Other Models of Price Rigidities

- We derived the new Keynesian Phillips curve using Calvo's model of price rigidities
- Macroeconomists pursued other models of price rigidities as well
- We will briefly go through (a) Taylor's model of staggered nominal adjustment and (b) Rotemberg's model of costly price adjustment
- Chapter 6 of Walsh's textbook contains these models as well as many other models

Taylor's Model

- Wages are set for two periods, with half of all contracts being renegotiated each period
- x_t is log contract wage set at time t. The average wage faced by firms in time t is
$$w_t = \frac{1}{2}x_t + \frac{1}{2}x_{t-1}$$
as the contract from the previous period is still in effect
- It is assumed that the log price level is proportional to the average wage:
$$p_t = w_t$$

Taylor's Model

- It is assumed that the contract wage is increasing in the level of economic activity:
$$x_t = \frac{1}{2}(p_t + E_t p_{t+1}) + k y_t$$
where y_t is log output and $k > 0$
- From the equations on the previous slide,
$$p_t = \frac{1}{2}(x_t + x_{t-1})$$
  - Substituting the contract wage into this,
$$p_t = \frac{1}{2}(\frac{1}{2}(p_t + E_t p_{t+1}) + k y_t + \frac{1}{2}(p_{t-1} + E_{t-1} p_t) + k y_{t-1})$$
$$= \frac{1}{4}(p_t + E_t p_{t+1} + p_{t-1} + E_{t-1} p_t) + \frac{k}{2}(y_t + y_{t-1})$$
$$= \frac{1}{4}(p_t + (p_t - p_t) + E_t p_{t+1} + p_{t-1} + E_{t-1} p_t) + \frac{k}{2}(y_t + y_{t-1})$$
$$= \frac{1}{4}(2p_t + E_t p_{t+1} + p_{t-1} + \eta_t) + \frac{k}{2}(y_t + y_{t-1})$$
where $\eta_t = E_{t-1} p_t - p_t$ is an expectations error

Taylor's Model

$$p_t = \frac{1}{4}(2p_t + E_t p_{t+1} + p_{t-1} + \eta_t) + \frac{k}{2}(y_t + y_{t-1})$$
$$\frac{1}{2}p_t = \frac{1}{4}(E_t p_{t+1} + p_{t-1} + \eta_t) + \frac{k}{2}(y_t + y_{t-1})$$
$$p_t = \frac{1}{2}p_{t-1} + \frac{1}{2}E_t p_{t+1} + k(y_t + y_{t-1}) + \frac{1}{2}\eta_t$$

so there is inertia in the price level: It depends on the past price level

- We can express this in terms of the inflation rate $\pi_t = p_t - p_{t-1}$:

$$2p_t = p_{t-1} + E_t p_{t+1} + 2k(y_t + y_{t-1}) + \eta_t$$
$$p_t - p_{t-1} = (E_t p_{t+1} - p_t) + 2k(y_t + y_{t-1}) + \eta_t$$
$$\pi_t = E_t \pi_{t+1} + 2k(y_t + y_{t-1}) + \eta_t$$

which does not have inertia!

Rotemberg's Model

- In principle, firms can adjust their prices each period
- However, they face quadratic costs of price adjustments
- The desired log price of firm j is

$$p_t^*(j) = p_t + \alpha x_t$$

  where p_t is the aggregate log price level and x_t is a measure of real economic activity
- Firm j's profit takes the form

$$\Pi_t(j) = -\delta(p_t(j) - p_t^*(j))^2 = -\delta(p_t(j) - p_t - \alpha x_t)^2$$

  where $p_t(j)$ is the log price actually set by the firm
- The cost of price adjustment is

$$c_t(j) = \phi[p_t(j) - p_{t-1}(j)]^2$$

Rotemberg's Model

- In each period, firm j maximizes

$$\sum_{i=0}^{\infty} \beta^i E_t[\Pi_{t+i}(j) - c_{t+i}(j)]$$

by choosing $p_t(j)$

- The FOC is

$$-2\delta(p_t(j) - p_t - \alpha x_t) - 2\phi(p_t(j) - p_{t-1}(j)) + \beta E_t\{2\phi(p_{t+1}(j) - p_t(j))\} = 0$$

- Because all firms are identical, $p_t(j) = p_t$, the FOC becomes

$$-\delta(-\alpha x_t) - \phi(p_t - p_{t-1}) + \beta\phi(E_t p_{t+1} - p_t) = 0$$

- It follows that

$$\pi_t = \beta E_t \pi_{t+1} + \left(\frac{\alpha\delta}{\phi}\right) x_t$$

which looks very similar to the Phillips curve based on the Calvo-pricing