Sticky Expectations and Consumption Dynamics

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Consumption Dynamics

Macro
- Theory: Uninsurable Risk Is Unimportant
- Evidence: Consumption Is Too Smooth
- Conclusion: Habits $\approx 0.75$

Micro
- Theory: Uninsurable Risk Is Essential
- Evidence: Habits $=0.75$ Rejectable With Confidence $= \infty$
- $\text{var}(\Delta \log c) \approx 100 \times \text{var}(\Delta \log C)$
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Proposal: Macro (Not Micro) Inattention

- Income Has Idiosyncratic And Aggregate Components
  - Idiosyncratic Component Is Perfectly Observed
  - Aggregate Component Is Stochastically Observed

Not *ad hoc*

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Why This Is Plausible

Idiosyncratic Variability Is $\sim 100 \times$ Bigger

- If Same Equation Estimated on Micro vs Macro Data
- Pervasive Lesson Of All Micro Data

Utility Cost Of Inattention

- Micro: Critical (and Easy) To Notice You’re Unemployed
- Unlike Pischke (1995)
- Macro: Not Critical To Instantly Notice If $\text{U} \uparrow$
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Total Wealth:

\[ z_{t+1} = (z_t - c_t)R + \zeta_{t+1}, \]  

(1)

Euler Equation:

\[ u'(c_t) = R\beta E_t[u'(c_{t+1})], \]  

(2)

Random Walk:

\[ \Delta c_{t+1} = \epsilon_{t+1}. \]  

(3)

Expected wealth:

\[ z_t = E_t[z_{t+1}] = E_t[z_{t+2}]... \]  

(4)
Sticky Expectations

- Consumer Who Happens To Update At $t$ and $t + n$

  
  
  
  \[
  \begin{align*}
  c_t & = (r/R)z_t \\
  c_{t+1} & = (r/R)\bar{z}_{t+1} = (r/R)z_t = c_t \\
  \vdots & \vdots \\
  c_{t+n-1} & = c_t.
  \end{align*}
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- Implies that $\Delta^n z_{t+n} \equiv z_{t+n} - z_t$ is white noise

- So individual $c$ is RW across updating periods:

  \[
  c_{t+n} - c_t = (r/R) \underbrace{(z_{t+n} - z_t)}_{\Delta^n z_{t+n}}
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  \[(5)\]
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  \[ c_{t+n} - c_t = \frac{r}{R} (z_{t+n} - z_t) \]

  \[ \Delta^nz_{t+n} \]

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\mathbf{c}_{t+n} - \mathbf{c}_t = \frac{(r/R)(\mathbf{z}_{t+n} - \mathbf{z}_t)}{\Delta^n\mathbf{z}_{t+n}} \tag{5}
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Sticky Expectations

- Pop normed to one, uniformly dist on $[0, 1]$

\[ C_t = \int_0^1 c_{t,i} \, di. \]

- Calvo (1983) Type Updating Of Expectations:
  - Probability $\Pi = 0.25$

- Economy Composed Of Many Sticky Consumers:

\[ \Delta C_{t+1} \approx (1 - \Pi) \Delta C_t + \epsilon_{t+1} \quad (6) \]

\[ = 0.75 \]
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Distinguish idiosyncratic and aggregate shocks

- Frictionless observation of idiosyncratic shocks
- True RW with respect to these
- Sticky observation of aggregate shocks

Result:

- Idiosyncratic $\Delta c$ dominated by frictionless RW part
- Aggregate $\Delta C$ highly serially correlated
- Law of large numbers: idiosyncratic part vanishes
One More Ingredient ... 

