Dissecting Saving Dynamics
Measuring Credit, Wealth and Precautionary Effects

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Presentation at Goethe-Universität Frankfurt, May 2012
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 \( E_t(u_{t+1} - u_t) \)

- “Credit Availability”
  - Secular Trend:
    - Parker (2000), Dynan and Kohn (2007), Muellbauer (many papers)
  - Cyclical Dynamics:
Great Recession 2007–2009

- $s$ rises by $\sim 4–5$ 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–

![Chart showing deviance from start of recession value in % over quarters after start of recession.](chart.png)
Household Wealth 2007– by 150% of Income

Historical Range

Historical Mean

2007–2009 Recession
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” ⇒ 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 $\ell$, agg wage $W$, emp status $\xi$:

$$ v(m_t) = \max_{c_t} u(c_t) + \beta E_t [v(m_{t+1})] $$

s.t.

$$ m_{t+1} = (m_t - c_t)R + \ell_{t+1}W_{t+1}\xi_{t+1} $$

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

\[ \Delta c^{e}_{t+1} = 0 \quad \text{and} \quad \Delta m^{e}_{t+1} = 0 \]

Steady State

\[ c^{e}(m) = \text{Stable Arm} \]
Target Wealth $\hat{m}$

Closed-form solution for target wealth depends on unemployment risk $\bar{\sigma}$ and generosity of unemployment insurance $\xi_u$:

$$\hat{m} = f(\bar{\sigma}, \xi_u, \text{preferences}, \ldots)$$
Consumption After a Wealth Shock

\[ \Delta m_{t+1} = 0 \]

\[ c_t \rightarrow c_{t+1} \]

\[ c(m) \rightarrow \]

Target

Wealth Shock

\[ m_t \rightarrow m \]
Permanent Rise in $\Upsilon$

Sustainable $c \rightarrow$

c$(m) \rightarrow$

$\leftarrow c(m)$ after unemployment rate increase
Saving Rate After a Permanent Rise in $\mathcal{U}$
Overshooting and Fiscal Policy

DSGE models:

- Frictions, frictions everywhere; but missing here
- If $\Delta c$ 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

\[ \text{Orig Target} \]

\[ \text{New } c(m) \]

\[ \text{Orig } c(m) \]

\[ \Delta m_{t+1}^e = 0 \]

\[ \text{Orig Target} \]

\[ \hat{m} \text{ is close to linear in credit conditions} \]
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.”
$U_t$ Implied by Michigan U Expectations

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

\[ s_t = \gamma_0 + \gamma_m m_t + \gamma_{CEA} CEA_t + \gamma_{Eu} E_t u_{t+4} + \gamma_t t + \gamma_{uC}(E_t u_{t+4} \times CEA_t) + \varepsilon_t \]

<table>
<thead>
<tr>
<th>Model</th>
<th>Time</th>
<th>Wealth</th>
<th>CEA</th>
<th>Un Risk</th>
<th>All 3</th>
<th>Baseline</th>
<th>Interact</th>
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- \(\bar{R}^2\): 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
<table>
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<tr>
<th>Model</th>
<th>Baseline</th>
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<th>$s_{t-1}$</th>
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<td>$\gamma_m$</td>
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<td>$-0.80^{**}$</td>
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<td>(0.36)</td>
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Notes: *p < 0.1, **p < 0.05, ***p < 0.01.
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
Minimize distance between model-implied $s_t^{\text{theor}}$ and actual $s_t^{\text{meas}}$:

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

where

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

\[ s_t^{\text{theor}} = s_t^{\text{theor}}(\Theta; m_t - \bar{m}(\bar{m}_t, \bar{\mathcal{U}}_t)), \]
\[ \bar{m}_t = \bar{\theta}_m + \theta_{\text{CEA}} CEA_t, \]
\[ \bar{\mathcal{U}}_t = \bar{\theta}_{\mathcal{U}} + \theta_u u_{t+4}. \]

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Calibrated Parameters</td>
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<tr>
<td>( r )</td>
<td>Interest Rate</td>
<td>0.04/4</td>
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<tr>
<td>( \Delta W )</td>
<td>Wage Growth</td>
<td>0.01/4</td>
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<td>( \rho )</td>
<td>Relative Risk Aversion</td>
<td>2</td>
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<tr>
<td>Estimated Parameters ( \Theta = {\beta, \bar{\theta}<em>m, \theta</em>{\text{CEA}}, \bar{\theta}_{\mathcal{U}}, \theta_u} )</td>
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<tr>
<td>( \beta )</td>
<td>Discount Rate</td>
<td>( 1 - 0.0064^{***} ) (0.0018)</td>
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<tr>
<td>( \bar{\theta}_m )</td>
<td>Scaling of ( \bar{m}_t )</td>
<td>0.0072 (0.0206)</td>
</tr>
<tr>
<td>( \theta_{\text{CEA}} )</td>
<td>Scaling of ( \bar{m}_t )</td>
<td>5.2215^{***} (0.1396)</td>
</tr>
<tr>
<td>( \bar{\theta}_{\mathcal{U}} )</td>
<td>Scaling of ( \bar{\mathcal{U}}_t )</td>
<td>( 5.3758 \times 10^{-5} ) (8.4334 \times 10^{-5})</td>
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<tr>
<td>( \theta_u )</td>
<td>Scaling of ( \bar{\mathcal{U}}_t )</td>
<td>0.0363 (0.1227)</td>
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<td>( \bar{R}^2 )</td>
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<td>DW stat</td>
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</table>
Estimated Extent of Credit Constraints $\bar{m}_t$ (Frac of DI)
Estimated Permanent Unemployment Risk $\mathcal{U}_t$

