Incomplete Cost Pass-Through Under Deep Habits

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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.

Some Key References: Giovannini (*JIE*, 1988), Kadiyali (*JIE* 1997), Hellerstein (2006), Goldberg and Campa (2006), Nakamura (2006), Goldberg and Hellerstein (2007).

- **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

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

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

$$x_t = \left[\int_0^1 \left(\frac{c_{it}}{c_{it-1}^{\theta}}\right)^{1-\frac{1}{\eta}} di\right]^{\frac{1}{1-\frac{1}{\eta}}}$$

A Model of Incomplete Pass-Through

Household j minimizes

$$\int_0^1 P_{it} c_{it}^j di,$$

subject to

$$\left[\int_0^1 \left(\frac{c_{it}^j}{c_{it-1}^{\theta}}\right)^{1-1/\eta} di\right]^{1/(1-1/\eta)} \geq x_t^j$$

$\theta =$ deep-habit parameter

$c_{it-1} =$ External habit stock, taken as given by households.

Demand for good i by household j

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

- Short-Run Price Elasticty $= \eta$

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

- 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

$$c_{it} = A_t P_{it}^{-\eta} c_{it-1}^{\theta(1-\eta)}$$

- 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

$$\widehat{MC}_{it+1} = \lambda \widehat{MC}_{it} + \epsilon_{t+1}$$

Calibration of the Model

Parameter	Value
β	0.99
η	6
λ	0
θ	-0.1

Impulse Response to a One-Percent Increase in Marginal Cost

period	price	marg.costs	markup
0	0.81	1	-0.19
1	-0.11	0	-0.11
2	-0.04	0	-0.04
3	-0.01	0	-0.01
4	-0.01	0	-0.01

Units: percent deviations from the steady state.

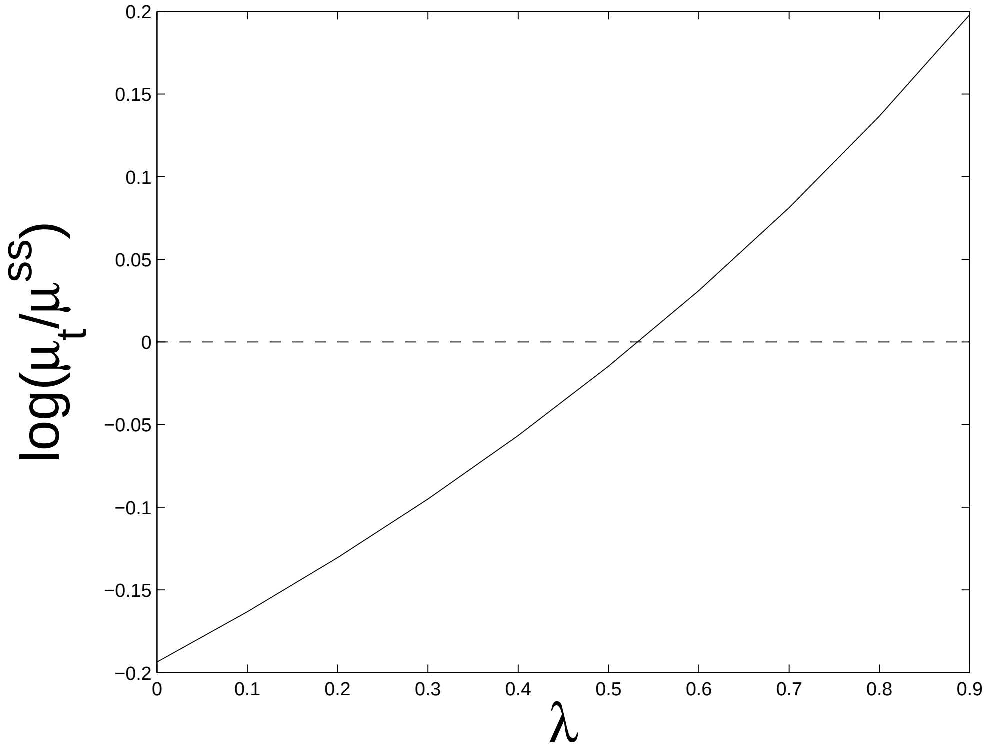
$\Rightarrow$ Incomplete Cost Pass-Through

Price-Cost Volatility Ratio

$$\frac{var(P_{it})}{var(MC_{it})} = 0.66$$

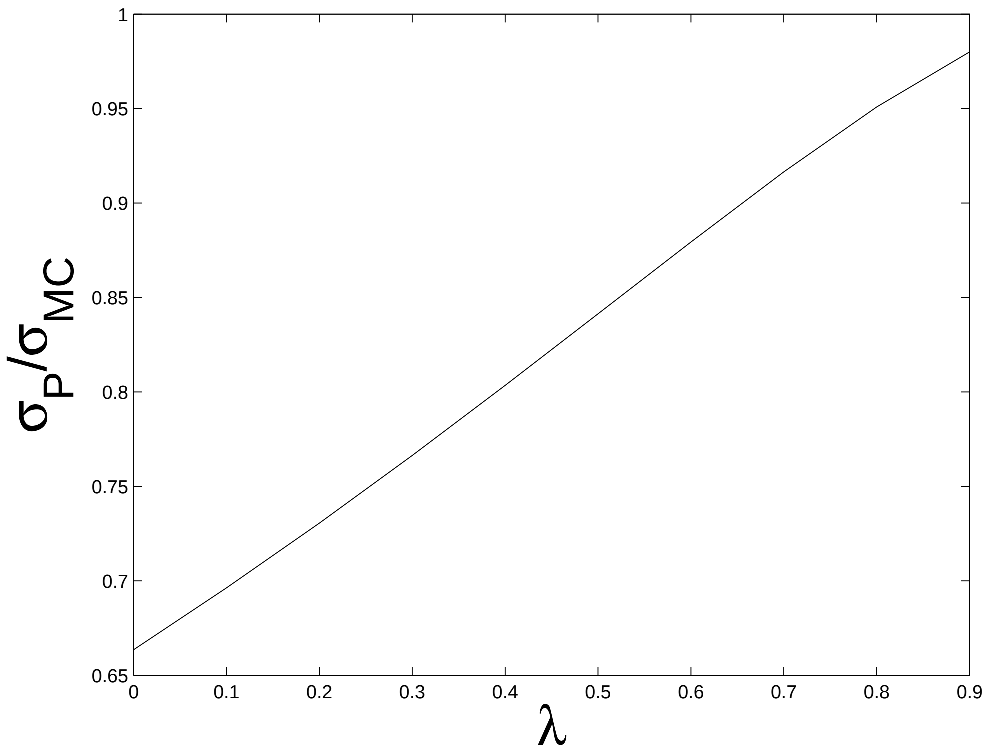
$\Rightarrow$ Prices are less volatile than marginal cost

Persistence of Cost Shocks and Incomplete Pass-Through



⇒ Pass-through increases with the persistence of marginal cost shocks.

Persistence of Cost Shocks and the Volatility of the Price-Cost Ratio



$\Rightarrow$ Prices remain less volatile than costs even for highly persistent cost shocks.

Anticipated Marginal-Cost Shocks

period	price	marg.costs	markup
0	0.29	0	0.29
1	0.77	1	-0.23
2	-0.12	0	-0.12
3	-0.05	0	-0.05
4	-0.02	0	-0.02

Units: percent deviations from the steady state.

$\Rightarrow$ 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 $\Rightarrow$ 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.