Aggregate Supply

Intermediate Macroeconomic Theory
Macroeconomic Analysis

University of North Texas
1. Aggregate Supply Models
   - The Sticky Wage Model
   - The Sticky Price Model
   - The Imperfect Information Model
   - Summary & Implications

2. New Keynesian Economics

3. Inflation, Unemployment, and the Phillips Curve
Outline

1. Aggregate Supply Models
   - The Sticky Wage Model
   - The Sticky Price Model
   - The Imperfect Information Model
   - Summary & Implications

2. New Keynesian Economics

3. Inflation, Unemployment, and the Phillips Curve
Aggregate supply (AS) behaves very differently in the short run than in the long run.

Economists disagree about how best to explain AS in the SR.

A common conclusion that the SRAS curve is upward sloping due to frictions of macroeconomics.

Lucas AS curve: \( Y_t = \bar{Y} + \alpha(P_t - P_t^e) + \nu_t \)
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  1. Sticky wages
  2. Sticky prices
  3. Imperfect information

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**Aggregate supply (AS) behaves very differently in the short run than in the long run**

**Economists disagree about how best to explain AS in the SR**

**A common conclusion that the SRAS curve is upward sloping due to friction of macroeconomics**

**Lucas AS curve:** \( Y_t = \bar{Y} + \alpha(P_t - P^e_t) + v_t \)

- \( P^e \): the expected price level
- \( \alpha \): how much \( Y \) responds to unexpected change in \( P \)
- \( v \): aggregate supply shocks
Friction: the sluggish adjustment of nominal wage

Firms and workers set \( W_1 \) based on the target real wage (\( \omega_1 \)) and on their expectation of the price level (\( P^e_1 \)): \( W_1 = \omega_1 \times P^e_1 \)

Real wage: \( \frac{W_1}{P_1} = \omega_1 \times \frac{P_1}{P^e_1} \)

- \( P = P^e \): 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

\[ Y = \bar{Y} + \alpha(P - P^e) \]
Friction: the sluggish adjustment of nominal wage

→ long-term contracts, implicit agreements on limited wage changes

- Firms and workers set $W_1$ based on the target real wage ($\omega_1$) and on their expectation of the price level ($P_e^1$): $W_1 = \omega_1 \times P_e^1$

- Real wage: $\frac{W_1}{P_1} = \omega_1 \times \frac{P_1}{P_e^1}$

- $P = P_e^c$: unemployment and output are at their natural rates

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$\Rightarrow Y = \bar{Y} + \alpha (P - P_e^c)$
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Aggregate Supply Models
The Sticky Wage Model

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$\Rightarrow Y = \overline{Y} + \alpha(P - P^e)$
Friction: the prices of goods and services adjust slowly

An individual firm’s pricing decision rule: \[ p = P + \beta(Y - \bar{Y}) \]

Suppose two types of firms:

- Firms with flexible prices, set prices as above
- Firms with sticky prices, must set their price before they know how \( P \) and \( Y \) will turn out: \[ p = P^e + \beta(Y^e - \bar{Y}) \Rightarrow p = P^e \]

Let \( s \) denote the fraction of firms with sticky prices. Then, the overall price level is

\[ P = sP^e + (1 - s)[P + \beta(Y - \bar{Y})] \]

\[ Y = \bar{Y} + \alpha(P - P^e) \text{ where } \alpha = \frac{s}{(1-s)\beta} \]
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→ long-term contract, menu cost, firms not wishing to annoy customers with frequent price changes

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Friction: the prices of goods and services adjust slowly

An individual firm’s **pricing decision rule**: \( p = P + \beta(Y - \bar{Y}) \)

Suppose two types of firms:

1. Firms with **flexible** prices, set prices as above
2. Firms with **sticky** prices, must set their price before they know how \( P \) and \( Y \) will turn out: \( p = P^e + \beta(Y^e - \bar{Y}) \Rightarrow p = P^e \)

Let \( s \) denote the fraction of firms with sticky prices. Then, the overall price level is

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\[ Y = \bar{Y} + \alpha(P - P^e) \text{ where } \alpha = \frac{s}{(1-s)\beta} \]
Assumptions:

- Supply of each good depends on its relative price: the nominal price of the good divided by the overall price level.
- Supplier does not 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.
  - Supplier thinks her relative price has risen, so she produces more.
  - With many producers thinking this way, $Y$ will rise whenever $P$ rises above $P^e$.

$$Y = \bar{Y} + \alpha (P - P^e)$$
Aggregate Supply Models
The Imperfect Information Model

Assumptions:

1. All wages and prices are perfectly flexible, all markets are clear
2. Each supplier produces one good and consumes many goods
3. Each supplier knows the nominal price of the good she produces, but does not know the overall price level

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1. \( \frac{p}{P} \) \Rightarrow \text{produces more}
2. \( \frac{p}{P} \) \Rightarrow \text{produces less}

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$$Y = \bar{Y} + \alpha (P - P_e)$$
Although the three models of AS differ in their assumptions and emphasis, their implications for aggregate output are similar:

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Is money neutral?

- SR versus LR
- Expected ↑ \( M \) versus Unexpected ↑ \( M \) in the short run
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1. \( P = P^e \iff Y = \bar{Y} \)
2. \( P > P^e \iff Y > \bar{Y} \)
3. \( P < P^e \iff Y < \bar{Y} \)

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**Is money neutral?**

1. **SR versus LR**
   - LR monetary neutrality and SR monetary non-neutrality are perfectly compatible in this model.