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- All you can see is Y
  - Lucas: Can’t distinguish agg. from idio.
  - Muth-Pischke: Can’t distinguish tran from perm
- Here: Can see own circumstances perfectly
- Only the (tiny) aggregate part is hard to see
- But can’t permit signal extraction wrt aggregate
  - Signal extraction wrt agg implies agg random walk
- Will return to this below

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Serious Model

Partial Equilibrium/Small Open Economy

- CRRA Utility
- Idiosyncratic Shocks Calibrated From Micro Data
- Aggregate Shocks Calibrated From Macro Data
- No Liquidity Constraints
- Mildly Impatient Consumers

DSGE Model

- Same!
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Individual's labor productivity is

\[ \ell_{t+1} = \theta_{t+1} \Theta_{t+1} p_{t+1} P_{t+1} \equiv p_{t+1} \] (7)

Idiosyncratic and aggregate p evolve according to

\[ p_{t+1} = p_t \psi_{t+1} \] (8)
\[ P_{t+1} = P_t \Psi_{t+1} \] (9)

\[ E_t[\theta_{t+n}] = E_t[\Theta_{t+n}] = E_t[\psi_{t+n}] = E_t[\Psi_{t+n}] = 1 \quad \forall \; n > 0 \]
Income Process

• Individual’s labor productivity is

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- \( E_t[\theta_{t+n}] = E_t[\Theta_{t+n}] = E_t[\psi_{t+n}] = E_t[\Psi_{t+n}] = 1 \ \forall \ n > 0 \)
Market resources:

\[ m_{t+1} = \mathcal{W}_{t+1} \ell_{t+1} + R_{t+1} k_{t+1} \equiv y_{t+1} \]  

\[ 1 + r_{t+1} \]  

(10)

‘Assets’: Unspent resources

\[ a_t = m_t - c_t \]  

(11)

Capital transition depends on prob of survival \( \Omega \):

\[ k_{t+1} = a_t / \Omega \]  

(12)
Resources

- Market resources:

\[ m_{t+1} = W_{t+1} l_{t+1} + R_{t+1} k_{t+1} \equiv y_{t+1} \frac{k_{t+1}}{1+r_{t+1}} \]  

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‘Assets’: Unspent resources

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Capital transition depends on prob of survival \( \Omega \):

\[ k_{t+1} = \frac{a_t}{\Omega} \]  \hspace{1cm} (12)
Frictionless Solution

- Assume constant $\mathcal{R}, \mathcal{W}$
- Normalize everything by $p_t P_t$ e.g. $m_t = m_t / p_t P_t$
- $c(m_t)$ is the function that solves
  
  $$v(m_t) = \max_c \left\{ u(c) + \beta E_t \left[ \psi_{t+1}^{1-\rho} v(m_{t+1}) \right] \right\}$$

- Level of consumption given by
  
  $$c_t = c(m_t) p_t.$$
Assume constant $\mathcal{R}, \mathcal{W}$

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Frictionless Solution

- Assume constant $\mathcal{R}, \mathcal{W}$
- Normalize everything by $p_tP_t$ e.g. $m_t = m_t/p_tP_t$
- $c(m_t)$ is the function that solves

\[
v(m_t) = \max_c \{ u(c) + \beta E_t[\psi_{t+1}^{1-\rho}v(m_{t+1})] \}\]

- Level of consumption given by

\[
c_t = c(m_t)p_t.
\]
Agent survives from $t$ to $t + 1$ with probability $\Omega$

$$p_{t+1,i} = \begin{cases} 
1 & \text{for newborns} \\
 p_{t,i} \psi_{t+1,i} & \text{for survivors,}
\end{cases}$$

Implies steady-state distribution of $p$ with variance:

$$\text{var}(p) = \left(\frac{1 - \Omega}{1 - \Omega E[\psi^2]} - 1\right)$$
Agent survives from $t$ to $t + 1$ with probability $\Omega$

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$$\text{var}(p) = \left( \frac{1 - \Omega}{1 - \Omega E[\psi^2]} - 1 \right)$$
Blanchard (1985) Insurance

\[ k_{t+1,i} = \begin{cases} 
0 & \text{if agent at } i \text{ dies, is replaced by a newborn} \\
 a_{t,i} / \Omega & \text{if agent at } i \text{ survives} 
\end{cases} \]

