Incomplete Cost Pass-Through Under Deep Habits

M. Ravn S. Schmitt-Grohé M. Uribe

December 2007

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 micro-level 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.

Aggregate demand for good i

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

- Short-Run Price Elasticty $= \eta$
- Long-Run Price Elasticty $= \frac{\eta}{1-\theta(1-\eta)} > \eta$
- Habit elasticity $= \theta(1 - \eta) \in (0, 1)$
- Empirical support: Houthakker and Taylor, 1970; Chintagunta, Kyriazidou, and Perktold, 2001;

The Firm

- Maximize present value of expected profits

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

subject to

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

$\rightarrow$ 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

Implied markup is 9 %

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

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

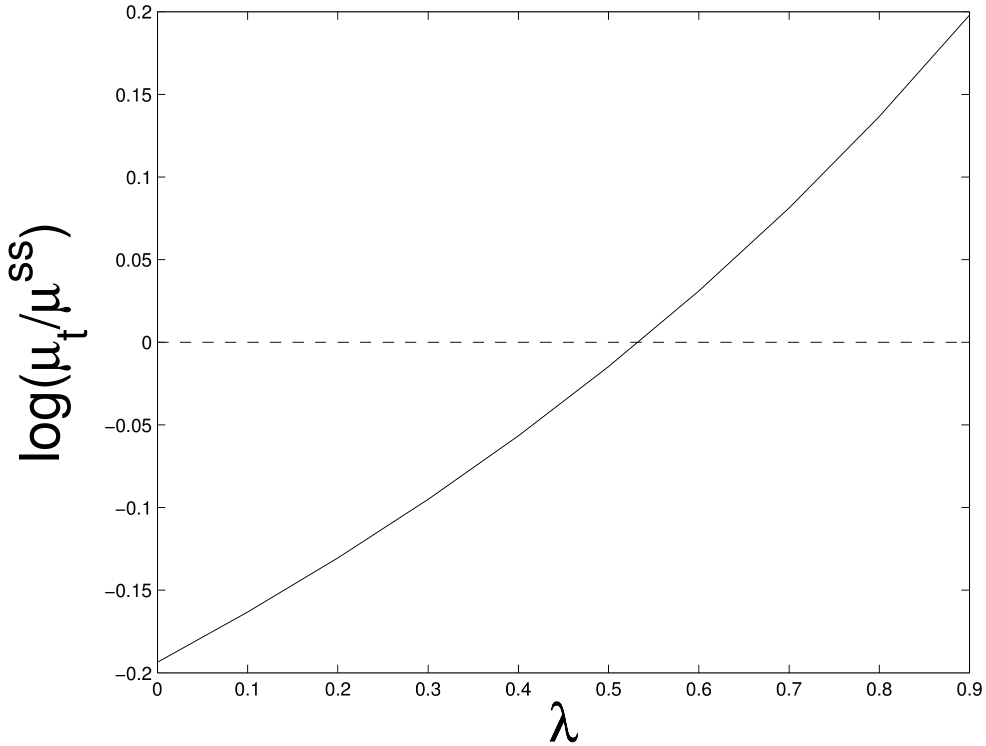
Anticipated Marginal-Cost Shocks

period	price	marg.costs	markup
0	0.29	0	0.29
1	0.77	1	-0.23
2	-0.12	0	-0.12

Units: percent deviations from the steady state.