![Graph showing estimated permanent unemployment risk with labeled years 1970 to 2010 and values ranging from $6.5 \times 10^{-5}$ to $9.5 \times 10^{-5}$.]
Fit of the Structural Model

[Graph showing the fit of the Structural Model with actual PSR and fitted PSR over the years from 1970 to 2010. The graph includes a y-axis with values ranging from 0 to 12 and an x-axis with years from 1970 to 2010. The graph compares actual PSR (black line) and fitted PSR (red line).]
Decomposition of Fitted PSR

Fix $\bar{U}_t$ and $CEA_t$ at their sample means, back out the implied $s_t$
Fit: Structural Model vs Reduced-Form
Reduced-Form Regressions on Model Data

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

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<td>8.42***</td>
<td>12.24***</td>
<td>12.51***</td>
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<td>(0.50)</td>
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</table>

| $\bar{R}^2$ | 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

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

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</tr>
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<td>(\gamma_{\text{CEA}})</td>
<td></td>
<td>–14.14***</td>
<td></td>
<td></td>
<td>–5.47***</td>
<td>–6.12***</td>
<td>–4.60***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.74)</td>
<td></td>
<td></td>
<td>(1.94)</td>
<td>(0.57)</td>
<td>(1.72)</td>
</tr>
<tr>
<td>(\gamma_{\text{Eu}})</td>
<td></td>
<td></td>
<td>0.67***</td>
<td></td>
<td>0.32***</td>
<td>0.29***</td>
<td>0.38***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.05)</td>
<td></td>
<td>(0.12)</td>
<td>(0.08)</td>
<td>(0.11)</td>
</tr>
<tr>
<td>(\gamma_t)</td>
<td>–0.04***</td>
<td>–0.03***</td>
<td>0.04***</td>
<td>–0.05***</td>
<td>–0.00</td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.01)</td>
<td>(0.00)</td>
<td>(0.01)</td>
<td></td>
<td>(0.01)</td>
</tr>
<tr>
<td>(\gamma_{\text{uC}})</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>–0.32**</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.16)</td>
</tr>
</tbody>
</table>

\(\bar{R}^2\) | 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 |
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

<table>
<thead>
<tr>
<th>Variable</th>
<th>Reduced-Form Model</th>
<th>Structural Model</th>
<th>Actual $\Delta s_t$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\gamma_m \times \Delta m_t$</td>
<td>$-1.18 \times -1.39 = 1.64$</td>
<td>$-0.97 \times -1.39 = 1.34$</td>
<td></td>
</tr>
<tr>
<td>$\gamma_{CEA} \times \Delta CEA_t$</td>
<td>$-6.12 \times -0.11 = 0.64$</td>
<td>$-6.38 \times -0.11 = 0.67$</td>
<td></td>
</tr>
<tr>
<td>$\gamma_{Eu} \times \Delta E_t u_{t+4}$</td>
<td>$0.29 \times 4.33 = 1.24$</td>
<td>$0.32 \times 4.33 = 1.39$</td>
<td></td>
</tr>
<tr>
<td>Explained $\Delta s_t$</td>
<td>3.53</td>
<td>3.40</td>
<td>2.93</td>
</tr>
</tbody>
</table>
PSR Forecasts—Out of Sample

2012–2015

(percent of disposable personal income)

Scenarios based on SPF and our judgement
Conclusions

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


Background Slides
Alternative Measures of Credit Availability

Abiad et al. Index of Financial Liberalization

CEA/Debt-Income Ratio

Assumptions/Scenarios for Out-of-Sample Forecasts

Household net wealth
(percent of disposable personal income)

Unemployment rate
(percent of labor force)

Sources: Haver Analytics and authors' estimates.
Assumptions/Scenarios for Out-of-Sample Forecasts

Credit conditions

- Baseline scenario
- Upside risk scenario
- Downside risk scenario

Household saving rate

- Baseline Scenario
- Upside Risk Scenario
- Downside Risk Scenario
- Fitted values of model

Sources: Haver Analytics and authors' estimates.