Aggregate Supply (Ch.13)

- three models of aggregate supply in which output depends positively on the price level in the short run
- the short-run tradeoff between inflation and unemployment known as the Phillips curve

Three models of aggregate supply

1. The sticky-wage model
2. The imperfect-information model
3. The sticky-price model

All three models imply:

\[ Y = \bar{Y} + \alpha (P - P^e) \]

The sticky-wage model

- Firms and workers negotiate contracts and fix the nominal wage before they know what the price level will turn out to be.
- The nominal wage, \( W \), they set is the product of a target real wage, \( \omega \), and the expected price level:

\[ W = \omega \times P^e \]

\[ \Rightarrow \frac{W}{P} = \omega \times \frac{P^e}{P} \]
1. The sticky-wage model

\[ \frac{W}{P} = \omega \times \frac{P^e}{P} \]

If it turns out that

- \( P = P^e \) then unemployment and output are at their natural rates
- \( P > P^e \) Real wage is less than its target, so firms hire more workers and output rises above its natural rate
- \( P < P^e \) Real wage exceeds its target, so firms hire fewer workers and output falls below its natural rate

The cyclical behavior of the real wage

Sticky wages imply that \( \frac{W}{P} \) should be counter-cyclical. Not true in the data!

2. The imperfect-information model

Assumptions:
- all wages and prices perfectly flexible, all markets clear
- each supplier produces one good, consumes many goods
- each supplier knows the nominal price of the good she produces, but does not know the overall price level
**The imperfect-information model**

- Supply of each good depends on its relative price: the nominal price of the good divided by the overall price level.
- Supplier doesn’t know price level at the time she makes her production decision, so uses the expected price level, \( P_e \).
- Suppose \( P \) rises but \( P_e \) does not. Then supplier thinks her relative price has risen, so she produces more.
- With many producers thinking this way, \( Y \) will rise whenever \( P \) rises above \( P_e \).

**3. The sticky-price model**

- Reasons for sticky prices:
  - long-term contracts between firms and customers
  - menu costs
  - firms do not wish to annoy customers with frequent price changes
- Assumption:
  - Firms set their own prices (e.g. as in monopolistic competition)
  - Notation \( \bar{Y} \)=natural level of \( Y \)

**The sticky-price model**

Suppose two types of firms:
- Flex p firms: \( p = P + a \left( Y - \bar{Y} \right) \) [ fraction 1-s ]
- Sticky p firms: \( p = P^e \) [ fraction s ]

- Hence: \( P = (1-s) \left( P + a \left( Y - \bar{Y} \right) \right) + s \ P^e \)
- \( P = P^e + a \left(1-s\right) \left( Y - \bar{Y} \right) / s \)
The sticky-price model

\[ P = P^* + \frac{(1-s)a}{s} (Y - \bar{Y}) \]

- High \( P^* \) or High \( Y \) \( \Rightarrow \) High \( P \)

\[ Y = \bar{Y} + \alpha(P - P^*) \]

Sticky-price model: procyclical real wage:
Suppose output falls. Then,
- Firms see a fall in demand for their products.
- Sticky price firms reduce production, and labor demand.
- Shift in labor demand causes the real wage to fall.

Summary & implications

Each of the three models of agg. supply imply the relationship summarized by the SRAS curve & equation

Summary & implications

If \( AD \) rises...
\[ P > P^* \]

\[ P = P^* \]

\[ P < P^* \]

\[ Y = \bar{Y} + \alpha(P - P^*) \]

\( \text{SRAS}_{1} \)

\( \text{SRAS}_{2} \)

\( Y = \bar{Y} \)
The Phillips curve is a different way to reinterpret the aggregate supply curve. It states that $\pi$ depends on
- expected inflation, $\pi^e$
- cyclical unemployment: the deviation of the actual rate of unemployment from the natural rate
- supply shocks, $\nu$

$$\pi = \pi^e - \beta(u - u^*) + \nu$$

where $\beta > 0$ is a parameter.