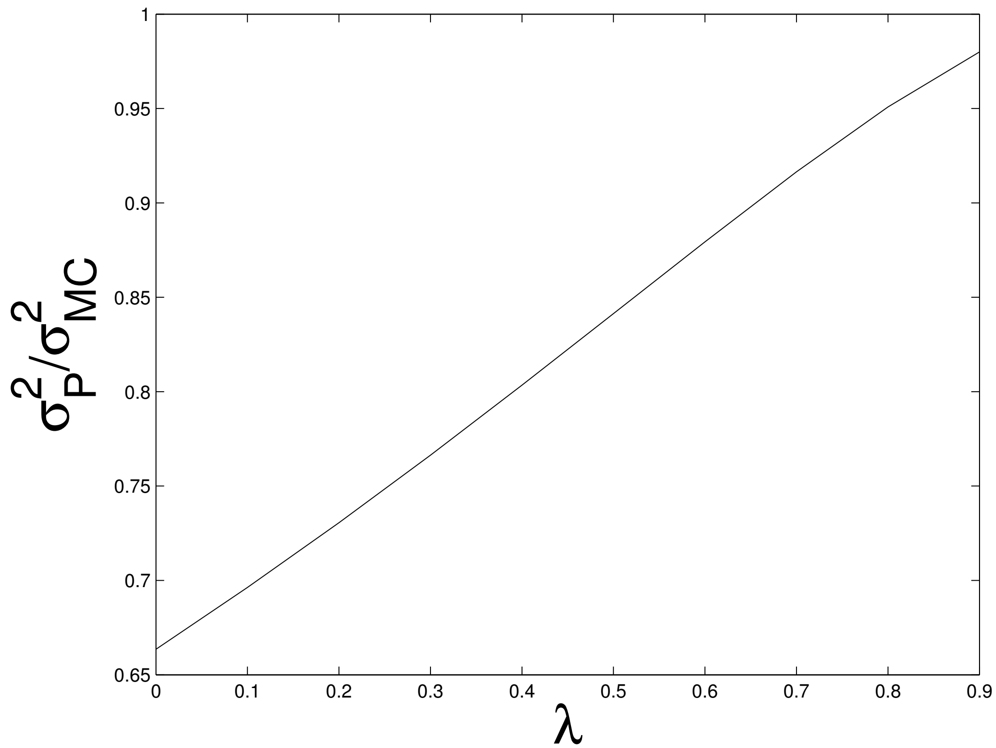
$\Rightarrow$ About 1/3 of the future expected increase in costs is passed onto prices upon arrival of information. Consequently, a smaller fraction of the cost shock is passed onto prices upon realization of the shock $\Rightarrow$ Measured pass-through is <u>more</u> incomplete, $\Delta \log P_t = 0.48$.

Persistence of Cost Shocks and Incomplete Pass-Through



$\Rightarrow$ Pass-through increases with the persistence of marginal cost shocks.

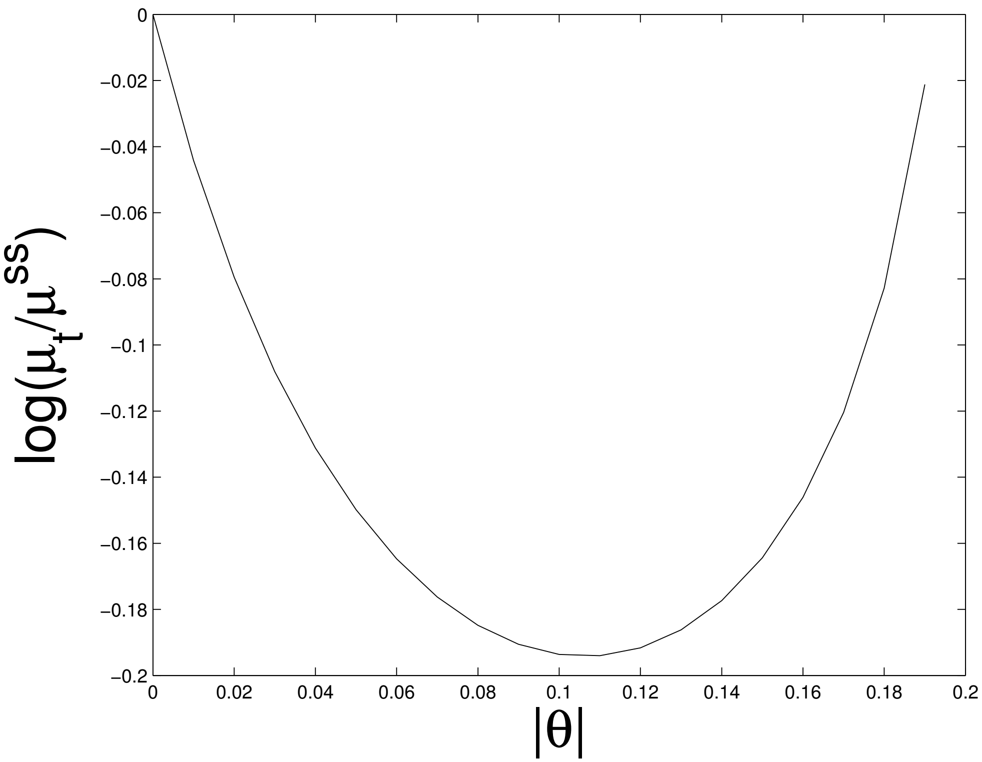
Persistence of Cost Shocks and the Volatility of the Price-Cost Ratio



