Economics 2
Fall 2024

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LECTURE 19

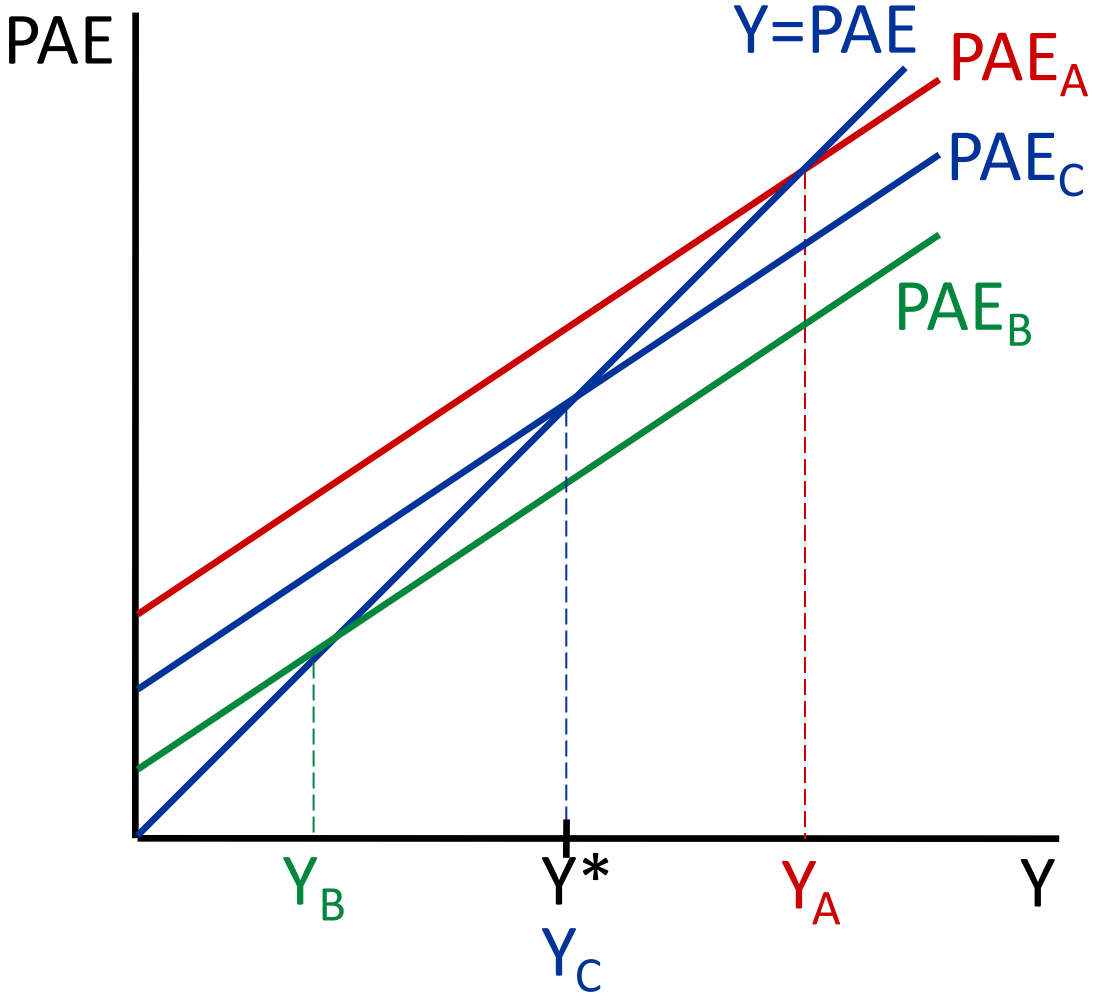
Inflation

I. The Keynesian Cross in the Short Run and the Long Run

Recall: How Output Is Determined in the Short Run

- In the short run, output is determined by the intersection of the planned spending (PAE) line and the 45-degree line in the Keynesian cross diagram.
- We have seen that there are many factors that can shift the PAE line.
- Two important sources of shifts in the PAE line are:
  - Fiscal policy (actions by the government that affect taxes and government purchases).
  - Monetary policy (actions by the central bank that affect nominal and real interest rates).

