IN CHAPTER 15

- how to incorporate dynamics into the AD-AS model we previously studied
- how to use the dynamic AD-AS model to illustrate long-run economic growth
- how to use the dynamic AD-AS model to trace out the effects over time of various shocks and policy changes on output, inflation, and other endogenous variables

Output:
The Demand for Goods and Services

$$Y_t = \bar{Y}_t - \alpha(r_t - \rho) + \varepsilon_t$$

output

natural level of output

real interest rate

$\alpha > 0, \ \rho > 0$

Negative relation between output and interest rate, same intuition as *IS* curve.

Output:
The Demand for Goods and Services

$$Y_t = \bar{Y}_t - \alpha(r_t - \rho) + \varepsilon_t$$

measures the interest-rate sensitivity of demand

"Natural rate of interest."
In absence of demand shocks,
$Y_t = \bar{Y}_t$ *when* $r_t = \rho$

demand shock, random and zero on average

The Real Interest Rate: The Fisher Equation

$$r_t = i_t - E_t \pi_{t+1}$$

ex ante (i.e. expected) real interest rate

nominal interest rate

expected inflation rate

π_{t+1} = increase in price level from period t to $t+1$, not known in period t

$E_t \pi_{t+1}$ = expectation, formed in period t, of inflation from t to $t+1$

Inflation:
The Phillips Curve

$$\pi_t = E_{t-1}\pi_t + \phi(Y_t - \bar{Y}_t) + \nu_t$$

current inflation

previously expected inflation

$\phi > 0$ *indicates how much inflation responds when output fluctuates around its natural level*

supply shock, random and zero on average

Expected Inflation: Adaptive Expectations

$$E_t \pi_{t+1} = \pi_t$$

For simplicity, we assume people expect prices to continue rising at the current inflation rate.

The Nominal Interest Rate: The Monetary-Policy Rule

$$i_t = \pi_t + \rho + \theta_\pi(\pi_t - \pi_t^*) + \theta_Y(Y_t - \bar{Y}_t)$$

nominal interest rate, set each period by the central bank

natural rate of interest

central bank's inflation target

$$\theta_\pi > 0, \ \theta_Y > 0$$

The Nominal Interest Rate: The Monetary-Policy Rule

$$i_t = \pi_t + \rho + \theta_\pi(\pi_t - \pi_t^*) + \theta_Y(Y_t - \bar{Y}_t)$$

measures how much the central bank adjusts the interest rate when inflation deviates from its target

measures how much the central bank adjusts the interest rate when output deviates from its natural rate

CASE STUDY
The Taylor rule

- Economist John Taylor proposed a monetary policy rule very similar to ours:

$$i_{ff} = \pi + 2 + 0.5(\pi - 2) - 0.5(\text{GDP gap})$$

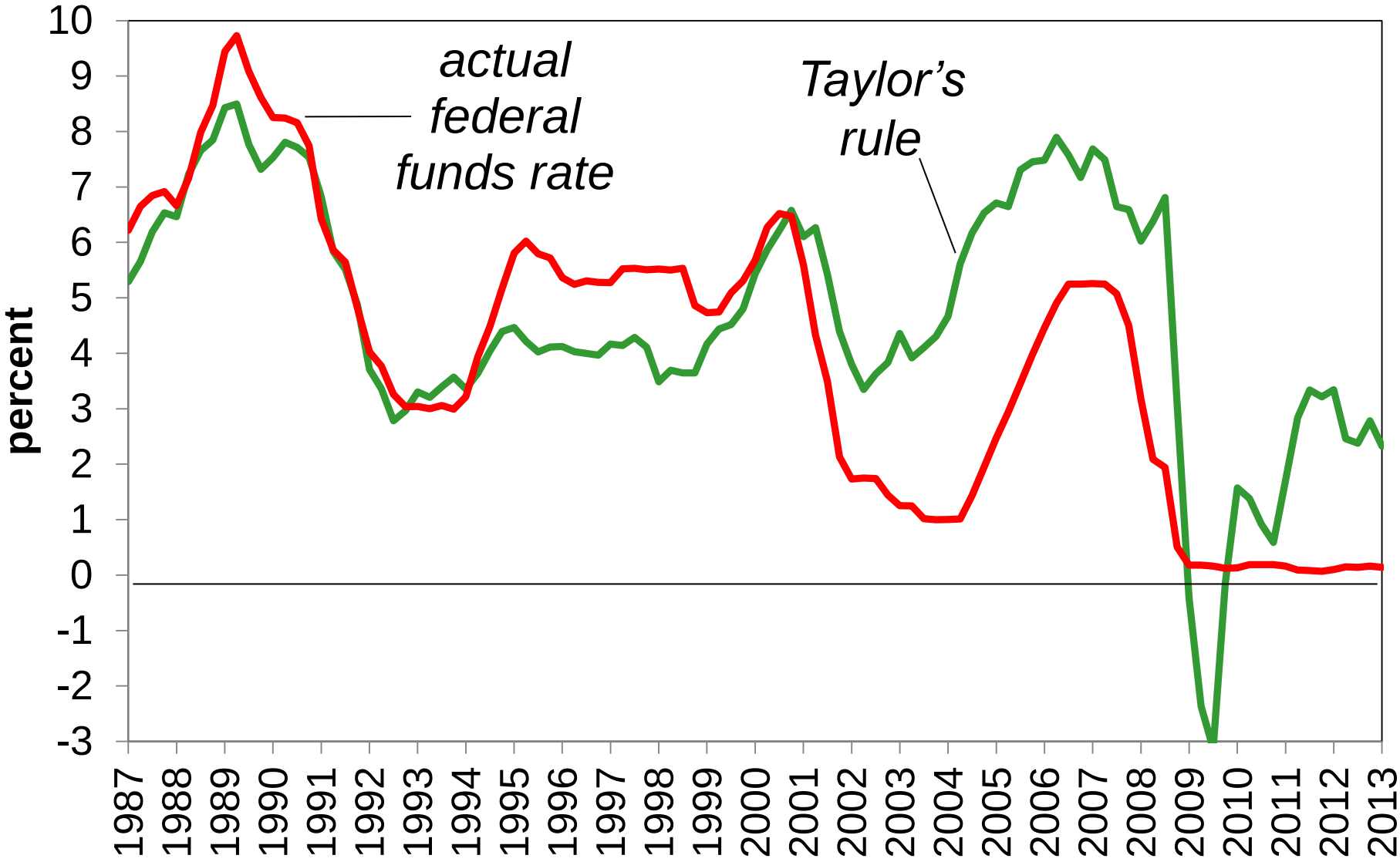
where

  - i_{ff} = nominal federal funds rate target
  - GDP gap = $100 \times \frac{\bar{Y} - Y}{\bar{Y}}$

    = percent by which real GDP is below its natural rate

- The Taylor rule matches Fed policy fairly well….

CASE STUDY
The Taylor rule



The model's variables and parameters

- Endogenous variables:

Y_t = Output

π_t = Inflation

r_t = Real interest rate

i_t = Nominal interest rate

$E_t \pi_{t+1}$ = Expected inflation

The model's variables and parameters

- Exogenous variables:

$\bar{Y}_t$ = Natural level of output

π_t^* = Central bank's target inflation rate

ε_t = Demand shock

ν_t = Supply shock

- Predetermined variable:

π_{t-1} = Previous period's inflation

The model's variables and parameters

- Parameters:

α = Responsiveness of demand to the real interest rate

ρ = Natural rate of interest

ϕ = Responsiveness of inflation to output in the Phillips Curve

θ_π = Responsiveness of i to inflation in the monetary-policy rule

θ_Y = Responsiveness of i to output in the monetary-policy rule

The model's long-run equilibrium

- The normal state around which the economy fluctuates.
- Two conditions required for long-run equilibrium:
  - There are no shocks: $\varepsilon_t = \nu_t = 0$
  - Inflation is constant: $\pi_{t-1} = \pi_t$