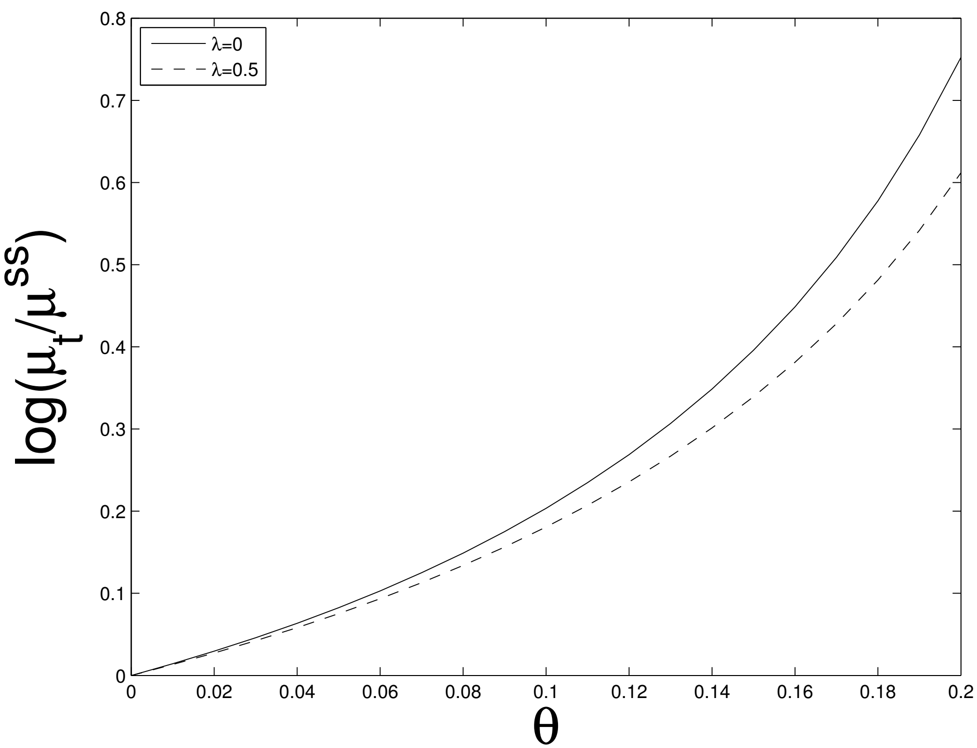
$\Rightarrow$ Prices remain less volatile than costs even for highly persistent cost shocks.

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.
- Anticipation of cost shocks exacerbates the incompleteness of cost pass-through.
- Incomplete pass-through is more severe the more transitory the cost shocks are.



0
−0.02
−0.04
−0.06
−0.08
−0.1
−0.12
−0.14
−0.16
−0.18
−0.2
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2
log(μt/μss)
|θ|



λ=0
λ=0.5
log(μt/μss)
θ
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.02
0.04
0.06
0.08
0.12
0.14
0.16
0.18