Deep Habits

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Existing Literature on Habit Formation

- Habits are formed at the level of a composite good. (Superficial Habits)

\[ U(c_t - \theta c_{t-1}) \]

\[ c_t = \left[ \int_0^1 c_{it} \eta d\dot{i} \right]^{\frac{1}{1-\eta}} \]

- This paper: Habits are formed at the level of individual goods. (Deep Habits)

\[ U(x_t) \]

with

\[ x_t = \left[ \int_0^1 (c_{it} - \theta c_{it-1})^{\frac{1}{\eta}} d\dot{i} \right]^{\frac{1}{1-\eta}} \]
Superficial Habits

Demand side effect: Euler equation with external superficial habit

\[ U'(c_t - \theta c_{t-1}) = \beta E_t U'(c_{t+1} - \theta c_t) R_{t+1} \]

No supply side effects: Demand function for good i as in a model without habits:

\[ c_{it} = \left( \frac{P_{it}}{P_t} \right)^{-\eta} c_t \]
Aggregate Implications of Deep Habits

• The economy's demand side (particularly the consumption Euler equation) is identical under deep and superficial external habits.

• Under deep habit formation, the supply side of the economy changes in fundamental ways.
Demand Function for Good \( i \) Under External Deep Habit Formation

\[
c_{it} = p_{it}^{-\eta}(c_t - \theta c_{t-1}) + \theta c_{it-1}
\]

- Deep Habits give rise to a theory of countercyclical markups. The price elasticity of demand becomes countercyclical: [Price-elasticity effect of deep habits]

- The pricing problem becomes dynamic: [Intertemporal effect of deep habits]
Three Variations

1. Good Specific Subsistence Points

\[ c_{it} = p_{it}^{-\eta} x_t + \theta c^* \]

2. Relative Deep Habits

\[ c_{it} = p_{it}^{-\eta} x_t c_{it-1}^{\theta(1-\eta)} \]

3. Internal Deep Habits

\[ c_{it} = \left[ \sum_{k=0}^{\infty} \theta^k r_{t,t+k} p_{it+k} \right]^{-\eta} X_t + \theta c_{it-1} \]
Equilibrium Under Deep Habits

\[ U_x(x_t, h_t) = \beta R_t E_t U_x(x_{t+1}, h_{t+1}) \]

\[ x_t = c_t - \theta c_{t-1} \]

\[ w_t = \frac{U_h(x_t, h_t)}{U_x(x_t, h_t)} \]

\[ c_t = A_t h_t \]

\[ \mu_t = \frac{A_t}{w_t} \]

\[ \nu_t = \frac{\mu_t - 1}{\mu_t} + \theta E_t r_{t,t+1} \nu_{t+1} \]

\[ c_t = \eta(c_t - \theta c_{t-1}) \nu_t \]

\[ \mu_t = \left[ 1 - \frac{1}{\eta \left( 1 - \frac{\theta c_{t-1}}{c_t} \right)} + \theta E_t r_{t,t+1} \nu_{t+1} \right]^{-1} \]
Deep Habits and Markups Dynamics in a Fully Fledged RBC Model

• Slow decay in habits:

\[
x_t = \left[ \int_0^1 (c_{it}^j - \theta s_{it-1})^{1-1/\eta} \, di \right]^{1/(1-1/\eta)},
\]

\[
s_{it} = \rho s_{it-1} + (1 - \rho) c_{it}.
\]

• Elastic labor supply and Capital accumulation

• Three shocks:
  - Productivity Shocks
  - Preference Shocks
  - Government Spending Shocks

• Government consumption is subject to deep habit formation
Estimating Deep Habits

Fully Fledged Deep-Habit Model: GMM
Estimates of Structural Parameters,


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<th>Measurement</th>
<th>Joint System Based Estimates</th>
<th>( \sigma )</th>
<th>( \theta )</th>
<th>( \eta )</th>
<th>( \rho )</th>
<th>J-test</th>
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<td>( C^\text{tot} )</td>
<td>( R_{\text{FFF}} )</td>
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Notes: Numbers in parentheses are heteroscedasticity consistent standard errors. Numbers in square brackets are P-values.
Impulse Responses to Positive Preference, Government Spending, and Productivity Shocks Under Deep Habit, Superficial Habit, and No Habit

Conclusion

• Deep habit formation implies that producers face demand functions that depend on past sales.

• Thus, the deep-habit model provides microfoundations to customer market (Phelps-Winter, 1970) and brand-switching-cost (Klemperer, 1995) models.

• Deep habits induce a theory of endogenous markup determination.

• Under deep habits markups are countercyclical, which is in line with empirical evidence.