The model's long-run equilibrium

- Plugging the preceding conditions into the model's five equations and using algebra yields these long-run values:

$$Y_t = \bar{Y}_t$$

$$r_t = \rho$$

$$\pi_t = \pi_t^*$$

$$E_t \pi_{t+1} = \pi_t^*$$

$$i_t = \rho + \pi_t^*$$

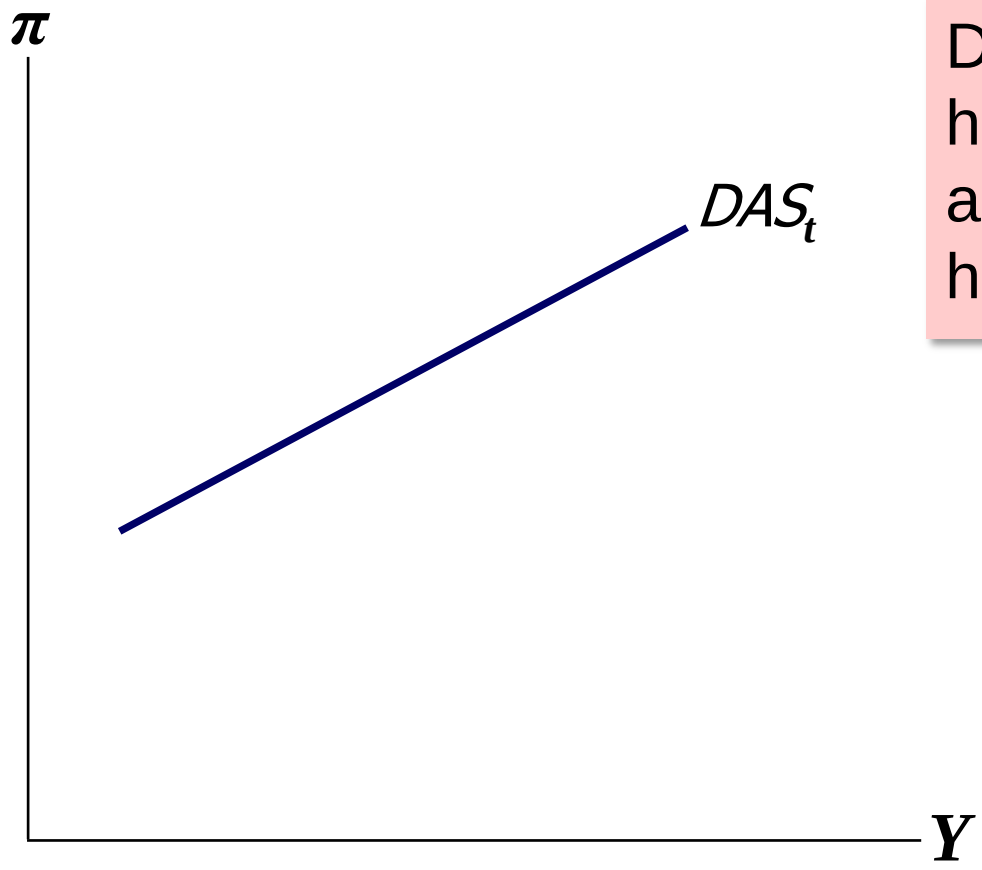
The Dynamic Aggregate Supply Curve

- The DAS curve shows a relation between output and inflation that comes from the Phillips Curve and Adaptive Expectations:

$$\pi_t = \pi_{t-1} + \phi(Y_t - \bar{Y}_t) + \nu_t \qquad (DAS)$$

The Dynamic Aggregate Supply Curve

$$\pi_t = \pi_{t-1} + \phi(Y_t - \bar{Y}_t) + \nu_t$$



DAS slopes upward: high levels of output are associated with high inflation.

DAS shifts in response to changes in the natural level of output, previous inflation, and supply shocks.

The Dynamic Aggregate Demand Curve

- To derive the DAD curve, we will combine four equations and then eliminate all the endogenous variables other than output and inflation.

  Start with the demand for goods and services:

$$Y_t = \bar{Y}_t - \alpha(r_t - \rho) + \varepsilon_t$$

using the Fisher eq'n

$$Y_t = \bar{Y}_t - \alpha(i_t - E_t \pi_{t+1} - \rho) + \varepsilon_t$$

The Dynamic Aggregate Demand Curve

result from previous slide

$$Y_t = \bar{Y}_t - \alpha(i_t - E_t\,\pi_{t+1} - \rho) + \varepsilon_t$$

using the expectations eq'n

$$Y_t = \bar{Y}_t - \alpha(i_t - \pi_t - \rho) + \varepsilon_t$$

using monetary policy rule

$$Y_t = \bar{Y}_t - \alpha[\pi_t + \rho + \theta_\pi(\pi_t - \pi_t^*) + \theta_Y(Y_t - \bar{Y}_t) - \pi_t - \rho] + \varepsilon_t$$

$$Y_t = \bar{Y}_t - \alpha[\theta_\pi(\pi_t - \pi_t^*) + \theta_Y(Y_t - \bar{Y}_t)] + \varepsilon_t$$

The Dynamic Aggregate Demand Curve

result from previous slide

$$Y_t = \bar{Y}_t - \alpha[\theta_\pi(\pi_t - \pi_t^*) + \theta_Y(Y_t - \bar{Y}_t)] + \varepsilon_t$$

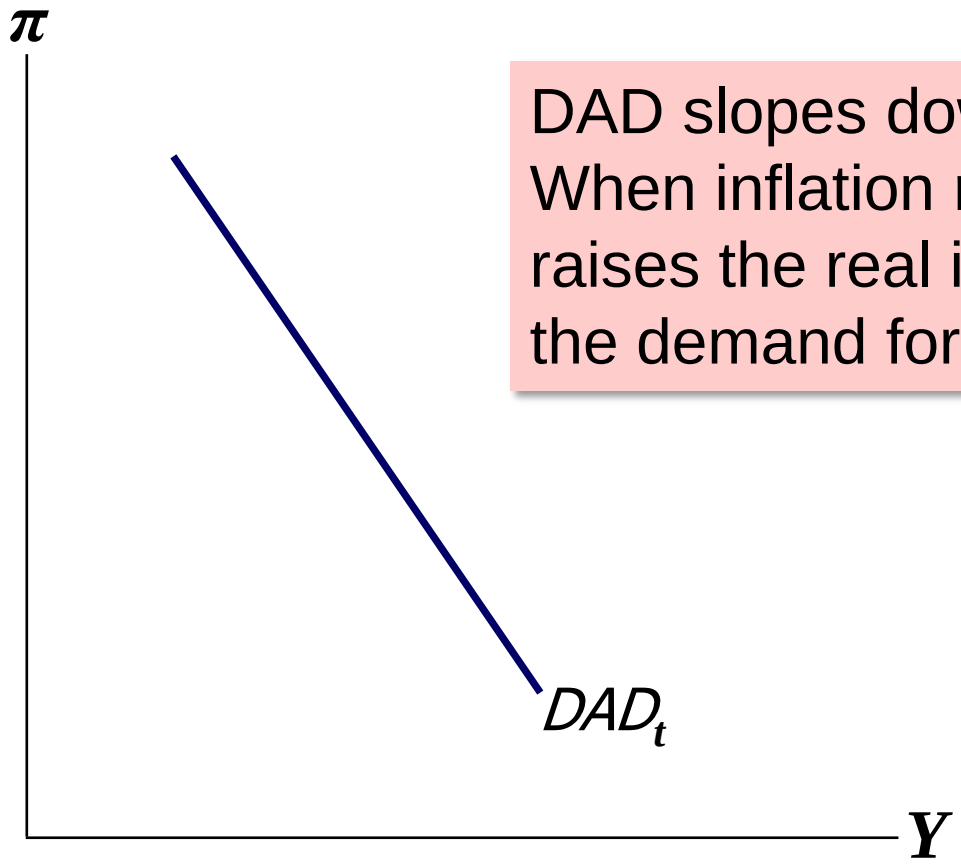
combine like terms, solve for Y

$$Y_t = \bar{Y}_t - \mathrm{A}(\pi_t - \pi_t^*) + \mathrm{B}\varepsilon_t, \qquad (DAD)$$

where $\mathrm{A} = \dfrac{\alpha\theta_\pi}{1+\alpha\theta_Y} > 0, \quad \mathrm{B} = \dfrac{1}{1+\alpha\theta_Y} > 0$

