Incomplete Nominal Adjustment

Lecture 8

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Lecture overview

Literature: Romer(2006) - chapters 5 and 6

1. Aggregate Demand
2. Alternative Assumptions about Wage and Price Rigidity
3. Output-Inflation Tradeoffs
4. Lucas Imperfect-Information Model
   - the Phillips Curve
   - Lucas critique

Motivation

- alternative models of economic fluctuations
  - **RBC approach:** emphasis on shocks to aggregate supply; propagation mechanism via intertemporal substitution of labor
  - **Keynesian tradition:** emphasis on aggregate demand changes, based on assumption of stickiness (slow adjustment) of nominal prices and/or wages
- analysis of the latter
  - behavior of aggregate demand
  - alternative assumptions about form/type of nominal rigidities
  - provide microfoundations

- start with extreme assumption: completely fixed prices
- output and interest rate are then determined by 2 equations:
  - demand for goods
  - money market
- **IS curve (Y,r):** planned = actual expenditures

$$E = E(Y, r, G, T)$$

where $0 < E_Y < 1$, $E_r < 0$, $E_G > 0$, $E_T < 0$

often $$E = C(Y - T) + I(r) + G$$

- these are ad-hoc assumptions about relationships among aggregates

- in equilibrium: $E = Y$, thus

$$Y = E(Y, r, G, T)$$

- increase in interest rate r (given Y) shifts planned expenditure E down in (Y,E) space (due to decrease in investment)
- **downward sloping** IS curve in (Y,r) space
- algebraically:

$$\begin{aligned}\frac{dY}{dr} &= E_Y \frac{dY}{dr} + E_r \\ \frac{dY}{dr} &= \frac{E_r}{1 - E_Y} < 0\end{aligned}$$

Aggregate Demand

Money market

- equilibrium in money market:
  (demand and supply of real money balances)

$$\frac{M}{P} = L(r + \pi^e, Y)$$

  where $L_{r+\pi^e} < 0, L_Y > 0$

- two approaches
  1. exogenous money supply: **LM curve**
     - fixed prices imply constant $\bar{P}$ and $\pi^e = 0$; from equation $\frac{M}{\bar{P}} = L(r, Y)$ we have $L(r, y)$ upward sloping in (Y,r) space
  2. endogenous money supply: **MP curve**
     - interest rate rule $r = r(Y, \pi)$ with $r_Y > 0$, $r_\pi < 0$ directly implies MP curve upward sloping in (Y,r) space

Equilibrium with flexible prices

- drop assumption of fixed prices
- new variable space (Y, π) - equilibrium determined as intersection of aggregate demand (AD) and aggregate supply (AS)

- **AS curve:** for now assume $\pi = \pi(Y)$ where $\pi_Y \geq 0$ (short run)
  - thus we allow prices to be responsive to output
- **AD curve:** derived from IS and LM curves:
  - consider rise in inflation (change of price level)
    - $E(\cdot)$ unaffected $=>$ IS unchanged
    - interest rate rule affected - CB sets higher interest rate for any given level of output $=>$ MP shifts up $=>$ equilibrium Y is lower
    - summary $\nearrow \pi => \searrow Y$
  - $=>$ AD curve is downward sloping in (Y, π) space

Source of fluctuations - shifts in AD curve

Example: Effect of an increase in government purchases

- consider rise in government expenditures ($\nearrow G$)
  - MP curve unaffected
  - higher $G =>$ higher $E =>$ higher Y for given r (IS curve shifts right)
  - i.e. for given P we have higher Y - AD shifts to the right
- implication: both real (higher output) and nominal (higher inflation) effects
- depends on the assumption about AS

Alternative assumptions about wage and price rigidity

- supply side of the model
- basic assumptions
  - long-run AS vertical (long-run neutrality of money)
  - short-run AS upward sloping (nominal rigidities matter in short run)
- implications of nominal wage and price rigidity + characteristics of labor and goods markets:
  1. basic Keynes's model
  2. sticky prices, flexible wages, competitive labor market
  3. sticky prices, flexible wages, real labor market imperfections
  4. flexible prices, sticky wages, imperfect competition
- frictions are assumed (endogenized later)

Case 1: Keynes's Model

- production: $Y = F(L)$, $F'(L) > 0$, $F''(L) < 0$
- nominal wage predetermined (not affected by current development): $W = \bar{W}$
- competitive labor market: $F'(L) = \frac{W}{P}$

Implications:

- higher inflation => lower real wage => higher demand for labor => higher employment => higher output
- **=> upward sloping AS** ($\nearrow \pi => \nearrow Y$)
- possibility of involuntary unemployment
- effect of fluctuations in aggregate demand: lower AD => lower Y & lower π => higher real wage => lower employment
- => rise in unemployment (OK), countercyclical real wage (NO)

Case 2: Sticky prices, flexible wages, competitive labor market

- prices and inflation are rigid: $P = \bar{P}$, $\pi = \bar{\pi}$
- flexible wages: labor supply $L = L^s\left(\frac{W}{P}\right)$; $L^{s'}\left(\frac{W}{P}\right) > 0$
- firms meet demand as long as marg.cost $\leq$ marg. product - i.e. $F'(L) = \frac{W}{P}$ is condition for max. level of output Y^{max}

Implications:

- AS is horizontal at $\bar{\pi}$ level, zero for $Y > Y^{max}$
  $=>$ rationing if $Y^D > Y^{max}$
- full employment (workers on their L^s)
- effect of fluctuations in aggregate demand: lower AD $=>$ lower Y $=>$ lower labor demand $=>$ lower employment $=>$ lower real wage
- procyclical real wage

Case 3: Sticky prices, flexible wages, real labor market imperfections

- goal: to link aggregate demand and unemployment fluctuations
- set-up as in case 2, but real-wage function paying more than marg. product

$$\frac{W}{P} = w(L); w'(L) \geq 0$$

- labor market frictions: wage bargaining (unions), efficiency wages
- AS horizontal - AD shifts same real effects as in previous case
- moreover: real wage function $\neq$ labor supply $=>$ **involuntary unemployment**
- if real wage flatter than L^s $=>$ unemployment rises when demand falls

Case 4: Sticky prices, flexible wages, imperfect competition

- goal: generalize basic Keynesian model
- set-up as for case 1 + introduce **imperfect competition**:

$$P = \mu(L)\frac{W}{F'(L)}$$

  where $\mu(L)$ is markup of price over marginal costs
- assumptions on $\mu(L)$ determine behavior of real wage $\frac{W}{P} = \frac{F'(L)}{\mu(L)}$
  - if $\mu(L)$ counter-cyclical ($\searrow Y => \nearrow \mu(L)$) $=>$ real wage procyclical
  - possibility of unemployment

Output - Inflation Tradeoff

- models based on nominal rigidities imply permanent tradeoff between output and inflation
- consider case 1: predetermined wages, flexible prices, comp. markets

$$
\begin{aligned}
W_t &= AP_{t-1},\ A > 0 \\
Y_t &= F(L_t);\ F'(L_t) > 0, F''(L_t) < 0 \\
F'(L_t) &= \frac{W_t}{P_t} = \frac{AP_{t-1}}{P_t} = \frac{A}{1+\pi_t}
\end{aligned}
$$

- stable positive relationship between employment and inflation = **Phillips Curve**

The Phillips Curve

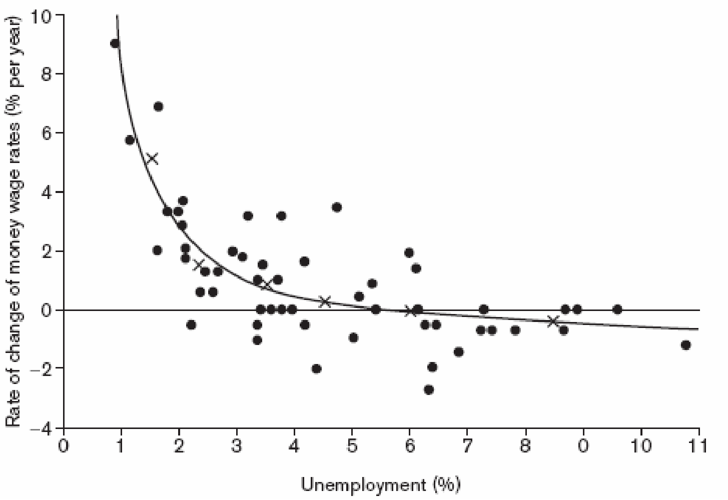

Figure: The Phillips Curve in the UK, 1861-1913.

The Phillips Curve

Figure: The Phillips Curve in the US, 1960s.

Output - Inflation Tradeoff: Critique

- attack of Phillips Curve in late 60s/early 70s
- **theory:**
  - in the long run, nominal forces cannot determine behavior of real variables
  - systematical exploitation of this tradeoff would lead to shifts in expectations
  - existence of natural rate of unemployment
- **empirically:** breakdown of Phillips Curve in 70s (as well as 80s and 90s)

The Phillips Curve?

Figure: The Phillips Curve in the US, 1961-1980.

The Expectations -Augmented Phillips Curve

- long-run analysis - flexible prices and wages
- long run AS vertical - changes in AD do not affect Y in long run
  - existence of natural rate of output $\bar{Y}$
- short run AS - differences of New Keynesian models
  - neither prices or wages are completely rigid
  - allow for supply shocks
  - adjustment both past and future inflation
- expectations-augmented Phillips Curve

$$\pi_t = \pi_t^* + \lambda(\ln Y_t - \ln \bar{Y}) + \epsilon_t^s, \ \lambda > 0$$

The Expectations - Augmented Phillips Curve

Formulations

- version 1: **core inflation** $\pi_t^* = \pi_{t-1}$

$$\pi_t = \pi_t^* + \lambda(\ln Y_t - \ln \bar{Y}) + \epsilon_t^s, \ \lambda > 0$$

  - tradeoff between output and changes of inflation
  - natural rate argument still applies (with increasing π) output higher than $\bar{Y}$

- version 2: **expected inflation** $\pi_t^e = \dots$

$$\pi_t = \pi_t^e + \lambda(\ln Y_t - \ln \bar{Y}) + \epsilon_t^s, \ \lambda > 0$$

  - how to formulate expectation?
  - under rational expectations: policy ineffectiveness

- version 3: **weighted average**

$$\pi_t = \phi\pi_t^e + (1-\phi)\pi_{t-1} + \lambda(\ln Y_t - \ln \bar{Y}) + \epsilon_t^s, \ \lambda > 0$$