ECON 815

A Basic New Keynesian Model I

Winter 2015

Overview

We will make two changes to the classical monetary model.

1. Monopolistic competition $\Longrightarrow$ demand determined equilibrium
2. Sticky prices $\Longrightarrow$ some firms cannot adjust prices

The first one leads to mark-ups (profits) relative to perfectly competitive markets.

The second one leads to fluctuations in these mark-ups in response to shocks.

Monetary policy cannot do anything about the first one, but can alleviate the second one.

Households

There are now many goods indexed by $i \in [0, 1]$.

Households value only aggregate consumption which is assumed to be given by

$$C_t = \left(\int_0^1 C_t(i)^{1-\frac{1}{\epsilon}} di \right)^{\frac{\epsilon}{\epsilon - 1}}$$

with $\epsilon > 1$.

Problem:

$$\max_{C(i)_t, N_t, B_t} E_0 \sum_{t=0}^{\infty} \beta^t \left(\frac{C_t^{1-\sigma}}{1-\sigma} - \frac{(N_t)^{1+\eta}}{1+\eta} \right)$$

subject to

$$\int_0^1 P_t(i) C_t(i) di + Q_t B_t \leq B_{t-1} + W_t N_t - T_t \text{ for all } t$$

Demand for individual goods

How do we choose $C_t(i)$ to achieve the maximum aggregate consumption, holding fixed the total expenditure at some level Z_t?

$$\max_{C_t(i)} C_t$$

subject to

$$\int_0^1 P_t(i) C_t(i) = Z_t$$

FOC:

$$\frac{C_t(i)}{C_t(j)} = \left(\frac{P_t(i)}{P_t(j)} \right)^{-\epsilon}$$

Define the aggregate price index by

$$P_t = \left(\int_0^1 P_t(i)^{1-\epsilon} di \right)^{\frac{1}{1-\epsilon}}$$

Plug in $C_t(i)$ in the expenditure constraint to get

$$C_t(j) P_t(j)^{\epsilon} \int_0^1 P_t(i)^{1-\epsilon} di = Z_t$$

$$C_t(j) = \frac{Z_t}{P_t} \left(\frac{P_t(j)}{P_t} \right)^{-\epsilon}$$

From the definition of C_t, we have that $Z_t = P_t C_t$. Hence,

$$C_t(j) = \left(\frac{P_t(j)}{P_t} \right)^{-\epsilon} C_t$$

IS equation

We can thus use only aggregate consumption and the aggregate price level in the household problem.

The FOC yield again

$$\begin{aligned}\frac{C_t^\sigma}{(1-N_t)^\eta} &= \frac{W_t}{P_t} \\ 1 &= \beta E_t\left[\left(\frac{C_t}{C_{t+1}}\right)^\sigma (1+i_t)\frac{P_t}{P_{t+1}}\right]\end{aligned}$$

The household problem remains unchanged and only aggregate demand matters for the IS equation.

Firms – Optimal Price Setting

The production function is given by $A_t N_t(i)^\alpha$.

The nominal costs of producing output $Y_t(i)$ are thus given by

$$W_t \left(\frac{Y_t(i)}{A_t}\right)^{\frac{1}{\alpha}}$$

Firms sets prices as a monopolist to maximize profits:

$$\max_{P_t(i)} P_t(i)Y_t(i) - W_t N_t(i)$$

subject to

$$Y_t(i) = \left(\frac{P_t(i)}{P_t}\right)^{-\epsilon} C_t$$

$$N_t(i) = \left(\frac{Y_t(i)}{A_t}\right)^{\frac{1}{\alpha}}$$

FOC:

$$P_t(i)\frac{\partial Y_t(i)}{\partial P_t(i)} + Y_t(i) - W_t\frac{1}{\alpha A_t}\left(\frac{Y_t(i)}{A_t}\right)^{\frac{1}{\alpha}-1}\frac{\partial Y_t(i)}{\partial P_t(i)} = 0$$

where

$$\frac{\partial Y_t(i)}{\partial P_t(i)} = (-\epsilon)\frac{Y_t(i)}{P_t(i)}$$

Hence:

$$P_t(i) = \left(\frac{\epsilon}{\epsilon - 1}\right)W_t\frac{1}{\alpha A N_t(i)(Y_t(i))^{\alpha-1}}$$

The last term are the <u>nominal marginal costs</u> when producing $Y_t(i)$.

Mark-ups

This yields a **mark-up** condition

$$P_t(i) = \left(\frac{\epsilon}{\epsilon - 1}\right)\varphi_t(i) \equiv \mu\varphi_t(i).$$

The mark-up μ measures the difference between prices and (nominal) marginal costs and thus measures the inefficiency from monopolistic competition.

It depends on how easily goods can be substituted:

- price elasticity of demand is given by $-\epsilon$
- if $\epsilon = \infty$, we get perfect competition
- if $\epsilon \to 1$, market power increases

All prices are identical across firms. Hence, inflation depends 1-1 on the price setting behaviour of firms.