Implies

\[ K_{t+1} = \int_{0}^{1} \omega_{t+1,i} a_{t,i} / \Omega \, di \\
= \Lambda A_t \\
K_{t+1} = \Lambda A_t / \psi_{t+1} \]
Sticky Aggregate Expectations

\[ \bar{\Theta}_{t,i} = \begin{cases} \Theta_t & \text{for updaters} \\ 1 & \text{for nonupdaters} \end{cases} \]

\[ \bar{P}_{t+1,i} = \pi_{t+1,i}P_{t+1} + (1 - \pi_{t+1,i})\bar{P}_{t,i} \] (13)

Sequence within period:

1. Shocks are Realized
2. Each Individual Updates (Or Not)
3. Consume Based on Beliefs
4. Consumer Sees End-Of-Period Bank Balance
Sticky Aggregate Expectations

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Sequence within period:

1. **Shocks are Realized**
2. **Each Individual Updates (Or Not)**
3. **Consume Based on Beliefs**
4. **Consumer Sees End-Of-Period Bank Balance**
Consumers behave according to frictionless consumption function:

\[ \bar{c}_{t,i} = c(\bar{m}_{t,i}) \]

\[ c_{t,i} = \bar{c}_{t,i} \bar{P}_{t,i} p_{t,i} \]

- Correctly perceive level of spending

\[ \bar{a}_{t,i} = \bar{m}_{t,i} - c_{t,i} \quad \text{(14)} \]

\[ \bar{k}_{t+1,i} = \omega_{t+1,i} \bar{\nabla} (a_{t,i} \pi_{t+1,i} + \bar{a}_{t,i} (1 - \pi_{t+1,i})) / \Omega + (1 - \omega_{t+1,i})0 \quad \text{(15)} \]
Newborns’ value can be approximated by

\[ \bar{v}(\mathcal{W}) \approx \hat{v}(\mathcal{W}) - (\kappa/\Pi)\sigma_\Psi^2. \]  

(16)

If Newborns Pick Optimal \( \Pi \), they solve

\[ \max_{\Pi} \hat{v}(\mathcal{W}) - (\kappa/\Pi)\sigma_\Psi^2 - \iota \Pi. \]  

(17)

Solution:

\[ \Pi = (\kappa/\iota)^{0.5} \sigma_\Psi \]  

(18)
\[ \bar{P}_{t+1} = \Pi P_{t+1} + (1 - \Pi) \bar{P}_t \]  

(19)

Observe \( \mathbf{Y} \)

Define signal-to-noise ratio \( \varphi = \frac{\sigma_\psi^2}{\sigma_\theta^2} \)

Optimal Estimate of \( P \) obtained from

\[ \bar{P}_{t+1} = \Pi \mathbf{Y}_{t+1} + (1 - \Pi) \bar{P}_t \]  

(20)

where

\[ \Pi = \left( \frac{1}{1 + 2/(\varphi + \sqrt{\varphi^2 + 4\varphi})} \right), \]  

(21)
\[ \bar{P}_{t+1} = \Pi P_{t+1} + (1 - \Pi) \bar{P}_t \]  \hspace{1cm} (19)

- Observe \( Y \)
- Define signal-to-noise ratio \( \varphi = \sigma^2_\psi / \sigma^2_\theta \)

Optimal Estimate of \( P \) obtained from

\[ \bar{P}_{t+1} = \Pi Y_{t+1} + (1 - \Pi) \bar{P}_t \]  \hspace{1cm} (20)

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\[ \Pi = \left( \frac{1}{1 + 2/(\varphi + \sqrt{\varphi^2 + 4\varphi})} \right), \] (22)

Pischke (1995): This is why \( C \) is too smooth

- If we calibrate using observed micro data
  - \( \Rightarrow \Delta \log C_{t+1} \approx 0.967 \Delta \log C_t \)
  - Goes too far!
- It’s because people can’t tell agg from ind shocks
- But calibration where they can see agg \( Y \Rightarrow RW \)
- Maybe could fiddle with calibration assumptions . . .
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\[ \Pi = \left( \frac{1}{1 + 2/(\phi + \sqrt{\phi^2 + 4\phi})} \right), \quad (22) \]

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Frictionless:

- No Idiosyncratic Shocks
- Aggregate Shocks Same as PE/SOE
- Cobb-Douglas production: \( M_t = K_t + K_t^\varepsilon \Theta_t^{1-\varepsilon} \)

\[
V(M_t) = \max_{C_t} \left\{ u(c_t) + \beta E_t[\Psi_{t+1}^{1-\rho} V(M_{t+1})] \right\} \\
\text{s.t.} \\
A_t = M_t - C_t \\
K_{t+1} = A_t / \Psi_{t+1} \\
M_{t+1} = R_{t+1} K_{t+1} + \mathcal{W}_{t+1} \Theta_{t+1}.
\]
DSGE Model

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\]

\[
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\]
Sticky Expectations DSGE

- Perception Dynamics Identical to Sticky PE/SOE

\[ \tilde{M}_t = \tilde{K}_t + \tilde{K}^\epsilon_t \tilde{\Theta}_t^{1-\epsilon} \]

- Solution: \( C_t = C(\tilde{M}_t) \tilde{P}_t \)
Perception Dynamics Identical to Sticky PE/SOE
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Solution: \[ C_t = C(\tilde{M}_t) \bar{P}_t \]
Sticky Expectations DSGE

- Perception Dynamics Identical to Sticky PE/SOE
- $\tilde{M}_t = \tilde{K}_t + \tilde{K}_t^\varepsilon \tilde{\Theta}_t^{1-\varepsilon}$
- Solution: $C_t = C(\tilde{M}_t)\tilde{P}_t$
* \[ \Delta \log C_{t+1} \approx \varsigma + \vartheta E_t[r_{t+1}] + \mu X_{t-1} + \epsilon_{t+1}, \] (24)

and random walk means \( \mu = 0 \).

In GE, \( r \) depends on \( A \) so \( \ast \) is equivalent to:

\[ \Delta \log C_{t+1} \approx \varsigma + \alpha A_t + \mu X_{t-1} + \epsilon_{t+1} \] (25)

In either case, lots of \( X_{t-1} \) were found for which \( \mu \neq 0 \).
\[ \Delta \log C_{t+1} \approx \varsigma + \alpha A_t + \eta E[\Delta \log Y_{t+1}] + \epsilon_{t+1} \] (26)

Claims:

- \( \eta \) estimates fraction of ‘rule-of-thumb’ \( C = Y \) consumers
- \( \eta \approx 0.5 \) robustly for U.S. and other countries
- No further predictability in \( \Delta \log C_{t+1} \)
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Macro Habits

Campbell and Deaton (1989); Rotemberg and Woodford (1997); Fuhrer (2000); Sommer (2001)
Dynan (2000)/Sommer specification:

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Claims:
- \( \eta \) no longer statistically significant
- \( \chi \approx 0.75 \) (Habits are huge!)
- OID tests succeed
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Micro Evidence

$$\Delta \log c_{t+1} \approx \varsigma + \alpha a_t + \eta E[\Delta \log y_{t+1}] + \chi E[\Delta \log c_t] + \epsilon_{t+1}$$

Separable Theory:
- $\alpha < 0$
- $0 < \eta < 1$
- $\chi \approx 0$

Micro Evidence on Habits:
- No: Meghir and Weber (1996); Dynan (2000); Flavin and Nakagawa (2005)
- Maybe a little: Carrasco, Labeaga, and Lòpez-Salido (2005)
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<table>
<thead>
<tr>
<th></th>
<th>(\chi)</th>
<th>(\eta)</th>
<th>(\alpha)</th>
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<tbody>
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<td><strong>Micro (Separable)</strong></td>
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<tr>
<td>Theory</td>
<td>(\approx 0)</td>
<td>(0 &lt; \eta &lt; 1)</td>
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<tr>
<td>Data</td>
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<tr>
<td>Theory:Separable</td>
<td>(\approx 0)</td>
<td>(\approx 0)</td>
<td>(&lt; 0)</td>
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<tr>
<td>Theory:CampMan</td>
<td>(\approx 0)</td>
<td>(\approx 0.5)</td>
<td>(&lt; 0)</td>
</tr>
<tr>
<td>Theory:Habits</td>
<td>(\approx 0.75)</td>
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<td>(&lt; 0)</td>
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Calibration—DSGE

