E C O N O M I C S B U L L E T I N

Habit Formation: Deep and Uncertain

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Abstract

We extend the Ravn, Schmitt-Grohe and Uribe (Review of Economic Studies, 2006) model of external deep-habits with the idea that some product varieties are more prone to habit formation than others. This creates uncertainty in habit formation which affects firm's pricing. Provided that uncertainty is strong, a profound implication is that role of market frictions, such as habit formation, and its consequences for the dynamic variations in the markups can be reversed.

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1. Introduction

The important contribution by Ravn, Schmitt-Grohé and Uribe (2006, RSU henceforth) presents a model where customers develop external habits as in Abel (1990) over varieties of consumer goods. In such a framework, the price mark-up policy is countercyclical in that a rise in current demand increases the importance of short-run elasticity relative to long-run elasticity- in the form of habits over varieties. Moreover, current pricing also affects future business as firms expect habit formation to take place through time. Therefore, when firms expect high future return they encourage habit formation by lowering their markups today; an idea reminiscent of the customer-market theory of Phelps and Winter (1970).

However, this picture ignores the possibility that at any given point in time households are not always certain about the varieties their neighbors are buying, unless of course there is a complete flow of information on the consumption of goods between neighbors. While some varieties may be infectious in the sense of 'catching-up with the Jonses,' others would fail to generate such desires. This is perhaps because some varieties are easily *observable* and *distinguishable* (i.e. conspicuous) than others ; for example cars and mobile phones against jewelry sets and evening dresses. Therefore, it is plausible that varieties are not equally habit-forming which in turn introduces some uncertainty in the process of habit formation. The RSU results overlook the relative importance of such *uncertainty* and its potential impact on firms' pricing policy.

In this paper we extend the RSU framework to include uncertainty in habit-formation. In doing so we find two important results: a) the intertemporal effects of habits matter less for pricing and b) markups are not necessarily countercyclical.

The following section lays down the model. Section 3 solves for a general equilibrium followed by a concluding section.

2. The Model

Assume an economy where there is a continuum of j representative households of measure one so that $j \in [0,1]$. At time t each household consumes a variety of differentiated goods indexed by $i \in [0,1]$. In the first instance, the household seeks to minimize total expenditure over consumption subject to an aggregation constraint so that

$$P_t x_t^j = \int_0^1 P_{it} c_{it}^j di, \tag{1a}$$

$$s.t\ x_t^j = \left[\int_0^1 \left(c_{it}^j - \alpha\theta c_{it-1} + (1-\alpha) z_t \right)^{1-\frac{1}{\eta}} di \right]^{\frac{1}{\left(1-\frac{1}{\eta}\right)}}, \tag{1b}$$

$$c_{it-1} = \int_0^1 c_{it-1}^j dj,\ z_t = \rho z_{t-1} + \varepsilon_t, \text{ and } \varepsilon_t \sim iid\left(\mu, \sigma^2\right). \tag{1c}$$

where $P_t = \left[\int_0^1 P_{it}^{1-\eta} di \right]^{\frac{1}{1-\eta}}$ is the aggregate Dixit-Stiglitz price index, x_t^j denotes an aggregation of jth agent's consumption of i varieties, P_{it} is the nominal price of the ith variety, c_{it}^j is jth agent's consumption of variety i at time t. The agent displays a tendency for external habit formation in varieties where c_{it-1} denotes an exogenously given average consumption over j agents of variety i in period $t-1$. The term θ captures the strength of the externality-effect of habit formation. The process of habit formation is also subject to uncertainty captured by the auto-regressive process z_t where ε_t is iid. The term $\alpha\ \epsilon\ (0,1)$ captures the extent to which a given variety is prone to habit-formation without uncertainty. For example, $\alpha = 0$ implies a habit-forming process dominated by uncertainty. The term η is the immediate demand elasticity.

Using standard methods, the optimal level of c_{it}^j is

$$c_{it}^j = \left(\frac{P_{it}}{P_t} \right)^{-\eta} x_t^j + \alpha\theta c_{it-1} - (1-\alpha) z_t. \tag{2}$$

Eq. (2) is jth agent's demand function for variety i that is adjusted for habit formation and uncertainty. Thus, demand is falling in relative prices but increasing in habit-adjusted consumption. Note that a rise in x_t^j raises the importance of short-run elasticity; hence elasticity is procyclical. Demand positively depends of past average consumption through habits but is negatively affected by our random variable; the last two terms on the RHS of (2) respectively. For example when $\alpha = 1$, habit formation over each variety occurs with certainty and its effects would be fully reflected on the demand function.