The Dynamic Aggregate Demand Curve

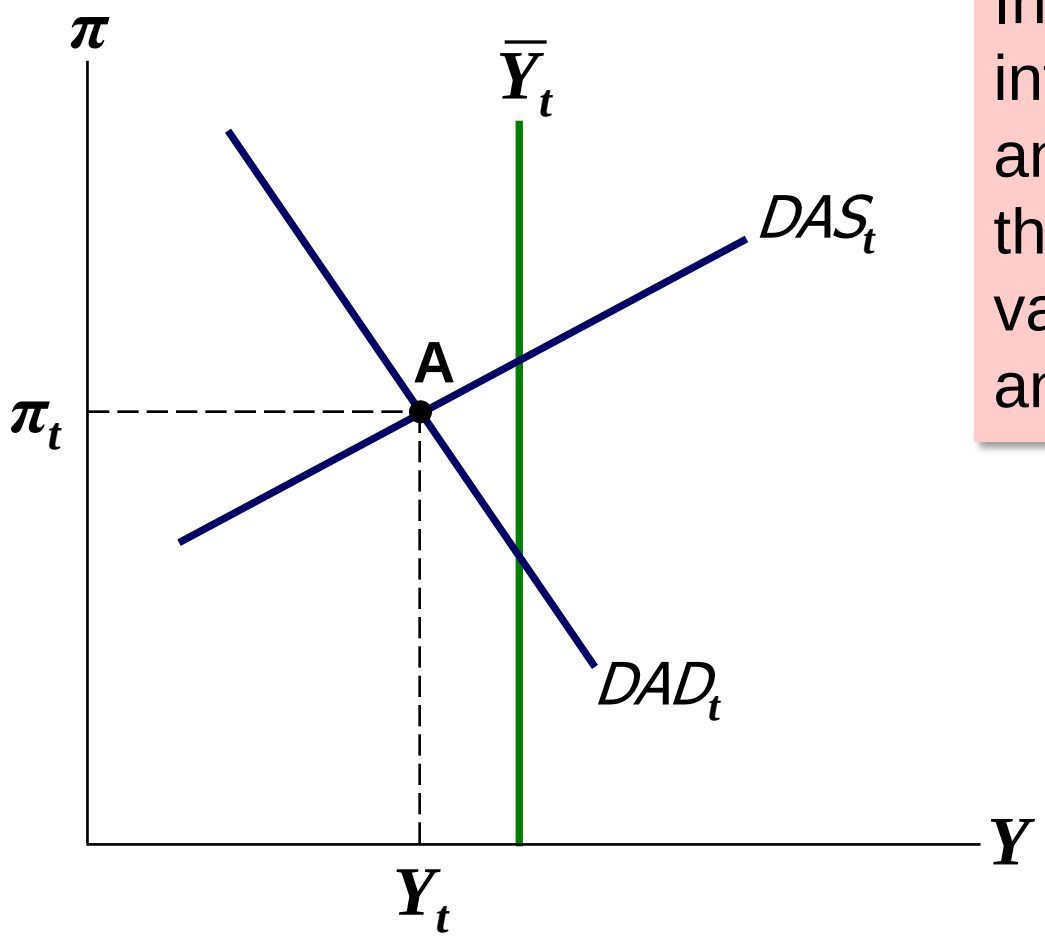
$$Y_t = \bar{Y}_t - \mathrm{A}(\pi_t - \pi_t^*) + \mathrm{B}\varepsilon_t$$



DAD slopes downward:
When inflation rises, the central bank raises the real interest rate, reducing the demand for goods & services.

DAD shifts in response to changes in the natural level of output, the inflation target, and demand shocks.

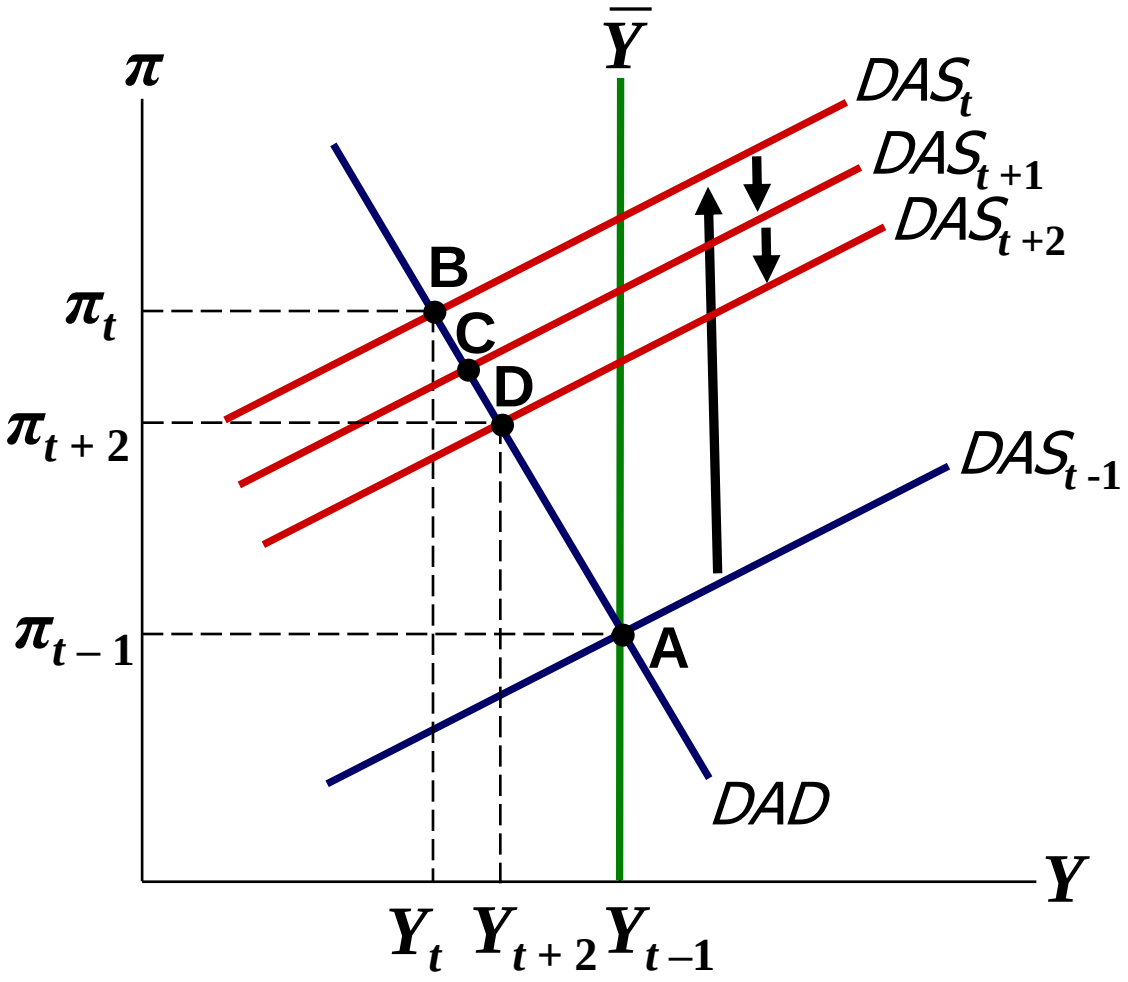
The short-run equilibrium



In each period, the intersection of DAD and DAS determines the short-run eq'm values of inflation and output.

In the eq'm shown here at **A**, output is below its natural level.

A shock to aggregate supply



Period t:
Supply shock ($v > 0$) shifts DAS upward; inflation rises, central bank responds by raising real interest rate, output falls.