DSGE Model

Calibrated Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\rho$</td>
<td>2.</td>
<td>Coefficient of Relative Risk Aversion</td>
</tr>
<tr>
<td>$\varpi$</td>
<td>0.94$^{1/4}$</td>
<td>Quarterly Depreciation Factor</td>
</tr>
<tr>
<td>$K/K^\varepsilon$</td>
<td>12</td>
<td>Perf Foresight SS Capital/Output Ratio</td>
</tr>
<tr>
<td>$\sigma_\Theta^2$</td>
<td>0.00001</td>
<td>Variance Qtrly Tran Agg Pty Shocks</td>
</tr>
<tr>
<td>$\sigma_\Psi^2$</td>
<td>0.00004</td>
<td>Variance Qtrly Perm Agg Pty Shocks</td>
</tr>
</tbody>
</table>

Steady State Solution of Model With $\sigma_\Psi = \sigma_\Theta = 0$

\[
K = 12^{1/(1-\varepsilon)} \approx 48.55 \quad \text{Steady State Quarterly } K/P \text{ Ratio}
\]
\[
M = K + K^\varepsilon \approx 52.6 \quad \text{Steady State Quarterly } M/P \text{ Ratio}
\]
\[
W = (1 - \varepsilon)K^\varepsilon \approx 2.59 \quad \text{Quarterly Wage Rate}
\]
\[
R = 1 + \varepsilon K^{\varepsilon - 1} \approx 1.03 \quad \text{Quarterly Gross Capital Income Factor}
\]
\[
R = R\varpi \approx 1.014 \quad \text{Quarterly Between-Period Interest Factor}
\]
\[
\beta = R^{-1} \approx 0.986 \quad \text{Quarterly Time Time Preference Factor}
\]
### Partial Equilibrium/Small Open Economy (PE/SOE) Model Parameters

#### Calibrated Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma^2_\psi$</td>
<td>0.016</td>
<td>Variance Annual Perm Idiosyncratic Shocks (PSID)</td>
</tr>
<tr>
<td>$\sigma^2_\theta$</td>
<td>0.03</td>
<td>Variance Annual Tran Idiosyncratic Shocks (PSID)</td>
</tr>
<tr>
<td>$\bar{\psi}$</td>
<td>0.05</td>
<td>Quarterly Probability of Unemployment Spell</td>
</tr>
<tr>
<td>$\Pi$</td>
<td>0.25</td>
<td>Quarterly Probability of Updating Expectations</td>
</tr>
<tr>
<td>$(1 - \Omega)$</td>
<td>0.005</td>
<td>Quarterly Probability of Mortality</td>
</tr>
</tbody>
</table>

#### Calculated Parameters

\[
\beta = 0.99\Omega / E[(\psi)^{-\rho}]R 
\]

0.965  
Satisfies Impatience Condition: $\beta < \Omega / E[(\psi)^{-\rho}]R$

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>$\sigma^2_\psi$</td>
<td>0.004</td>
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<tr>
<td>$\sigma^2_\theta$</td>
<td>0.12</td>
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# Equilibrium