The cost-minimization problem set out above is secondary, the primal issue faced by the representative household is to maximize the utility over x_t^j and h_t^j (hours worked by household j) subject to his/her period-by-period budget constraint. In this paper, the focus is on the role of uncertainty in the habit formation process. Nonetheless, the introduction of uncertainty does not directly affect the

utility function and the budget-constraint of the households. Thus, the typical first-order conditions associated with the household's utility maximization problem in RSU are used to generate the equilibrium conditions for marginal substitutions and labour-leisure choice as shown below (see equations 8b and 8c).

2.1. ***Firms***

Each differentiated good i is produced by firms in a monoplistiscally competitive environment. The aggregate demand for each variety i is simply $c_{it} \equiv \int_0^1 c_{it}^j dj$, which is the sum of (2) over j households so that

$$c_{it} = \left(\frac{P_{it}}{P_t}\right)^{-\eta} x_t + \alpha\theta c_{it-1} - (1-\alpha)z_t,\ x_t \equiv \int_0^1 x_t^j dj \tag{3}$$

Assume that each firm manufacturing variety i is endowed with a linear technology and employs labour as the only factor of production with wage w_t. Then, the profit of firm i in period t can be expressed as[1]

$$\Phi_{it} = \left(\frac{\mu_{it}-1}{\mu_t}\right) c_{it}, \tag{4}$$

where μ_{it} and μ_t denote the markup (price-cost margin) of variety i and the average economy-wide markup respectively.

The objective of the firm is to maximize the expected present value of profits given by

$$\underset{\mu_{it}, c_{it}}{\text{Max}}\ E_t \sum_{j=0}^{\infty} r_{t,t+1}\Phi_{it+j} \tag{5}$$

subject to a process for the discount rate r, (3) and μ_t.

The Lagrangian for the firm's optimization problem is

$$\begin{aligned} \mathcal{L} \quad = \quad & E_0 \sum_{j=0}^{\infty} r_{0,t}\{c_{it}\left(\frac{\mu_{it}-1}{\mu_t}\right) \\ & + v_{it}\left[\left(\frac{\mu_{it}}{\mu_t}\right)^{-\eta} x_t + \alpha\theta c_{it-1} - (1-\alpha)z_t - c_{it}\right]\}, \end{aligned} \tag{6}$$

where v_{it} is the shadow value of selling a marginal unit of the variety i. The first-order conditions associated with (6) are

$$v_{it} \quad = \quad \left(\frac{\mu_{it}-1}{\mu_t}\right) + \alpha\theta E_t r_{t,t+1} v_{it+1}, \tag{7a}$$

$$c_{it} \quad = \quad \eta v_{it}\left(\frac{\mu_{it}}{\mu_t}\right)^{-\eta-1} x_t. \tag{7b}$$

Eq. (7a) says that the value of an extra unit of sale is composed of the unit profit, the first term on the right-hand-side, and the uncertainty-adjusted expected value of future sales, the second term. For example when $\alpha = 1/2$, the firm values future sales half as much due to the uncertain nature of habits for its variety. The second condition (7b) says that at the optimum the marginal benefit from raising the markup (the left-hand-side) –arising from selling all output at a higher prices– must equate to its marginal cost in the form of lower demand evaluated at its shadow value. The first-order-condition collapses to the text-book monopoly markup, $\eta/(\eta - 1)$, without habit formation (i.e., $\theta = 0$).

3. Equilibrium

By restricting ourselves to symmetry across firms and households (i.e. dropping both i and j) we are able to define the steady-state using the following set of equations

$$\begin{aligned}
\text{Demand; } x_t &= c_t - \alpha\theta c_{t-1} + (1-\alpha)z_t, && \text{(8a)}\\
\text{Marginal Substitution; } 0 &= \beta U_x(x_{t+1}, h_{t+1}) - U_x(x_t, h_t) r_{t,t+1}, && \text{(8b)}\\
\text{Labour-Leisure Choice; } w_t &= -\frac{U_h(x_t, h_t)}{U_x(x_t, h_t)}, && \text{(8c)}\\
\text{Markup; } \mu_t &= A_t / w_t, && \text{(8d)}\\
\text{Shadow Value of Marginal Unit; } v_t &= \alpha\theta E_t r_{t,t+1} v_{t+1} + 1 - \frac{1}{\mu_t}, && \text{(8e)}\\
\text{Combining (8a) and (7b) } c_t &= \eta v_t (c_t - \alpha\theta c_{t-1} + (1-\alpha)z_t). && \text{(8f)}
\end{aligned}$$

What sets these conditions apart from those presented in RSU is the presence of uncertainty in (8a) (8e) and (8f). Indeed with high uncertainty (e.g. $\alpha = 0$) the firm cares less about the future in (8e) and together with (8f) it will charge a markup with a premium on the text-book monopoly markup to correct for the presence of uncertainty as we show below. Let us consider the mark-up for the more general case. Manipulating (8f) together with (8e) and using standard methods we obtain the general time-varying markup equation

$$\mu_t = \left[1 - \frac{1}{\eta(1 - (\alpha\theta c_{t-1} - (1-\alpha)z_t)/c_t)} + \alpha\theta E_t r_{t,t+1} v_{t+1}\right]^{-1} \tag{9}$$

This expression is convenient as it defines the markup in terms of short-run and long-run elasticities adjusted for the presence of uncertainty habit formation. Consider the simplest case where $\alpha = 1$ and $\theta = 0$ so that there are no uncertainty and habit formation. In this case, the markup collapses to the constant text-book monopoly markup $\frac{\eta}{\eta-1}$.