Parameter values for simulations

$$\bar{Y}_t = 100$$

$$\pi_t^* = 2.0$$

$$\alpha = 1.0$$

$$\rho = 2.0$$

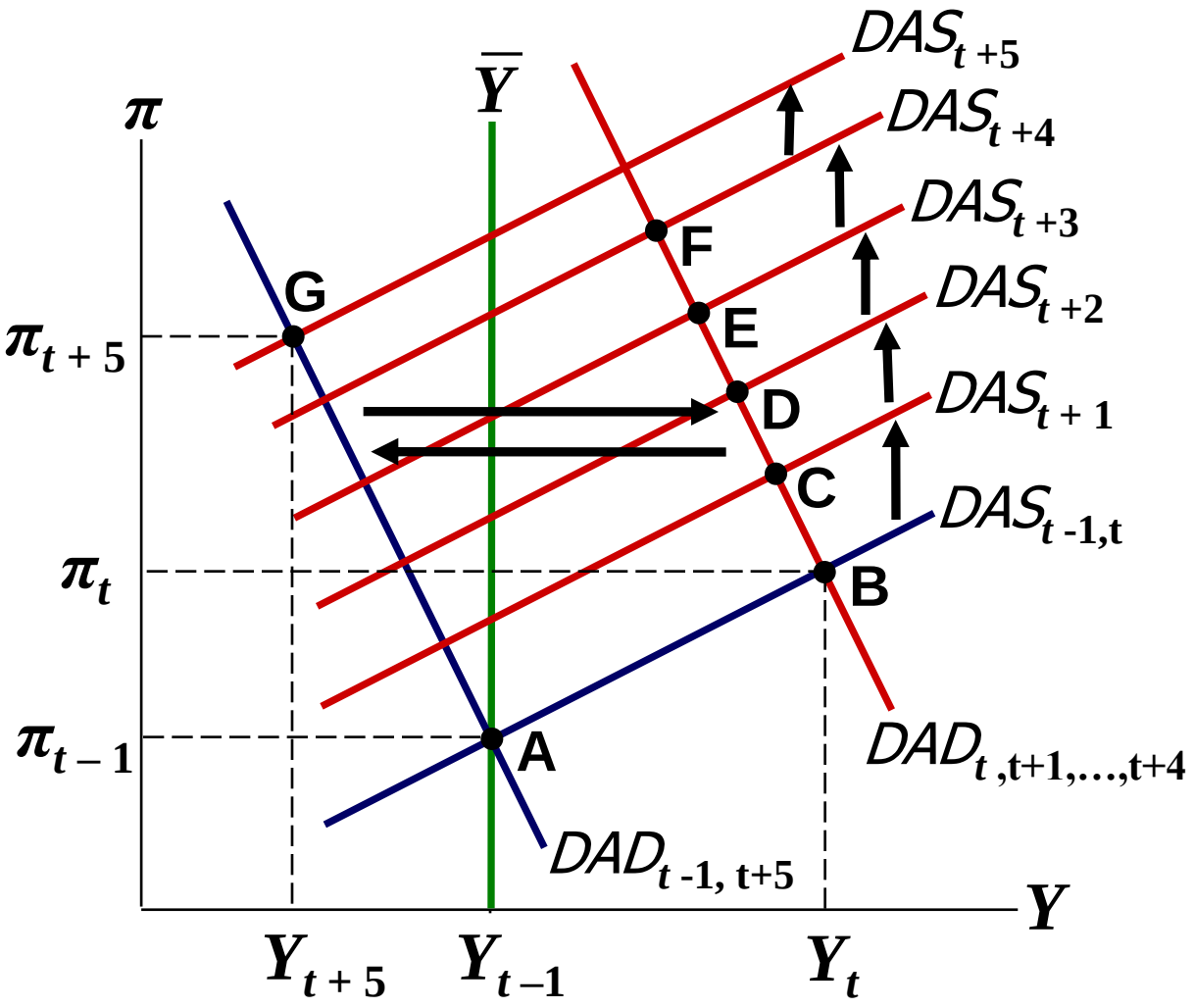
$$\phi = 0.25$$

$$\theta_\pi = 0.5$$

$$\theta_Y = 0.5$$

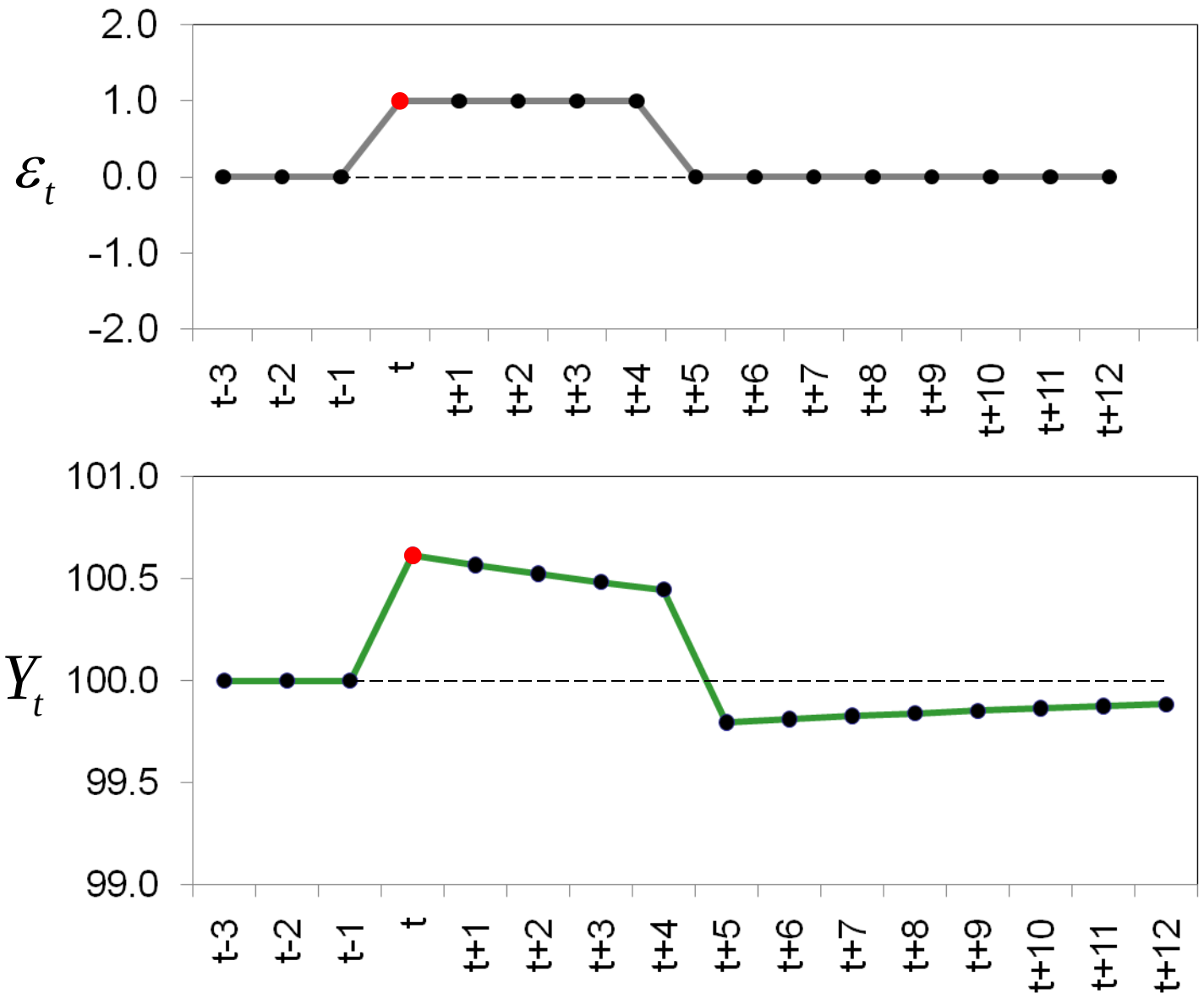
The following graphs are called ***impulse response functions***. They show the *response* of the endogenous variables to the *impulse* (the shock).