<table>
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<th>PE/SOE Economy</th>
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<th>DSGE Economy</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frictionless</td>
<td>Sticky</td>
<td>Frictionless</td>
<td>Sticky</td>
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<tr>
<td><strong>Means</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>$A$</td>
<td>6.650</td>
<td>6.648</td>
<td>49.382</td>
<td>49.371</td>
</tr>
<tr>
<td>$C$</td>
<td>2.684</td>
<td>2.684</td>
<td>3.290</td>
<td>3.289</td>
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<tr>
<td><strong>Standard Deviations</strong></td>
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<td>Aggregate Time Series ('Macro')</td>
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<tr>
<td>$\log A$</td>
<td>0.089</td>
<td>0.091</td>
<td>0.085</td>
<td>0.085</td>
</tr>
<tr>
<td>$\Delta \log C$</td>
<td>0.005</td>
<td>0.002</td>
<td>0.003</td>
<td>0.001</td>
</tr>
<tr>
<td>$\Delta \log Y$</td>
<td>0.008</td>
<td>0.003</td>
<td>0.005</td>
<td>0.002</td>
</tr>
<tr>
<td>Individual Cross Sectional ('Micro')</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\log a$</td>
<td>1.273</td>
<td>1.273</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\log c$</td>
<td>1.207</td>
<td>1.207</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\log p$</td>
<td>1.221</td>
<td>1.221</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\log y \mid y &gt; 0$</td>
<td>0.846</td>
<td>0.846</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta \log c$</td>
<td>0.151</td>
<td>0.149</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cost Of Stickiness</strong></td>
<td>$0.31 \times 10^{-4}$</td>
<td></td>
<td>$0.53 \times 10^{-5}$</td>
<td></td>
</tr>
</tbody>
</table>
**Micro Theory: Frictionless**

\[
\Delta \log c_{t+1,i} = \varsigma + \chi \Delta \log c_{t,i} + \eta E_{t,i} [\Delta \log y_{t+1,i}] + \alpha a_{t,i}
\]

<table>
<thead>
<tr>
<th>Model of Expectations</th>
<th>(\chi)</th>
<th>(\eta)</th>
<th>(\alpha)</th>
<th>(\bar{R}^2)</th>
<th>nobs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frictionless</td>
<td>0.083</td>
<td>0.003</td>
<td>-0.111</td>
<td>0.007</td>
<td>76020</td>
</tr>
<tr>
<td></td>
<td>(0.077)</td>
<td>(0.004)</td>
<td>(0.052)</td>
<td>(0.004)</td>
<td>(0.024)</td>
</tr>
</tbody>
</table>
Micro Theory: Sticky

\[ \Delta \log c_{t+1,i} = \zeta + \chi \Delta \log c_{t,i} + \eta E_{t,i}[\Delta \log y_{t+1,i}] + \alpha a_{t,i} \]

<table>
<thead>
<tr>
<th>Model of Expectations</th>
<th>(\chi)</th>
<th>(\eta)</th>
<th>(\alpha)</th>
<th>(\bar{R}^2)</th>
<th>nobs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sticky</td>
<td>0.084</td>
<td>0.003</td>
<td>-0.111</td>
<td>0.007</td>
<td>76020</td>
</tr>
<tr>
<td></td>
<td>(0.077)</td>
<td>(0.004)</td>
<td>(0.051)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<td>0.009</td>
<td>-0.059</td>
<td>0.007</td>
<td>76020</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.024)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
$\Delta \log C_{t+1} = \zeta + \chi \Delta E[\log C_t] + \eta E[\Delta \log Y_{t+1}] + \alpha E[A_t]$
\[ \Delta \log C_{t+1} = \zeta + \chi \Delta E[\log C_t] + \eta \Delta E[\log Y_{t+1}] + \alpha \Delta E[A_t] \]

<table>
<thead>
<tr>
<th>Expectations: Dep Var</th>
<th>OLS or IV</th>
<th>2nd Stage ( R^2 )</th>
<th>IV F p-val</th>
<th>IV OID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sticky ( \Delta \log \bar{C}<em>t ) ( \Delta \log \bar{Y}</em>{t+1} ) ( \bar{A}_t )</td>
<td>OLS</td>
<td>0.677</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.823 (0.018)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Delta \log \tilde{C}_t )</td>
<td>OLS</td>
<td>0.141</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.387 (0.030)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.845 (0.042)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.815 (0.025)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[ -0.0004 ] (0.0000)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Delta \log \tilde{C}_t )</td>
<td>OLS</td>
<td>0.115</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.750 (0.148)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.065 (0.146)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[ -0.0001 ] (0.0000)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Memo: For instruments ( Z_t ), ( \Delta \log C_{t+1} = Z_t \zeta ), ( R^2 = 0.425 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Carroll and Slacalek: Sticky Expectations and Consumption Dynamics
\[
\Delta \log C_{t+1} = \kappa + \chi \Delta E[\log C_t] + \eta E[\Delta \log Y_{t+1}] + \alpha E[A_t]
\]