Now consider the case where there is no uncertainty ($\alpha = 1$) but habits accrue with strength $\theta > 0$. In this case the general markup collapses to that of RSU,

$$\mu_t = \left[1 - \frac{1}{\eta(1 - \theta\frac{c_{t-1}}{c_t})} + \theta E_t r_{t,t+1} v_{t+1}\right]^{-1} \tag{10}$$

The term $\eta(1 - \alpha\theta\frac{c_{t-1}}{c_t})$ captures the short-run elasticity and it rises with current consumption c_t, and as a result markups fall. Hence, markups appear countercyclical. Furthermore, a rise in the expected value of sales of the marginal unit, through the creation of habits θ evaluated at its shadow-value v_{t+1}, induces firms to reduce markups today; this is the famous long-run customer-market effect which is responsible for the intertemporal dynamics in the markup.

The efficacy of both the effects discussed above is reduced in the presence of uncertainty. Indeed, from (9), the short-term elasticity is $\eta(1 - (\alpha\theta c_{t-1} - (1 - \alpha)z_t)/c_t)$ and its procylicality very much depends on α, the certainty with which customers form habits. A sufficiently low α will dampen the role of countercyclicality and in the limit it may in fact raise the markup to correct for the fact that firms have to bear sales uncertainty; reversing the RSU result of procyclical elasticities. Moreover, a low α implies that firms care less about the future, as habit-formation is less likely to occur, and thus invest less on the expansion of their customer-base by trimming markups.

4. Conclusion

In this paper we revisited the Ravn, Schmitt-Grohe and Uribe (2006) results that in the presence of external habit formation: a) short-run elasticities are procyclical hence markups are countercyclical and b) firms invest on their future customer-base by lowering their current markups. We find that these results qualitatively change when there is uncertainty in habit formation as some products may fail to generate sufficient public interest. The context in which we develop our results is simple, but extending it to include other sectors such as the government will make a quantitative difference. A profound implication is that shifts in aggregate demand will induce economy-wide countercyclical markups if-and-only-if the proportion of products that create market frictions in the economy, in the form of habit formation, outweigh those which constrain the generation of such frictions.

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References

Abel, A, B., 1990, Asset Price Under Habit Formation and Catching Up with the Joneses, The American Economic Review Papers and Proceedings, 80, 38-42.

Ravn, M., Schmitt-Grohe, S., and Uribe, M., 2006, Deep Habits, Review of Economic Studies, 73(1),

Phelps, E. S., Winter, S. G., 1970, Optimal Price Policy Under Atomistic Competition, in E. Phelps, Ed., Microfoundations of Employment and Inflation Theory, New York, NY: W.W Norton.

Notes

[1]The linear production technology for firm i is given by $y_{it} = A_t h_{it}$ where y_{it} denotes output of variety i, A_t denotes an aggregate technology shock and h_{it} denotes labour input. Firm i must satisfy $y_{it} \geq c_{it}$, then we can rewrite the aggregate demand as $c_{it} = A_t h_{it}$ or $\frac{c_{it}}{A_t} = h_{it}$. Nomainal marginal costs are given by $MC_t = (P_t w_t / A_t)$ where w_t/A_t is real marginal costs and w_t is the real wage rate. The profit of firm i in period t is given by $\Phi_t^j = \left(\frac{P_{it}}{P_t}\right) c_{it} - w_t h_{it}$. The markup of prices over marginal costs charged by firm i is given by $\mu_{it} = P_{it}/MC_t$ and the average markup charged in the economy is given by $\mu_t = P_t/MC_t$. Then we can rewrite firm i's profits as

$$\Phi_t^j = \left(\frac{\mu_{it} MC_t}{\mu_t MC_t}\right) c_{it} - w_t \left(\frac{c_{it}}{A_t}\right) = \left(\frac{\mu_{it}}{\mu_t}\right) c_{it} - \left(\frac{MC_t}{P_t}\right) c_{it} = \left(\frac{\mu_{it}}{\mu_t}\right) c_{it} - \left(\frac{MC_t}{\mu_t MC_t}\right) c_{it}$$

and thus

$$\Phi_t^j = \left(\frac{\mu_{it} - 1}{\mu_t}\right) c_{it}.$$