A shock to aggregate demand



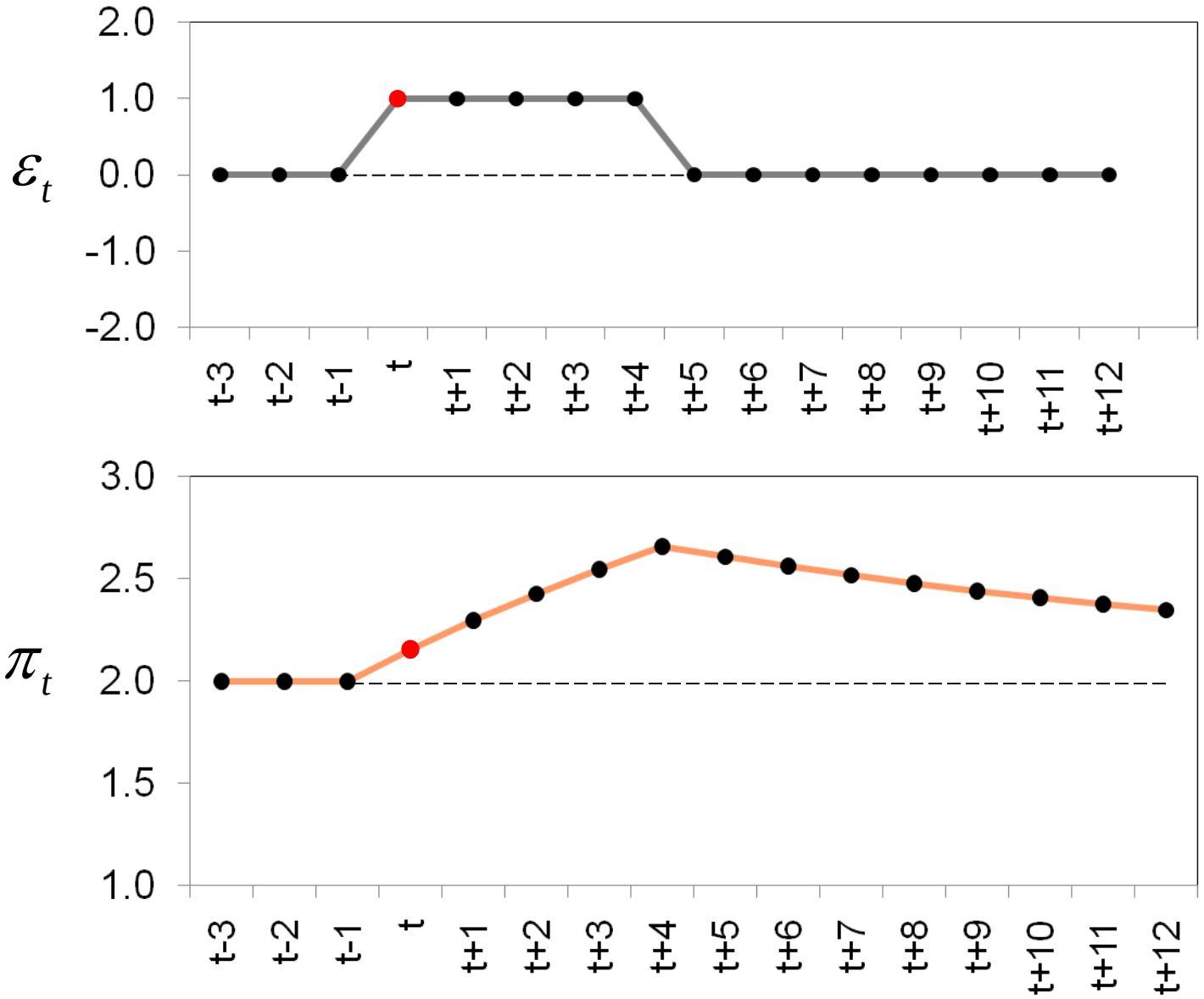
Period t: Positive demand shock ($\varepsilon > 0$) shifts AD to the right; output and inflation rise.

The dynamic response to a demand shock



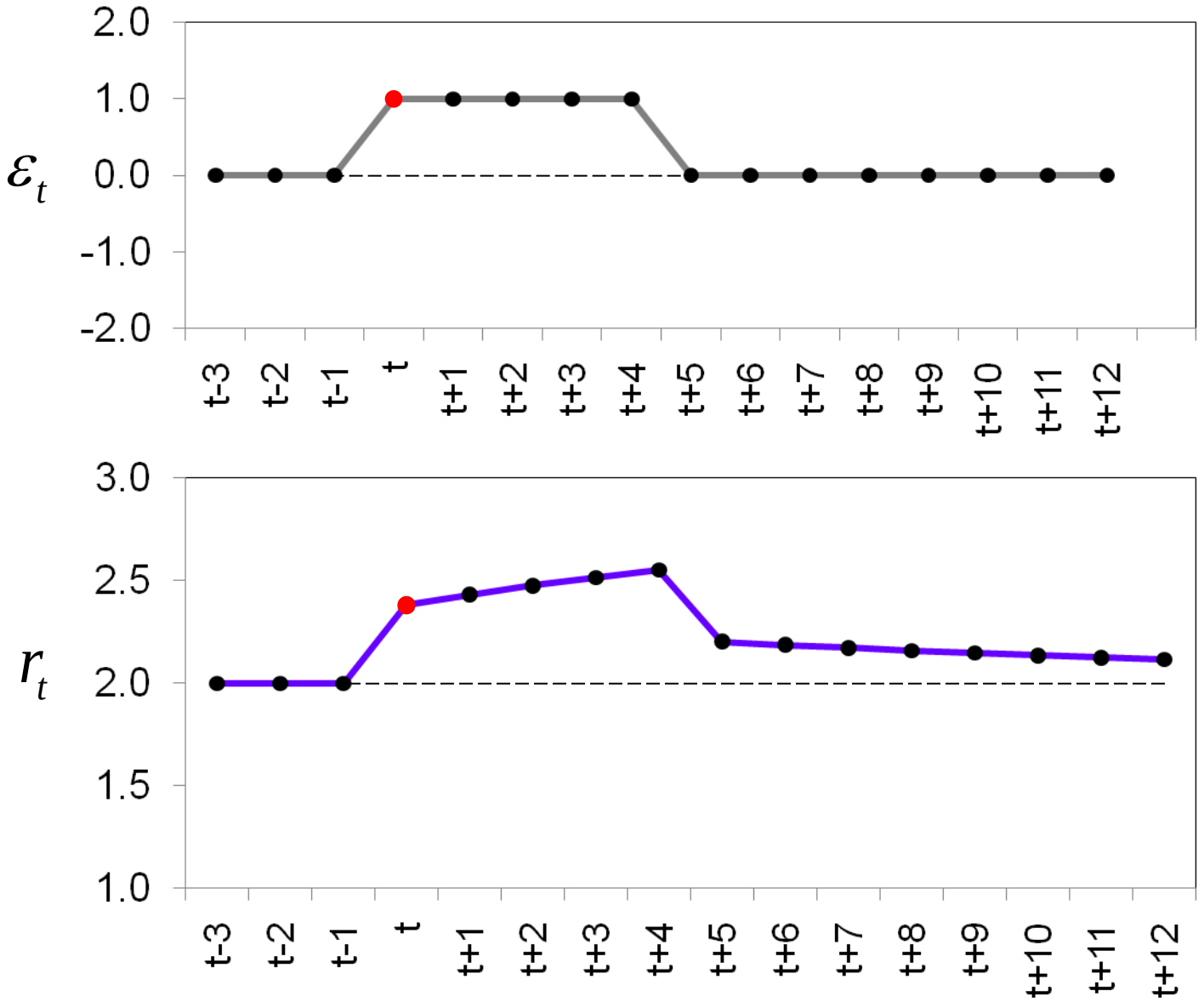
The demand shock raises output for five periods. When the shock ends, output falls below its natural level and recovers gradually.