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Deriving the Phillips Curve from SRAS

1. $Y = Y_\text{bar} + \alpha(P - P^*)$ [SRAS]
2. $P = P^e + (1/\alpha)(Y - Y_\text{bar})$
3. $P = P^e + (1/\alpha)(Y - Y_\text{bar}) + \nu$
4. $(P - P_{t-1}) = (P^e - P_{t-1}) + (1/\alpha)(Y - Y_\text{bar}) + \nu$
5. $\pi = \pi^e + (1/\alpha)(Y - Y_\text{bar}) + \nu$
6. $(1/\alpha)(Y - Y_\text{bar}) = -\beta(u - u^*)$
7. $\pi = \pi^e - \beta(u - u^*) + \nu$ [Phillips Curve]

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How to form expectations? (1) Adaptive

- So far, we have not explained how expectations are formed
- Adaptive: people form expectations based on immediate past.
  \[ \pi^e = \pi_{t-1} \]
- Then, the P.C. becomes
  \[ \pi = \pi_{t-1} - \beta(u - u^*) + \nu \]

Inflation inertia... → Past inflation influences expectations of current inflation, which in turn influences the wages & prices that people set.
Two causes of rising & falling inflation

\[ \pi = \pi_t - \beta(u - u^n) + \nu \]

- **cost-push inflation**: inflation resulting from supply shocks. Adverse supply shocks raise production costs and induce firms to raise prices.

- **demand-pull inflation**: inflation resulting from demand shocks. Positive shocks to aggregate demand cause unemployment to fall below its natural rate.

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Graphing the Phillips curve

\[ \pi = \pi^* - \beta(u - u^n) + \nu \]

The short-run Phillips Curve

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Shifting the Phillips curve

E.g., an increase in \( \pi^* \) shifts the short-run P.C. upward.
The sacrifice ratio

- To reduce inflation, policymakers can contract AD, causing unemployment to rise
- The sacrifice ratio measures: $-\Delta Y/\Delta \pi$
- SR: GDP that must be foregone to reduce inflation by 1\% (typical estimate is 5)
- If the ratio is 5, then reducing inflation by 4\% requires a loss of $4 \times 5 = 20\%$ of GDP (e.g. GDP can fall 10\% for two years...)

Forming expectations (2) Rational

With rational expectations:
People base their expectations on all available information, including information about current and prospective future policies.

How we believe people form expectations is important for shaping economic policy.

Why do we care about adaptive vs rational?

Painless disinflation?

- Proponents of rational expectations believe that the sacrifice ratio may be very small:
- Suppose $u = u^n$ and $\pi = \pi^e = 6\%$, and suppose the Fed announces that it will do whatever is necessary to reduce inflation from 6 to 2 percent as soon as possible.
- If the announcement is credible, then $\pi^e$ will fall, perhaps by the full 4 points.
- Then, $\pi$ can fall without an increase in $u$. 
Volcker disinflations

- 1981: $\pi = 9.7\%$
- 1985: $\pi = 3.0\%$

Total disinflation = 6.7%

<table>
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<th>year</th>
<th>$u$</th>
<th>$u^*$</th>
<th>$u-u^*$</th>
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<td>1982</td>
<td>9.5%</td>
<td>6.0%</td>
<td>3.5%</td>
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<tr>
<td>1983</td>
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Total 9.5%

The sacrifice ratio for Volcker disinflation

- Previous slide: $Du/u / D\pi/\pi = 9.5 / 6.7 = -1.4$
- So $Dy/y / D\pi/\pi = -2 \times -1.4 = 2.8\%$

- Sacrifice ratio = 2.8
- percentage points of GDP were lost for each 1 percentage point reduction in inflation.

The natural rate hypothesis

Our analysis of the costs of disinflation, and of economic fluctuations in the preceding chapters, is based on the natural rate hypothesis:

In the SR, AD changes can affect Y and L

In the LR, the economy behaves according to the classical model.
An alternative hypothesis: hysteresis

- **Hysteresis**: the long-lasting influence of history on variables such as the natural rate of unemployment.
- Negative shocks may increase \( u^* \), so economy may not fully recover:
  - The skills of cyclically unemployed workers deteriorate while unemployed, and they cannot find a job when the recession ends.
  - Cyclically unemployed workers may lose their influence on wage-setting; insiders (employed workers) may then bargain for higher wages for themselves. Then, the cyclically unemployed "outsiders" may become structurally unemployed when the recession ends.