V Money, Inflation and Monetary Policy (Continued)

5 Imperfect Competition and Price-Setting

The model of imperfect competition is important in macroeconomics and also provides a framework for analyzing the determination of prices.

5.1 Assumptions

- There are a large number of individuals. They sell their labor and hire workers in a competitive labor market.
- Each individual is the sole producer of some good. He produces according to: $Q_i = L_i$.
- The producer sets the price of his product. The price is above the marginal cost, so it profitable to produce more if the demand for the product increases.
- The demand for good i is assumed to be

$$q_i = y - \eta(p_i - p), \quad \eta > 1. \tag{1}$$

- Individual i's utility function is given by

$$U_i = C_i - L_i^{\gamma}/\gamma. \tag{2}$$

- Individual i's income is the sum of profit income [i.e., $(P_i - W)Q_i$] and labor income [i.e., WL_i], where W is the nominal wage rate. As a result, we have

$$U_i = \ - \frac{(P_i - W)Q_i + WL_i}{P} L_i^{\gamma}. \tag{3}$$

- The aggregate demand is given by

$$y = m - p. \tag{4}$$

Note that m is publicly observed.

5.2 Individual Behavior

From (1), we have: $Q_i = Y(P_i/P)^{-\eta}$. Substituting this expression into (3) yields:

$$U_i = \frac{(P_i - W)Y(P_i/P)^{-\eta} + WL_i}{P} - \frac{1}{\gamma}L_i^\gamma. \tag{5}$$

Individual i chooses P_i and L_i to maximize (5), leading to the following solutions for P_i and L_i:

$$\frac{P_i}{P} = \left(\frac{\eta}{\eta - 1}\right)\frac{W}{P} \quad \text{(monopoly pricing)}, \tag{6}$$

$$L_i = \left(\frac{W}{P}\right)^{\frac{1}{\gamma-1}}. \tag{7}$$

5.3 Equilibrium

In equilibrium, each individual has the same labor supply L and the same output Y. From (7) and (6), we have

$$\frac{W}{P} = Y^{\gamma-1}, \tag{8}$$

$$\frac{P_i^*}{P} = \frac{\eta}{\eta - 1}Y^{\gamma-1}. \tag{9}$$

Taking logs, (9) can be rewritten as

$$p_i^* - p = \ln\left(\frac{\eta}{\eta - 1}\right) + (\gamma - 1)y \equiv c + \phi y. \tag{10}$$

Because of symmetry, $P_i = P$. Substituting this expression into (9) gives the equilibrium output:

$$Y = \left(\frac{\eta - 1}{\eta}\right)^{\frac{1}{\gamma - 1}} < 1. \tag{11}$$

Then the aggregate demand equation, $Y = M/P$, gives the equilibrium price level:

$$P = \frac{M}{Y} = M\left(\frac{\eta - 1}{\eta}\right)^{\frac{1}{1-\gamma}}. \tag{12}$$

5.4 Implications

The socially optimal output is given by $Y = \bar{L} = 1$, where $\bar{L}$ solves the maximization problem: $\max\{\bar{L} - \bar{L}^\gamma/\gamma\}$. The equilibrium output is less than the socially optimal output because the real wage is lower than the marginal product of labor.

- Recessions and booms have asymmetric effects on welfare: A boom makes the output gap (between the equilibrium output and the socially optimal output) smaller, while a recession does the opposite.
- Pricing decisions have externalities (aggregate demand externalities): A decrease in P increases aggregate output, leading to a higher level of welfare.
- Imperfect competition alone does not imply monetary nonneutrality: A change in money leads to proportional changes in the

nominal wage and all nominal prices, leaving output and the real wage unchanged.

- A price-setter's optimal relative price is increasing in aggregate output.

6 Predetermined Prices (Fischer, 1977)

6.1 Framework and Assumptions

The basic model is the same as the model of imperfect competition with the following assumptions:

- Producers set their prices every other period for the next two periods. In any given period, 50% of the producers are setting their prices for the next two periods. As a result, in any period, 50% of the prices are those set in the previous period and the other 50% are those set two periods ago.
- Setting $c = 0$ for simplicity in the equation for the desired relative price:

$$p_{it}^{*} = \phi m_t + (1-\phi)p_t.$$

- The assumption of certainty equivalence still applies.
- Producers' expectations are rational.

6.2 Equilibrium

The average price is given by

$$p_t = \frac{1}{2}(p_t^1 + p_t^2), \tag{13}$$

where p_t^j is the price set in period $t-j$, $j = 1, 2$. Assuming certainty-equivalence pricing behavior and using $p_{it}^{*} = (1-\phi)p_t + \phi m_t$, we have

$$p_t^1 = E_{t-1}p_{it}^{*} = \phi E_{t-1}m_t + (1-\phi)\frac{1}{2}(p_t^1 + p_t^2), \tag{14}$$

$$p_t^2 = E_{t-2}p_{it}^* = \phi E_{t-2}m_t + (1-\phi)\frac{1}{2}(E_{t-2}p_t^1 + p_t^2), \tag{15}$$

Using the law of iterated projections (the current expectation of a future expectation of a variable equals the current expectation of the variable) to solve (14) and (15) gives

$$p_t^2 = E_{t-2}m_t, \tag{16}$$

$$p_t^1 = E_{t-2}m_t + \frac{2\phi}{1+\phi}(E_{t-1}m_t - E_{t-2}m_t). \tag{17}$$

Substituting these two equations into the definition of the average price and the aggregate demand equation yields:

$$p_t = E_{t-2}m_t + \frac{2\phi}{1+\phi}(E_{t-1}m_t - E_{t-2}m_t), \tag{18}$$

$$y_t = \frac{1}{1+\phi}(E_{t-1}m_t - E_{t-2}m_t) + (m_t - E_{t-1}m_t). \tag{19}$$

6.3 Implications

- Unanticipated aggregate demand shifts (i.e., $m_t - E_{t-1}m_t$) have real effects.
- Aggregate demand shifts that become anticipated after the first prices are set (i.e., $E_{t-1}m_t - E_{t-2}m_t$) also have real effects.
- Monetary policy can stabilize the economy by responding to information learned between $t-2$ and $t-1$.
- Interactions among price-setters can either increase or decrease the effects of microeconomic price-stickiness. The proportion of shifts that is passed into output is $1/(1+\phi)$. A smaller ϕ (greater real rigidity) leads to larger real effects because price-setters are more reluctant to changes prices.

- Any information about aggregate demand that price-setters have a chance to respond to (i.e, $E_{t-2}m_t$) has no real effects.