Incomplete Cost Pass-Through  
Under Deep Habits  

M. Ravn  S. Schmitt-Grohé  M. Uribe  

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Stylized Facts We Wish To Address

• Innovations in marginal costs are associated with less than proportional increases in prices (incomplete cost pass-through).

• Prices are less volatile than marginal costs.

• Markup adjustments explain a significant fraction of incomplete cost pass-through.

• **Observation:** Most existing structural estimations of cost pass-through using highly disaggregate data are based on static models.

• **Limitations of Static Models:**
  
  – Cannot distinguish between effects of permanent versus transitory cost shocks.
  
  – Cannot distinguish between effects of anticipated versus unanticipated cost shocks.

• **This Paper:** Dynamics take center stage.
Habit Formation

Period Utility Function: $U(x_t)$

**Superficial Habit Formation:** Habits are formed at the level of a composite good

$$x_t = \frac{c_t}{c_{t-1}^θ} \text{ with } c_t = \left[ \int_0^1 c_{it}^{1-\frac{1}{\eta}} di \right]^{\frac{1}{1-\frac{1}{\eta}}}$$

**Deep Habit Formation:** Habits are formed at the level of individual goods

$$x_t = \left[ \int_0^1 \left( \frac{c_{it}}{c_{it-1}^θ} \right)^{1-\frac{1}{\eta}} di \right]^{\frac{1}{1-\frac{1}{\eta}}}$$
A Model of Incomplete Pass-Through

Household $j$ minimizes

$$\int_0^1 P_{it} c^j_{it} di,$$

subject to

$$\left[ \int_0^1 \left( \frac{c^j_{it}}{c^j_{it-1}} \right)^{1-1/\eta} di \right]^{1/(1-1/\eta)} \geq x^j_t$$

$\theta = \text{deep-habit parameter}$

c_{it-1} = \text{External habit stock, taken as given by households.}$
Demand for good $i$ by household $j$

$$c_{it}^j = \left( \frac{P_{it}}{P_t} \right)^{-\eta} \theta^{(1-\eta)} c_{it-1}^j x_t^j,$$

- Short-Run Price Elasticity $= \eta$

- Long-Run Price Elasticity $= \frac{\eta}{1-\theta(1-\eta)} > \eta$

- Habit elasticity $\theta(1-\eta)$
The Firm

- Maximize present value of expected profits

\[ \sum_{t=0}^{\infty} \beta^t E_0(P_{it} - MC_{it})c_{it}, \]

subject to

\[ c_{it} = A_t P_{it} c^{\theta(1-\eta)}_{it-1} \]

- Pricing problem of the firm becomes dynamic

- First-order condition:

\[ P_{it} \left(1 - \frac{1}{\eta}\right) + \beta \theta \frac{1-\eta}{\eta} E_t P_{it+1} + \frac{c_{it+1}}{c_{it}} = MC_{it} \]
The Markup

- Define the markup as

$$\mu_{it} \equiv \frac{P_{it}}{MC_{it}}$$

Then, the firm’s FOC implies

$$\mu_{it} = \frac{1}{\left(1 - \frac{1}{\eta}\right) \left[1 - \beta \theta E_t \frac{P_{it+1}c_{it+1}}{P_{it}c_{it}}\right]}$$

- The markup is time varying.

- The markup is decreasing in the expected growth of sales.
• Steady state markup

\[ \mu = \left( \frac{\eta}{\eta - 1} \right) \left( \frac{1}{1 - \beta \theta} \right) < \frac{\eta}{(\eta - 1)}. \]
A Law of Motion for Marginal Costs

\[ \hat{MC}_{it+1} = \lambda \hat{MC}_{it} + \epsilon_{t+1} \]

Calibration of the Model

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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Impulse Response to a One-Percent Increase in Marginal Cost

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<th>markup</th>
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<tr>
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</table>

Units: percent deviations from the steady state.

⇒ Incomplete Cost Pass-Through
Price-Cost Volatility Ratio

\[ \frac{\text{var}(P_{it})}{\text{var}(MC_{it})} = 0.66 \]

⇒ Prices are less volatile than marginal cost
Persistence of Cost Shocks and Incomplete Pass-Through

$\log(\mu_t/\mu_{ss})$ vs. $\lambda$

$\Rightarrow$ Pass-through increases with the persistence of marginal cost shocks.
⇒ Prices remain less volatile than costs even for highly persistent cost shocks.
**Anticipated Marginal-Cost Shocks**

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<th>marg. costs</th>
<th>markup</th>
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</table>

Units: percent deviations from the steady state.

⇒ About 1/3 of the future expected increase in costs is passed onto prices upon arrival of information. Consequently, a smaller fraction of the cost shock is passed onto prices upon realization of the shock ⇒ Measured pass-through is more incomplete.
Conclusions

- Deep habit formation gives rise to a theory of time-varying markups.
- The markup is a decreasing function of expected revenue growth.
- Deep habit formation induces incomplete pass-through of marginal cost shocks.
- Incomplete pass-through is more severe the more transitory the cost shocks are.
- Anticipation of cost shocks exacerbates the incompleteness of cost pass-through.