**Unemployment and Inflation, Part 3**

**Agenda**
- Inflation and the Triangle Model.
- The DAD – SAS Model.
- Inflation Adjustment and the Attainment of General Equilibrium.
- Inflation, Disinflation, and Deflation.

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**Inflation and the triangle model**

- Definition of inflation:
  \[
  \pi_t = \left( \frac{P_t - P_{t-1}}{P_{t-1}} \right) \times 100
  \]
  - Where \( P \) is the general price level.

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**Inflation and the triangle model**

- Three explicit factors for explaining inflation.
  - Called the triangle model.
  - Inflation, \( \pi \), depends on 3 components:
    - Inflationary expectations, \( \pi^e \).
    - Excess demand, \( \pi^{ED} \).
    - Inflation shocks, \( \pi^z \).
• Inflationary expectations, $\pi^e$:

- If people expect a particular level of inflation, that level will likely occur even without any pressure from the output or labor market.

Modeling $\pi^e$ is extremely difficult.

- Rational expectations
  - Based on forward-looking behavior.

- Adaptive expectations
  - Based on backward-looking behavior
  - Dependent on effect of staggered wage and price behavior.

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• Excess demand inflation, $\pi^{ED}$:

- Excess demand is measured by the output gap.

$$\pi^{ED} = f( Y - Y^*)$$

- Where $f > 0$.

  - The bigger is $f$, the faster is the change in $\pi_t$ for any given output gap.
  - The bigger is the output gap, the faster is the change in $\pi_t$ for any given $f$. 

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• Key Assumption: Inflation expectations are formed by simple adaptive expectations.

$$\pi^e = \pi_{t-1}$$
Inflation and the triangle model

• Excess demand inflation, $\pi^{ED}$:

  ➢ **Key Assumption**: Because of wage and price stickiness, current excess demand inflation depends on lagged excess demand.

  $$\pi^{ED}_t = f(Y_{t-1} - Y^*_{t-1})$$

• Inflation shocks, $\pi^Z$:

  ➢ Inflation shocks are assumed to be exogenous.
  - Changes in input costs that are independent of demand:
    - Changes in imported goods prices, especially oil.
    - Price versus exchange rate.
    - Changes in competitive pressures.

• Inflation:

  $$\pi_t = \pi_{t-1} + f(Y_{t-1} - Y^*_{t-1}) + Z_t$$

  ➢ Expected inflation, plus
  ➢ Excess demand inflation, plus
  ➢ Inflation shocks.

• This is also the **new** SRAS curve.
The SRAS curve

- The original SRAS curve was based on $P$-level adjustment

- The new SRAS curve is now based on $\pi$ adjustment

The Phillips curve and the SRAS curve

- The expectations-augmented Phillips curve:
  \[ \pi = \pi' - f(u - \overline{u}) \]

- Okun’s Law:
  \[ \frac{(Y^* - Y)}{Y^*} = 2(u - \overline{u}) \]
  or
  \[ u - \overline{u} = 0.5 \frac{(Y^* - Y)}{Y^*} \]

The Phillips curve and the SRAS curve

- Short-run Aggregate Supply (SRAS) curve:
  \[ \pi = \pi' + g(Y - Y^*) \]
  - If \[ \pi_t = \pi_{t-1} \]
  - then \[ \pi_t = \pi_{t-1} + g(Y_{t-1} - Y^*_{t-1}) \]
The Phillips curve and the SRAS curve

- Short-run Aggregate Supply (SRAS) curve:
  \[ \pi_t = \pi_{t-1} + g(Y_{t-1} - Y^*_{t-1}) \]
  - Adding inflation shocks:
    \[ \pi_t = \pi_{t-1} + g(Y_{t-1} - Y^*_{t-1}) + Z_t \]
  - and we have the new SRAS curve.

The Phillips curve and the SRAS curve

- Short-run Aggregate Supply (SRAS) curve:
  \[ \pi_t = \pi_{t-1} + g(Y_{t-1} - Y^*_{t-1}) + Z_t \]
  - Inflation equals:
    - Expected inflation, plus
    - Excess demand inflation, plus
    - Inflation (or supply) shocks.

The new SRAS Curve

The AD Curve

- The Aggregate Demand (AD) curve is based on levels of the underlying variables.
  - The level of C^d, I^d, G, T, L, and M^s \(\Rightarrow\) level of Y and P.
The **DAD Curve**

- The *Dynamic Aggregate Demand* (DAD) curve is based on growth rates of the underlying variables.
  - Growth rate of $C^d$, $I^d$, $G$, $T$, $L$, and $M^s$ $\Rightarrow$ growth rate of $Y$ and $P$ (or $\pi$).