The dynamic response to a demand shock



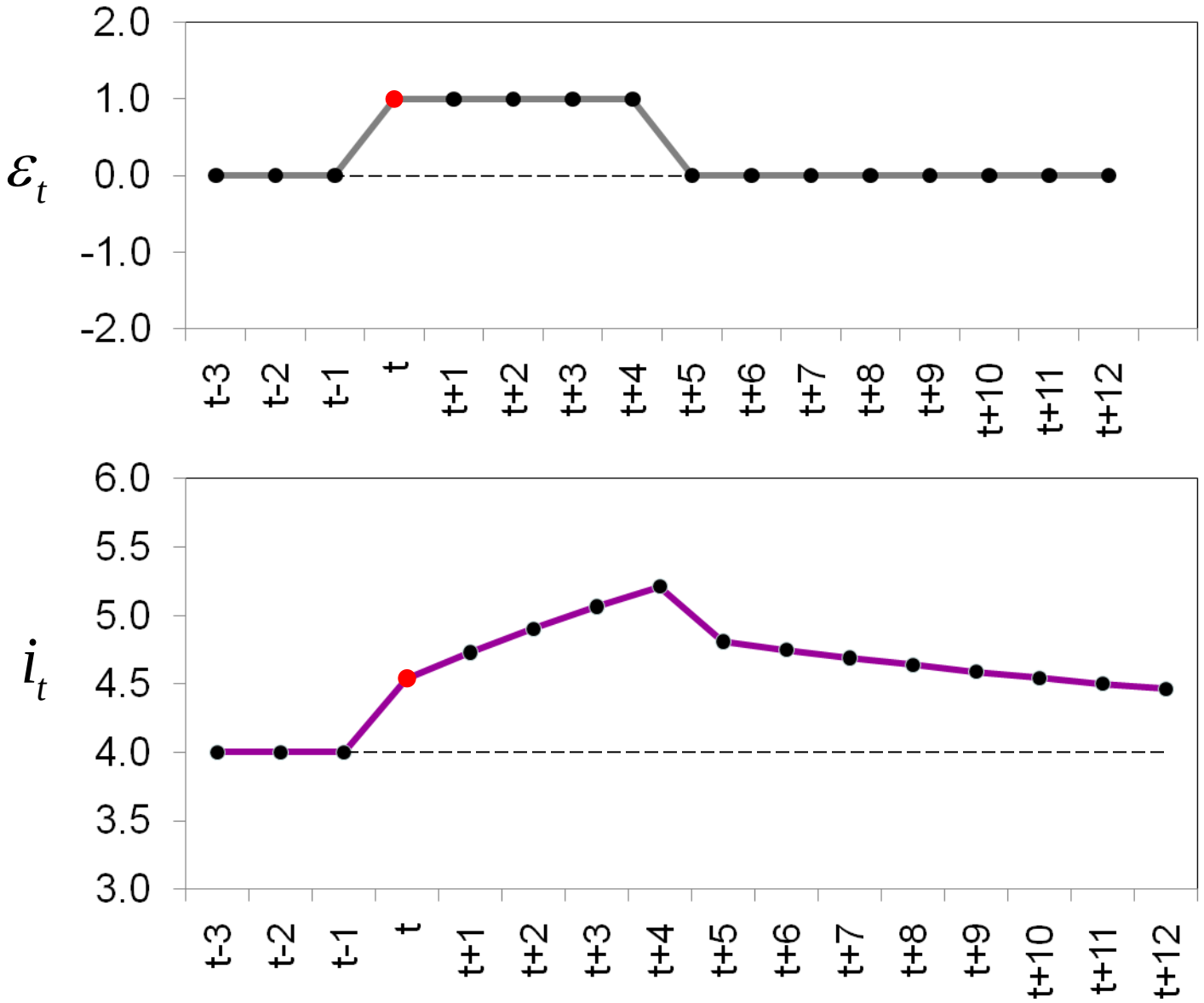
The demand shock causes inflation to rise. When the shock ends, inflation gradually falls toward its initial level.

The dynamic response to a demand shock



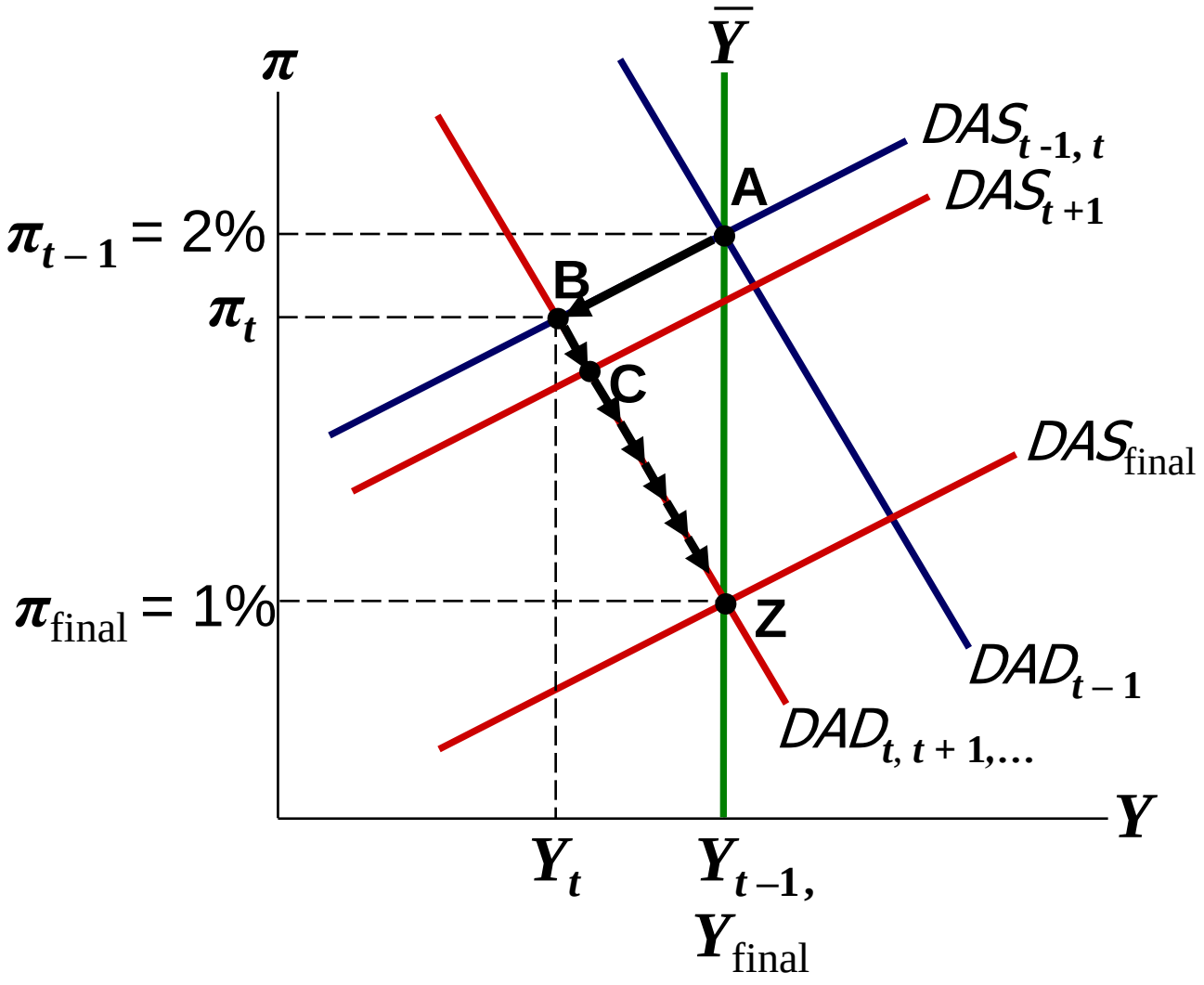
The demand shock raises the real interest rate.
After the shock ends, the real interest rate falls and approaches its initial level.

The dynamic response to a demand shock



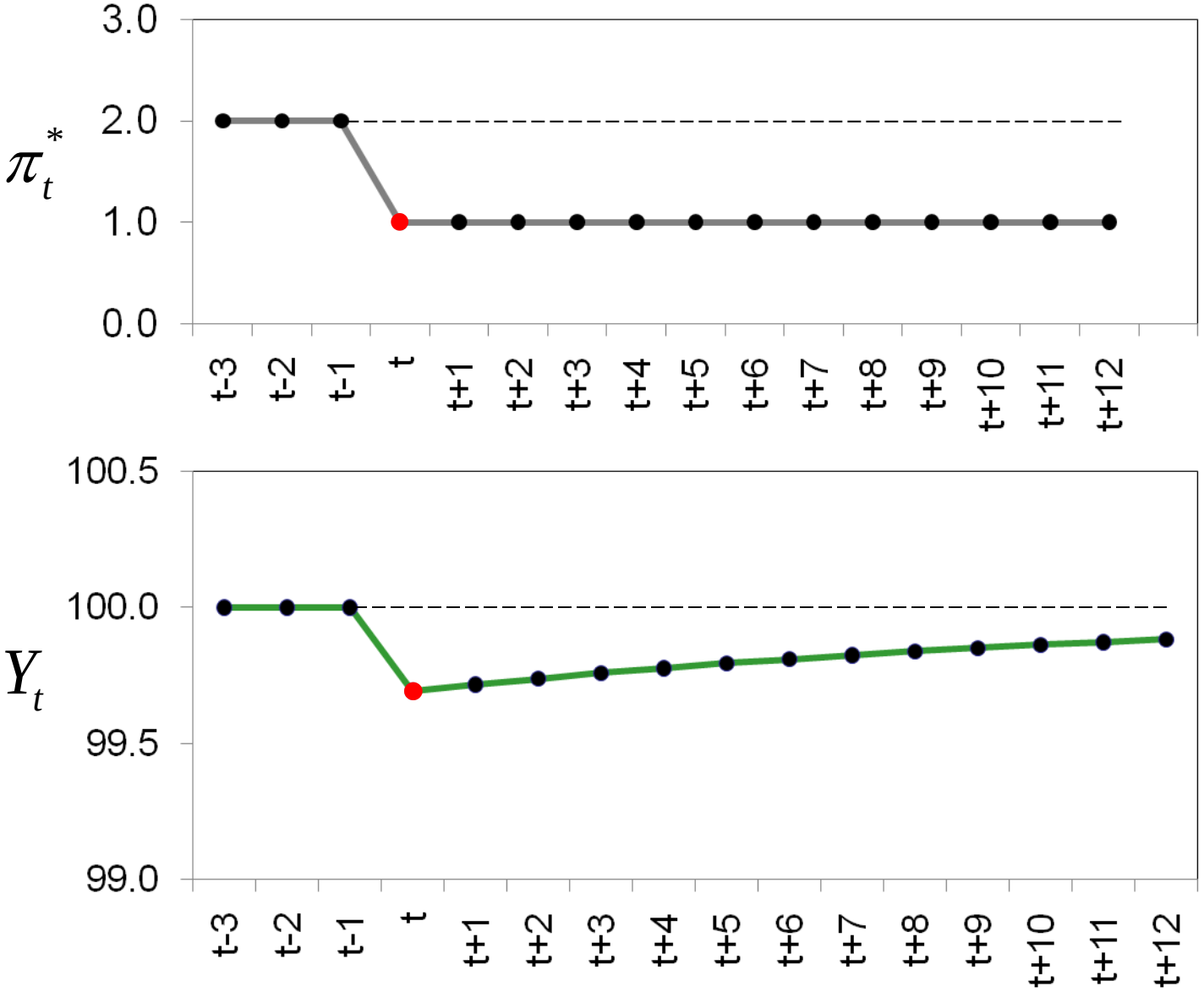
The behavior of the nominal interest rate depends on that of the inflation and real interest rates.

