	$-0.97 \times -1.39 = 1.34$	
$\gamma_{CEA} \times \Delta CEA_t$	$-6.12 \times -0.11 = 0.64$	$-6.38 \times -0.11 = 0.67$	
$\gamma_{Eu} \times \Delta \mathbb{E}_t u_{t+4}$	$0.29 \times 4.33 = 1.24$	$0.32 \times 4.33 = 1.39$	
Explained Δs_t	3.53	3.40	2.93

PSR Forecasts—Out of Sample

2012–2015



Scenarios based on SPF and our judgement

Conclusions

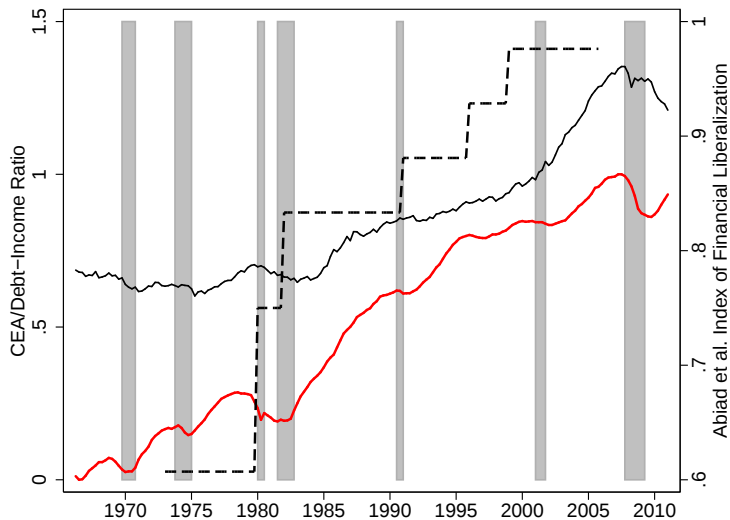
- ▶ All three effects present
- ▶ Easier borrowing largely explains secular declines
- ▶ Order of importance in Great Recession:
 1. Wealth shock
 2. Labor income risk
 3. Credit tightening
- ▶ PSR to remain elevated

References

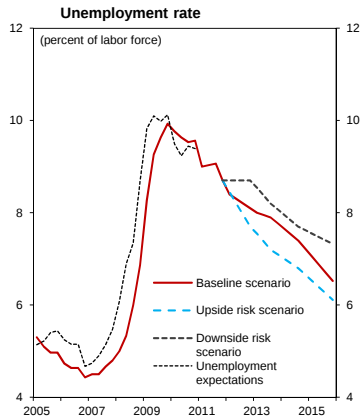
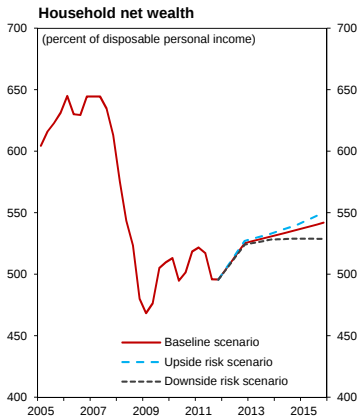
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Background Slides

Alternative Measures of Credit Availability

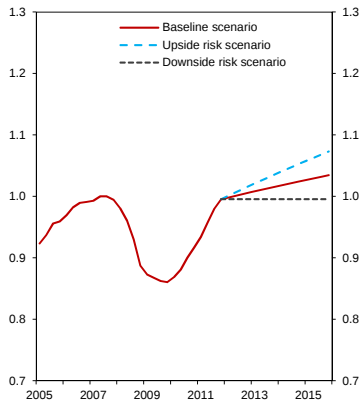


Assumptions/Scenarios for Out-of-Sample Forecasts

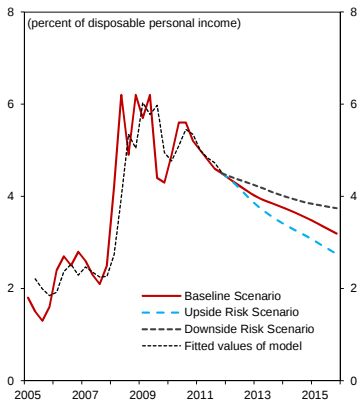


Assumptions/Scenarios for Out-of-Sample Forecasts

Credit conditions



Household saving rate



Actual and Target Wealth