<table>
<thead>
<tr>
<th>Expectations: Dep Var</th>
<th>OLS or IV</th>
<th>2nd Stage</th>
<th>IV_F p-val</th>
<th>IV OID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent Variables</td>
<td>(R^2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frictionless: (\Delta \log C_{t+1})</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\Delta \log C_t)</td>
<td>0.022</td>
<td>OLS</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>(\Delta \log Y_{t+1})</td>
<td>0.028</td>
<td>IV</td>
<td>0.000</td>
<td>0.030</td>
</tr>
<tr>
<td>(A_t)</td>
<td>(-0.0008) (0.0004)</td>
<td>OLS</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>(\Delta \log C_t)</td>
<td>0.019</td>
<td>IV</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>(\Delta \log Y_{t+1})</td>
<td>0.028</td>
<td>(-0.0005) (0.0004)</td>
<td>IV</td>
<td>0.000</td>
</tr>
</tbody>
</table>
\[ \Delta \log C_{t+1} = \xi + \chi \Delta E[\log C_t] + \eta E[\Delta \log Y_{t+1}] + \alpha E[A_t] \]

<table>
<thead>
<tr>
<th>Expectations: Dep Var</th>
<th>OLS or IV</th>
<th>2nd Stage ( \bar{R}^2 )</th>
<th>IV F p-val</th>
<th>IV OID</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Delta \log \bar{C}_t )</td>
<td>0.345 (0.009)</td>
<td>OLS 0.121</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Delta \log \bar{Y}_{t+1} )</td>
<td>0.805 (0.014)</td>
<td>IV 0.363 0.000</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>( \bar{A}_t )</td>
<td>1.150 (0.015)</td>
<td>IV 0.352 0.000</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>( \Delta \log C_{t+1} = Z_t \xi )</td>
<td>0.498 (0.028)</td>
<td>IV 0.375 0.000</td>
<td>0.000</td>
<td></td>
</tr>
</tbody>
</table>

Memo: For instruments \( Z_t \), \( \Delta \log C_{t+1} = Z_t \xi \), \( \bar{R}^2 = 0.390 \)
Empirical Results for U.S.

\[ \Delta \log C_{t+1} = \varsigma + \chi \Delta \log C_t + \eta E[\Delta \log Y_{t+1}] + \alpha A_t \]

<table>
<thead>
<tr>
<th>Consumption Series</th>
<th>(\chi)</th>
<th>(\eta)</th>
<th>(\alpha)</th>
<th>Method</th>
<th>(\bar{R}^2)</th>
<th>IV F p-val</th>
<th>IV OID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nondurables and Services</td>
<td>0.358*** (0.066)</td>
<td>0.577*** (0.118)</td>
<td>0.0006 (0.0006)</td>
<td>OLS</td>
<td>0.123</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.826*** (0.147)</td>
<td>0.071 (0.230)</td>
<td>0.0000 (0.118)</td>
<td>IV</td>
<td>0.143</td>
<td>0.000</td>
<td>0.714</td>
</tr>
<tr>
<td></td>
<td>0.731*** (0.230)</td>
<td>0.071 (0.230)</td>
<td>0.0000 (0.0003)</td>
<td>IV</td>
<td>0.135</td>
<td></td>
<td>0.482</td>
</tr>
</tbody>
</table>

Memo: For instruments \(Z\), \(\Delta \log C_{t+1} = Z\varsigma\), \(\bar{R}^2 = 0.168\)

Time frame: 1960Q1–2004Q3, \(\sigma^2_\psi = 0.0000429\), \(\sigma^2_\Theta = 0.0000107\)


Carrasco, Raquel, José M. Labeaga, and J. David Lòpez-Salido (2005): “Consumption and Habits: Evidence Carrol and Slacalek Sticky Expectations and Consumption Dynamics


Sommer, Martin (2001): “Habits, Sentiment and Predictable Income in the Dynamics of Aggregate Consumption,”