A shift in monetary policy



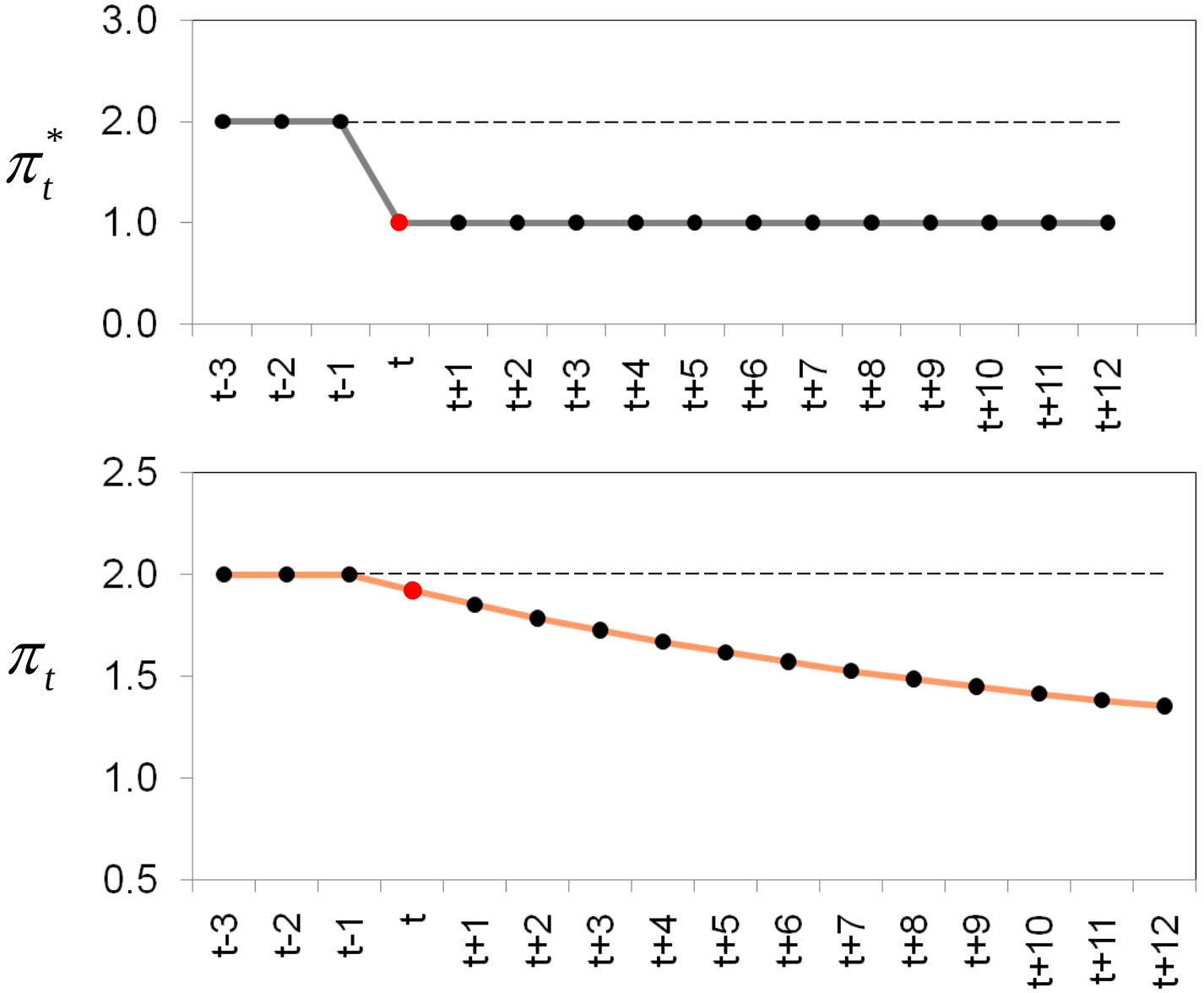
Period ***t***: Central bank lowers target to π^* = 1%, raises real interest rate, shifts DAD leftward. Output and inflation fall.

The dynamic response to a reduction in target inflation



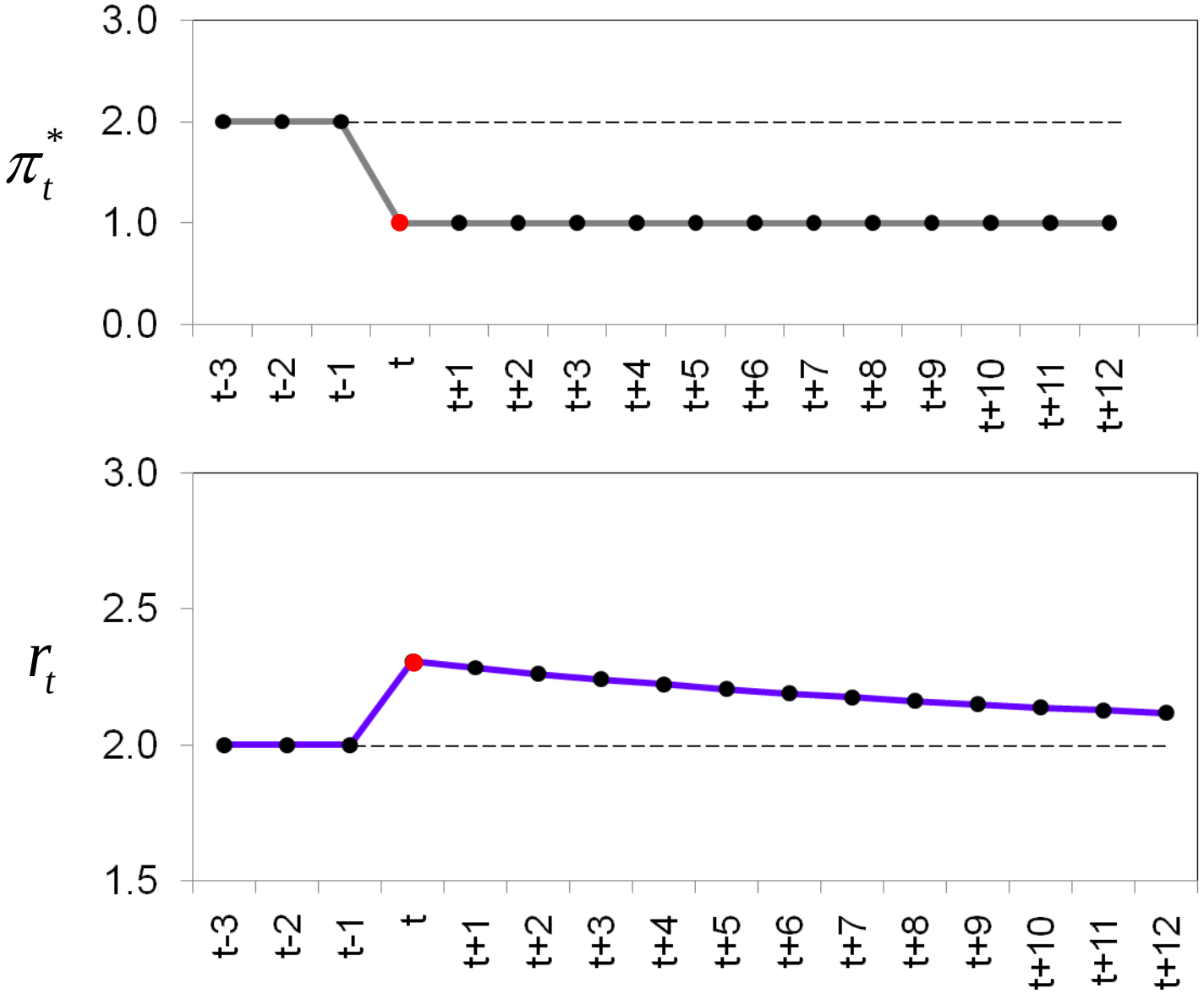
Reducing the target inflation rate causes output to fall below its natural level for a while. Output recovers gradually.