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The **DAD Curve**

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General equilibrium in the **DAD-SAS model**

- $\pi$ adjustment can occur because of:
  - Demand shocks (shifts in the DAD curve),
  - Inflation shocks (shifts in the SRAS curve), or
  - Supply shocks (shifts in both the SRAS and LRAS curve).
The DAD–SAS model and $\pi$ adjustment

- Types of DAD Shock:
  - Favorable (increases $Y$ relative to $Y^*$):
    - Rightward shifts in the IS curve and/or the LM curve that increases output relative to full-employment output.
  - Unfavorable (decreases $Y$ relative to $Y^*$):
    - Leftward shifts in the IS curve and/or the LM curve that decreases output relative to full-employment output.

An increase in government purchases:

- In Year 0, the economy is in general equilibrium.
  - Denote the general equilibrium level of output by $Y^*$.

The DAD–SAS model and $\pi$ adjustment

- An increase in government purchases:
  - In Year 1, government purchases increase.
    - Assume Ricardian equivalence does NOT hold.
    - An increase in government purchases shifts both the IS and DAD curves to the right.
The DAD–SAS model and $\pi$ adjustment

• An increase in government purchases:

  ➢ In Year 1, the increase in government purchases increases output but leaves inflation unchanged.

    • Short-run equilibrium at the DAD and SRAS intersection.
      – The labor market is temporarily out of equilibrium.

    • $\pi$ adjustment does NOT take place in Year 1 because of:
      – Lagged adjustment to excess demand, and
      – Inflationary expectations (which are lagged inflation).

• An increase in government purchases:

  ➢ In Year 2, inflation begins to rise.

    • In Year 2, the SRAS curve shifts up because of excess aggregate demand in Year 1, i.e., $Y_1 > Y^*_1$.

      – How far the SRAS curve shifts up depends on the explicit inflation adjustment process for the economy.

      – Generally it is a multiyear process dependent on the amount of excess aggregate demand.

• An increase in government purchases:

  ➢ In Year 2, inflation begins to rise.

    • Higher inflation reduces the real money supply, $M/P$.

      – Alternatively, the purchasing power of the nominal money supply, $M^*$, has been reduced.

    • A lower real money supply shifts the LM curve to the left, raising the real interest rate.

• An increase in government purchases:

  ➢ In Year 2, inflation begins to rise.

    • A higher real interest rate will:

      – Reduce interest-sensitive spending.
      – Reduce output and employment, and
      – Raise the unemployment rate.
The DAD–SAS model and $\pi$ adjustment

- An increase in government purchases:
  - In Year 3, inflation continues to rise.
    - In Year 3, the SRAS curve shifts up again because of excess aggregate demand in Year 2, i.e., $Y_3 > Y^*$. 
      - Because excess aggregate demand in Year 2 is less than in Year 1, the upward shift of the SRAS in Year 3 will be smaller than in Year 2.

- In Year 4 and beyond, this process continues until general equilibrium is re-established in both the IS-LM and DAD-SAS models.
  - Output will be at its full-employment level.
  - The real money supply is lower.
  - The real interest rate is higher.
  - Inflation will be permanently higher.

The DAD–SAS model and $\pi$ adjustment

- Results of demand shocks:
  - The economy reaches $Y^*$ through the repetition of $\pi$ adjustment year after year.
  - Each year, conditions in the previous year determine $\pi$ in the current year:
    - Inflationary expectations and
    - Excess/insufficient demand.

The DAD–SAS model and $\pi$ adjustment

- Types of Inflation Shocks:
  - Unfavorable (increases $\pi$):
    - Higher imported goods and/or raw material prices.
      - Especially oil.
      - Weaker currency.
    - Reduced competitive pressures.
      - Exogenous wage push.
      - Reduced globalization.
      - Increased regulation.
The DAD–SAS model and $\pi$ adjustment

• Types of Inflation Shock:
  ➢ Favorable (reduces $\pi$):
    • Lower imported goods or raw material prices.
      ➢ Especially oil.
      ➢ Stronger currency.
    • Increased competitive pressures.
      ➢ Globalization.
      ➢ Decreased regulation.

• A short-run adverse supply shock:
  ➢ In Year 0, the economy is in general equilibrium.

A short-run adverse inflation shock

\[ \pi \]
\[ Y^* \]
\[ \pi_0 \]
\[ SAS_0 \]
\[ DAD_0 \]
\[ Y_0 \]
\[ Y \]

The DAD–SAS model and $\pi$ adjustment

• A short-run adverse inflation shock:
  ➢ In Year 1, imported goods inflation increases.
    • An increase in imported goods inflation immediately increases the inflation rate and shifts the SRAS curve up.
    • Higher inflation reduces the real money supply, $M/P$.
    • A lower real money supply shifts the LM curve shifts to the left, raising the real interest rate.
The DAD–SAS model and \( \pi \) adjustment

- A short-run adverse inflation shock:
  - In Year 1, the increase in imported goods inflation raises the inflation rate and decreases output.
    - A higher real interest rate will:
      - Reduce interest-sensitive spending,
      - Reduce output and employment, and
      - Raise the unemployment rate.

- In Year 2, inflation will begin to fall.
  - The SRAS curve shifts down because of the insufficient aggregate demand in Year 1, i.e., \( Y_1 < Y^* \).
    - As the SRAS curve shifts down, inflation falls.
    - A lower price level increases the real money supply.
    - A higher real money supply shifts the LM curve to the right, reducing the real interest rate.

