Econ 314

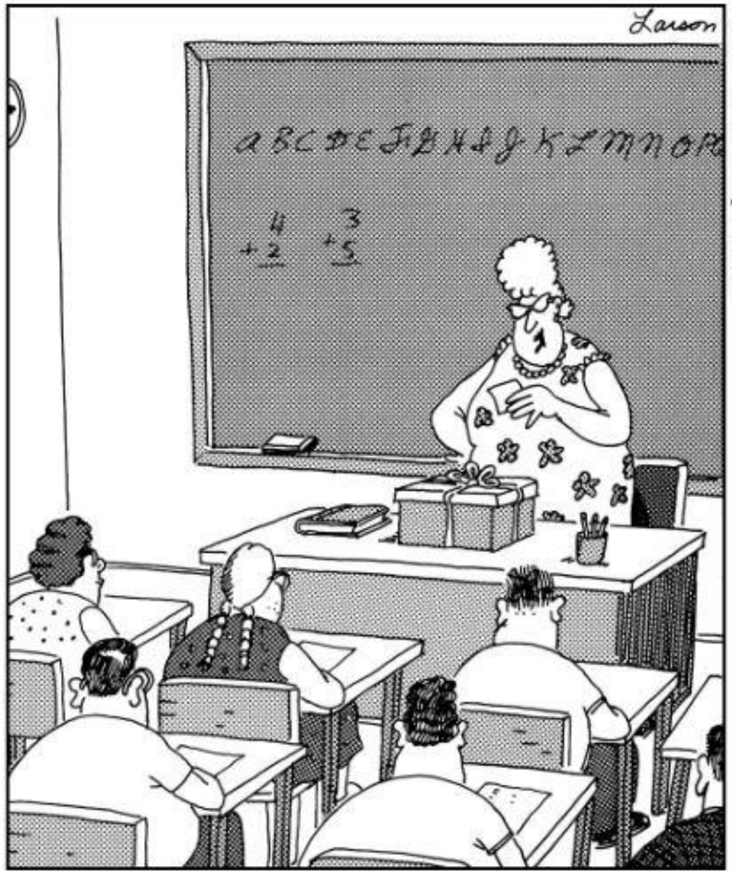
Wednesday, April 8
Fischer's Predetermined Price Model

Reading: Romer's Section 7.2

Coursebook: Chapter 12 (relevant sections)

Class notes: Pages 122 - 125

Today's Far Side offering



"And the note says: 'Dear classmates and Ms. Kilgore: Now that my family has moved away, I feel bad that I whined so much about being mistreated. Hope the contents of this box will set things right. Love, Pandora.'... How sweet."

There's no one in our class named Pandora, right? Right?

Context and overview

- Stanley Fischer's **predetermined-price model** is the first of three dynamic pricing models that we study
- Each of these models applies the microeconomic outcome of price stickiness to a macroeconomic model
- Fischer's model is based on his 1977 model with wage contracts: arguably the very first "new Keynesian" models
- Prices are set in **contracts lasting two periods**, with a (possibly) different price set for each period
- This is appropriate when costs of price setting are decision costs more than explicit menu costs

Basic setup

- **Two equal-sized groups** of firms: A and B
  - Group A sets prices at beginning of odd-numbered periods
  - Group B sets prices at beginning of even-numbered periods
- Notation:
  - Price for period *t* in first period of contract: p_t^1
    - Set at beginning of period *t* as first half of period (*t*, *t*+1) contracts
  - Price for period *t* in second period of contract: p_t^2
    - Set at beginning of period *t* – 1 as second half of period (*t* – 1, *t*) contracts
  - These two prices are both in effect in *t*, so $p_t = \frac{1}{2}\left(p_t^1 + p_t^2\right)$
  - In general, $p_{t+1}^2 \neq p_t^1$ because firms at beginning of *t* can set different price for first and second halves of contract

Pattern of price setting

t	1	2	3	4	5	6
Group A	p_1^1	p_2^2	p_3^1	p_4^2	p_5^1	p_6^2
Group B	p_1^2	p_2^1	p_3^2	p_4^1	p_5^2	p_6^1
p_t	$\frac{p_1^1 + p_1^2}{2}$	$\frac{p_2^1 + p_2^2}{2}$	$\frac{p_3^1 + p_3^2}{2}$	$\frac{p_4^1 + p_4^2}{2}$	$\frac{p_5^1 + p_5^2}{2}$	$\frac{p_6^1 + p_6^2}{2}$

- Shaded and unshaded areas with double lines between them show timing of overlapping contracts
- p is average of price set for first period of new contracts and price set for second period of one-period-old contracts

Price-setting rule

- From imperfect-competition model, **profit-maximizing price** is

$$p_t^* = \phi m_t + (1 - \phi) p_t$$

- At beginning of t, group with expiring contracts sets prices for two periods of contract as

$$p_t^1 = E_{t-1}\left(p_t^*\right) \quad p_{t+1}^2 = E_{t-1}\left(p_{t+1}^*\right)$$

- **Rational expectations** use all information available through $t - 1$
- Warning: **Algebra ahead!**

Setting up solution

$$p_t^1 = \phi E_{t-1} m_t + (1-\phi) E_{t-1} p_t$$
$$= \phi E_{t-1} m_t + \tfrac{1}{2}(1-\phi)\left(p_t^1 + p_t^2\right)$$

$$p_t^2 = \phi E_{t-2} m_t + (1-\phi) E_{t-2} p_t$$
$$= \phi E_{t-2} m_t + \tfrac{1}{2}(1-\phi)\left(p_t^2 + E_{t-2} p_t^1\right)$$

$$E_{t-2} p_t^1 = E_{t-2}\left[\phi E_{t-1} m_t + \tfrac{1}{2}(1-\phi)\left(p_t^1 + p_t^2\right)\right]$$
$$= \phi E_{t-2} m_t + \tfrac{1}{2}(1-\phi)\left(E_{t-2} p_t^1 + p_t^2\right) = p_t^2$$

After more algebra … a solution!