2. **Expected \( \uparrow M \) versus Unexpected \( \uparrow M \) in the short run**
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2 New Keynesian Economics

3 Inflation, Unemployment, and the Phillips Curve
Traditional Keynesian theory:

New Keynesian Economics: develop more fully the Keynesian approach to economic fluctuations

⇒ Examining the microeconomics behind SR price adjustment

- Menu costs
- Coordination failure
- Staggering wages and prices
New Keynesian Economics

- **Traditional Keynesian theory:**
  1. abandon the classical presumption that wages and prices adjust quickly to equilibrate market
  2. Aggregate demand is a primary determinant of national income in the short run

- **New Keynesian Economics:** develop more fully the Keynesian approach to economic fluctuations
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New Keynesian Economics

- Traditional Keynesian theory:
- **New Keynesian Economics**: develop more fully the Keynesian approach to economic fluctuations
  1. Accept $IS - LM$ model as the theory of AD and try to refine the theory of AS
  2. How wages and prices behave in the short run by identifying more precisely the market imperfections that make wages and prices sticky and that cause the economy to deviate from its natural rate
  3. Stickiness makes the SRAS curve upward sloping
  4. Fluctuations in aggregate demand cause SR fluctuations in output and employment

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  ⇒ Examining the microeconomics behind SR price adjustment
  1. Menu costs
  2. Coordination failure
  3. Staggering wages and prices
Menu costs are the costs of changing prices

Externalities to price adjustment:

In the presence of menu costs,
Menu costs are the costs of changing prices

1. Costs of printing new menus
2. Mailing new catalogs

Externalities to price adjustment:

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Externalities to price adjustment:

In the presence of menu costs,
**Menu costs** are the costs of changing prices

**Externalities to price adjustment:**

- A price reduction by one firm causes the overall price level to fall (albeit slightly)
- This raises real money balances and increases aggregate demand, which benefits other firms

In the presence of menu costs,
- **Menu costs** are the costs of changing prices.
- Externalities to price adjustment:
- In the presence of menu costs,
Menu costs are the costs of changing prices

Externalities to price adjustment:

In the presence of menu costs,

- The firm ignore the externality when making its decision
- Sticky price may be optimal for the firm setting them even though they are undesirable for the economy as a whole
In recessions, output is low, workers are unemployed, and factories sit idle.

If all firms and workers would reduce their prices, then economy would return to full employment.

But no individual firm or worker would be willing to cut his price without knowing that others will cut their prices → Coordination Failure.

⇒ Prices remain high and the recession continues.
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Example:

Outcomes:

1. If each firm expects the other to cut its price, both will cut prices, resulting in the preferred outcome.
2. If each firm expects the other to maintain its prices, both will maintain their prices, resulting in the inferior outcome.

Coordination is often difficult because the number of firms setting prices is large.

⇒ Prices can be sticky simply because people expect them to be sticky, even though stickiness is in no one’s interest.
New Keynesian Economics
Recessions as Coordination Failure

Example:

1. A fall in money supply
2. Each firm must decide whether to cut its price
3. Each firm’s profit depends not only on its pricing decision but also on the decision made by other firms

Outcomes:

1. If each firm expects the other to cut its price, both will cut prices, resulting in the preferred outcome
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Coordination is often difficult because the number of firms setting prices is large

⇒ Prices can be sticky simply because people expect them to be sticky, even though stickiness is in no one’s interest
Example:

<table>
<thead>
<tr>
<th>Firm 1</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Firm 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cut Price</td>
<td>Firm 1 makes $30</td>
<td>Firm 1 makes $5</td>
</tr>
<tr>
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<td>Firm 2 makes $15</td>
</tr>
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The staggering of wages and prices

- All wages and prices do not adjust at the same time

- Staggering makes the overall level of wages and prices adjust gradually, even when individual wages and prices changes frequently

- Example: AD shock on May 10th
  - Synchronized price setting: every firm adjusts its price on the first day of every month
  - Staggered price setting: half the firms set prices on the first day of each month and half on the fifteenth

→ Price level rises slowly as the result of small price increases on the 1st and the 15th of each month because no firm wishes to be the first to post a substantial price increase
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  - Half the firms raise their prices on the 15th (but probably raise prices not very much).
  - The other firms will make little adjustment when their turn comes.

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   - The Sticky Wage Model
   - The Sticky Price Model
   - The Imperfect Information Model
   - Summary & Implications

2. New Keynesian Economics

3. Inflation, Unemployment, and the Phillips Curve
The goals of economic policy makers

⇒ Tradeoff between inflation and unemployment in the short run

The Phillips Curve: \( \pi_t = \pi^e_t - \gamma(u_t - u^n) + v_t \)

The causes of rising and falling inflation

Is money neutral?

- SR versus LR
- Expected ↑ \( M \) versus Unexpected ↑ \( M \) in the short run
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- $\pi^e_t$: expected inflation
- $u_t - u^n$: cyclical unemployment
- $\nu$: supply shocks

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Cost-push inflation: adverse supply shocks typically raise production costs and induce firms to raise prices, “pushing” inflation up

Demand-pull inflation: positive shocks to aggregate demand cause unemployment to fall below its natural rate, which “pulls” the inflation rate up

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