- In Year 3 and beyond, inflation continues to fall until general equilibrium is re-established in both the IS-LM and DAD-SAS models.
  - Output will be at its full-employment level.
  - The real money supply is back to its original level.
  - The real interest rate is back to its original level.
  - Inflation will be back at its original level.
The DAD–SAS model and $\pi$ adjustment

• Results of inflation shocks:
  - The economy reaches $Y^*$ through the repetition of $\pi$ adjustment year after year.
  - Each year, conditions in the previous year determine $\pi$ in the current year:
    • Inflationary expectations and
    • Excess/insufficient demand.

• Summary of (Short-term) Effects:
  - Favorable DAD Shock
    • Higher $Y$ (relative to $Y^*$) and $\pi$.
  - Unfavorable DAD Shock
    • Lower $Y$ (relative to $Y^*$) and $\pi$.
  - Favorable SAS Shock
    • Higher $Y$ (relative to $Y^*$) and lower $\pi$.
  - Unfavorable SAS Shock
    • Lower $Y$ (relative to $Y^*$) and higher $\pi$.

• (Long-run) Supply shocks:
  - Supply shocks occur when there are permanent changes in:
    • Productivity.
    • Competitive pressures.
  - (Long-run) Supply shocks change $Y^*$.
    • Because $Y^*$ changes, the $\pi$ adjustment process is altered.
    • and permanently change $\pi$.

• A long-run adverse supply shock:
  - In Year 0, the economy is in general equilibrium.
An adverse supply shock

The DAD–SAS model and $\pi$ adjustment

- A long-run adverse supply shock:
  - In Year 1, there is a decrease in productivity.

  - A decrease in productivity shifts BOTH the SRAS curve up and the LRAS curve (and the $FE$ line) to the left.
    - The short-run effects could be:
      - Greater than,
      - Equal to, or
      - Less than the long-run effects.

The DAD–SAS model and $\pi$ adjustment

- A long-run adverse supply shock:
  - In Year 1, the upward shift of the SRAS curve:
    - Increases inflation,
    - Reduces the real money supply,
    - Shifts the $LM$ curve to the left,
    - Raises the real interest rate,
    - Reduces interest-sensitive spending, and
    - Reduces output and employment.

The DAD–SAS model and $\pi$ adjustment

- A long-run adverse supply shock:
  - In Year 1, the leftward shift of the LRAS curve also reduces the economy’s full-employment level of output.
    - Which reduces general equilibrium output.
The **DAD–SAS model and \( \pi \) adjustment**

- A long-run adverse supply shock:
  - In Year 2, if the short-run effects are less than the long-run effects, then:
    - Output in Year 1 is greater than the new, lower full-employment level of output, i.e., \( Y_1 > Y^*_{1} \).
    - So there is excess aggregate demand and the SRAS curve will shift up and inflation will rise.
  - This process continues until general equilibrium is re-established.

- An adverse supply shock:
  - The economy moves to its new \( Y^* \) and results in a permanent change in \( \pi \).
  - It is likely that the new \( Y^* \) will be reached through a repetition of \( \pi \) adjustment year after year.
  - Each year, conditions in the previous year determine \( \pi \) in the current year:
    - Inflationary expectations and
    - Excess/insufficient demand.

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**Aggregate Demand and Aggregate Supply**

- A long-run adverse supply shock:
  - Once general equilibrium has been re-established:
    - Output is at its new, lower full-employment level.
    - Inflation will be permanently higher.

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**Inflation & Deflation**

- The key to understanding rates of change in inflation is the \( \pi \) adjustment equation.

\[
\pi_t = \pi_{t-1} + g(Y_{t-1} - Y^*_{t-1}) + Z_t
\]

- This equation can describe the process of:
  - Steady inflation,
  - Accelerating inflation,
  - Disinflation, or
  - Deflation
Inflation, disinflation and deflation

- Stable inflation, $\pi_t = \pi_{t-1}$:
  - Inflation stabilizes when $Y_{t-1} = Y^*_{t-1}$.
    - $u = \overline{u}$

- Accelerating inflation, $\pi_t > \pi_{t-1}$:
  - Inflation accelerates when $Y_{t-1} > Y^*_{t-1}$.
    - $u < \overline{u}$

- Disinflation, $\pi_t < \pi_{t-1}$:
  - Inflation decelerates when $Y_{t-1} < Y^*_{t-1}$.
    - $u > \overline{u}$
  - Policy makers can choose a disinflationary path.
    - The deeper the recession, the faster the disinflation
    - The shallower the recession, the slower disinflation
    - Either way, $u$ must rise above $\overline{u}$.

- Deflation, $\pi_t < 0$:
  - Prices decline generally requires that $Y_{t-1}$ be substantially below $Y^*_{t-1}$.
    - $u > \overline{u}$ by a substantial amount and
    - for a sustained period of time.