- See pages 123 and 124 of class notes for a couple of steps I'm omitting here …
- **Solution for p_t** is

$$p_t = E_{t-2}m_t + \frac{2\phi}{1+\phi}\left[E_{t-1}m_t - E_{t-2}m_t\right]$$

- Price level set in the two contracts for *t* depends on:
  - Expectation of period-*t* AD as of $t - 2$
  - New information about period-*t* AD that arrives in period $t - 1$

Properties of price equation

$$p_t = E_{t-2}m_t + \frac{2\phi}{1+\phi}\left[E_{t-1}m_t - E_{t-2}m_t\right]$$

- **Real-rigidity** parameter ϕ plays key role:
  - If there is no real rigidity, $\phi = 1$ and the fraction is 1, so $p_t = E_{t-1}m_t$
  - Positive real rigidity makes the fraction < 1 and effects of $E_{t-2}m_t$ persist
- If there is no real rigidity and firms do not care about rivals' prices, then when prices are set in *t* the prices from previous contracts are irrelevant
  - Everyone updates fully to knowledge about aggregate demand rather than trying to compete with prices based on older information

Behavior of output

$$y_t = m_t - p_t = [m_t - E_{t-1}m_t] + \frac{1}{1+\phi}[E_{t-1}m_t - E_{t-2}m_t]$$

- Real output depends on two pieces of information about m_t:
  - $[m_t - E_{t-1}m_t]$ is information that is learned at t (after new contract price is set)
  - $[E_{t-1}m_t - E_{t-2}m_t]$ is information learned in $t-1$ (after old contract price was set)
- First is like Lucas model (AD surprise)
- Second is due to **holdover effects of contracts**
  - AD shocks have effects that last as long as the longest contract
- AD shocks that were known about in $t-2$ have **no effect on output**

Intuition

- Suppose a shock occurs to AD that is learned in period 1
- p_1^1, p_1^2, and p_2^2 were all set before shock is known
- Although p_2^1 is set later, with **real rigidity**, price-setters will compete with p_2^2 that does not reflect AD shock
- Price in period 2 does not fully reflect AD shock, so output (which is $y = m - p$) will still be affected

Optimal monetary policy

- **Aggregate demand** is $m_t = f_t + v_t$
  - v is random variation (velocity?) with $v_t = v_{t-1} + \varepsilon_t$
  - ε is "white noise" shock to v
  - f is Fed monetary policy

- Fed sets f to **stabilize *y*** by responding to last period's shock (because it doesn't know this period's shock): $f_t = \alpha\varepsilon_{t-1}$

- What is **optimal α**?

Solving

- Aggregate demand in *t* depends on most recent two shocks, plus level of *v* two periods ago:

$$
\begin{aligned}
m_t &= f_t + v_t \\
&= \alpha\varepsilon_{t-1} + v_{t-1} + \varepsilon_t \\
&= \alpha\varepsilon_{t-1} + v_{t-2} + \varepsilon_{t-1} + \varepsilon_t \\
m_t &= v_{t-2} + (1+\alpha)\varepsilon_{t-1} + \varepsilon_t
\end{aligned}
$$

- Taking expectations and plugging into equation for y_t

$$y_t = \varepsilon_t + \frac{1+\alpha}{1+\phi}\varepsilon_{t-1}$$

Choosing α

$$y_t = \varepsilon_t + \frac{1+\alpha}{1+\phi}\varepsilon_{t-1}$$

- Current shock ε_t always affects y_t and the Fed cannot do anything about it

- **Fed can fully offset effect of lagged shock** ε_{t-1} by setting $\alpha = -1$

- That is the **optimal monetary rule** and it helps stabilize output even if everyone knows that the Fed is doing it

Review and summary

- Fischer model has **two-period overlapping contracts** with possibly a **different price** set for each period

- Any AD shocks that were **known before oldest contract** still in effect have no effect on current output (long-run neutrality)

- Unexpected AD shocks have **real effects that last as long as the longest contract**

- **Monetary policy can help stabilize** output by offsetting lagged shocks

Challenge for today

Take a common phrase and change one letter to make a new phrase that is meaningful. For example, I avoid the free samples at Costco under the principle of:

"**Taste not, want not.**"

Send me one that you come up with, or just add it to the conversation at the end of our conference.

What's next?

- **Fischer model** is one way that prices can be sticky

- **Taylor model** is similar, but firms must set same price for both periods of contract
  - Dynamics of the model are more complex
  - Real effects of demand shocks die out slowly

- **Calvo model** of probabilistic price adjustment is most common application of sticky prices now