The dynamic response to a reduction in target inflation



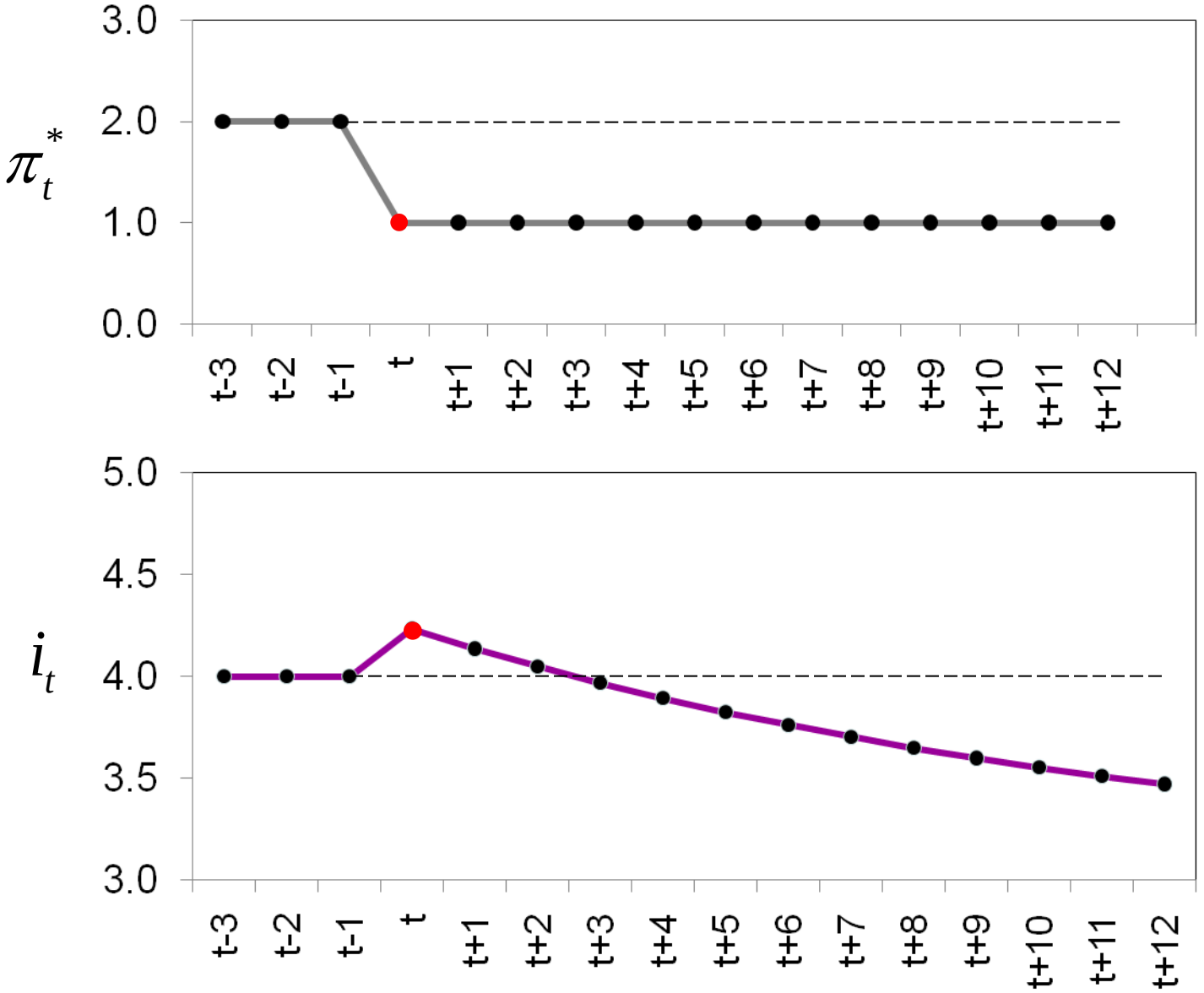
Because expect-ations adjust slowly, it takes many periods for inflation to reach the new target.

The dynamic response to a reduction in target inflation



To reduce inflation, the central bank raises the real interest rate to reduce aggregate demand. The real interest rate gradually returns to its natural rate.

The dynamic response to a reduction in target inflation



The initial increase in the real interest rate raises the nominal interest rate.
As the inflation and real interest rates fall, the nominal rate falls.

IN CHAPTER 18:

about two policy debates:

1. Should policy be active or passive?
2. Should policy be by rule or discretion?

Arguments for active policy

- Recessions cause economic hardship for millions of people.
- The Employment Act of 1946:
  "It is the continuing policy and responsibility of the Federal Government to…promote full employment and production."
- The model of aggregate demand and supply (Chaps. 10–14) shows how fiscal and monetary policy can respond to shocks and stabilize the economy.

Arguments against active policy

Policies act with long & variable lags, including:

inside lag:
the time between the shock and the policy response.

- takes time to recognize shock
- takes time to implement policy, especially fiscal policy

outside lag:
the time it takes for policy to affect economy.

If conditions change before policy's impact is felt, the policy may destabilize the economy.

Automatic stabilizers

- definition:
  policies that stimulate or depress the economy when necessary without any deliberate policy change.
- Designed to reduce the lags associated with stabilization policy.
- Examples:
  - income tax
  - unemployment insurance
  - welfare

The Lucas critique

- Due to Robert Lucas who won Nobel Prize in 1995 for his work on rational expectations.
- Forecasting the effects of policy changes has often been done using models estimated with historical data.
- Lucas pointed out that such predictions would not be valid if the policy change alters expectations in a way that changes the fundamental relationships between variables.

An example of the Lucas critique

- Prediction (based on past experience):
  An increase in the money growth rate will reduce unemployment.
- The Lucas critique points out that increasing the money growth rate may raise expected inflation, in which case unemployment would not necessarily fall.

Rules and discretion: Basic concepts

- *Policy conducted by rule:*
  Policymakers announce in advance how policy will respond in various situations and commit themselves to following through.
- *Policy conducted by discretion:*
  As events occur and circumstances change, policymakers use their judgment and apply whatever policies seem appropriate at the time.

Arguments for rules

1. Distrust of policymakers and the political process
   - misinformed politicians
   - politicians' interests sometimes not the same as the interests of society

Arguments for rules

2. **The time inconsistency of discretionary policy**
   - def: A scenario in which policymakers have an incentive to renege on a previously announced policy once others have acted on that announcement.
   - Destroys policymakers' credibility, thereby reducing effectiveness of their policies.

Monetary policy rules

a. Constant money supply growth rate
   - Advocated by monetarists.
   - Stabilizes aggregate demand only if velocity is stable.

Monetary policy rules

a. Constant money supply growth rate

b. Target growth rate of nominal GDP

- Automatically increase money growth whenever nominal GDP grows slower than targeted; decrease money growth when nominal GDP growth exceeds target.

Monetary policy rules

a. Constant money supply growth rate

b. Target growth rate of nominal GDP

c. Target the inflation rate
   - Automatically reduce money growth whenever inflation rises above the target rate.
   - Many countries' central banks now practice inflation targeting but allow themselves a little discretion.

Central bank independence

- A policy rule announced by central bank will work only if the announcement is credible.
- Credibility depends in part on degree of independence of central bank.

Inflation and central bank independence