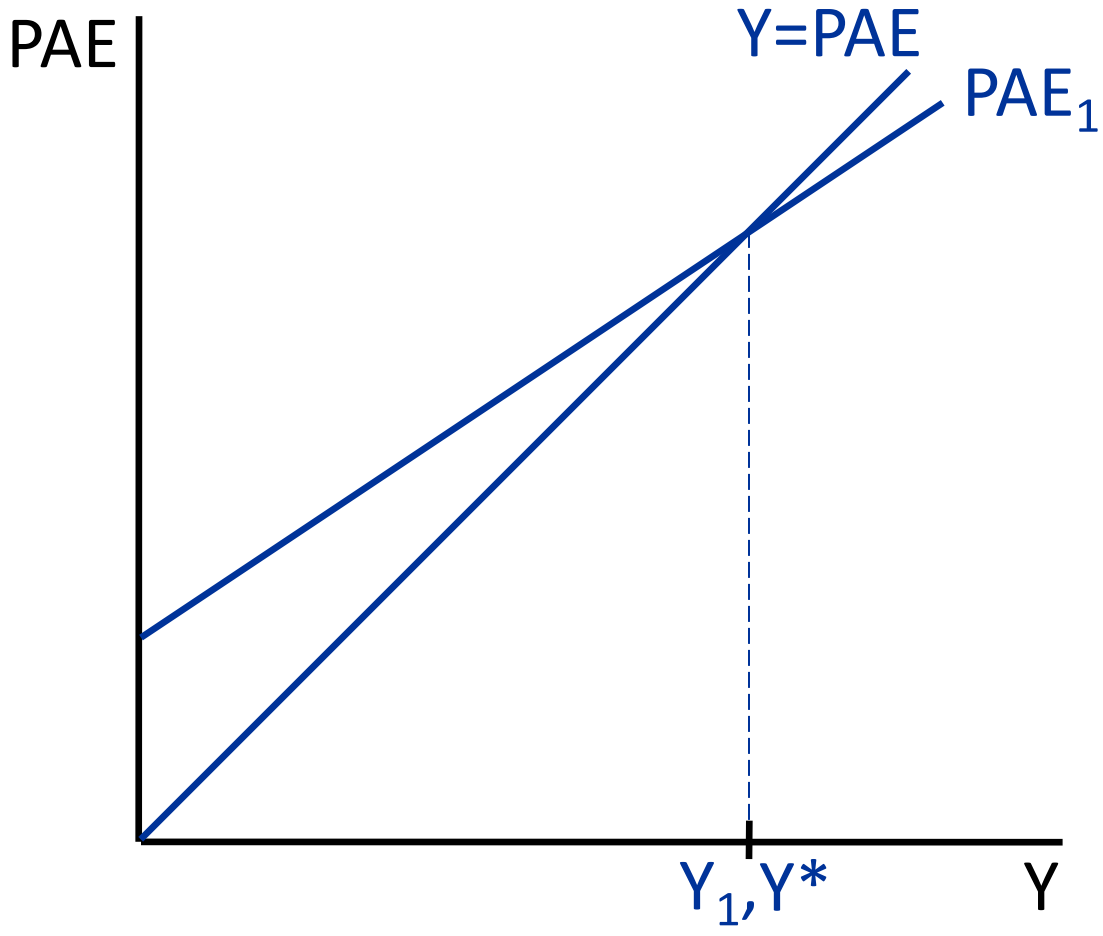
In the Short Run, Y Can Be Below, Above, or Equal to Y*



What's Happening When the PAE Line Crosses the 45-Degree Line at Y = Y*?

- The economy is in long-run equilibrium.
- Recall that PAE line decreases with real interest rate r.
- Therefore, r must equal its long-run equilibrium value: r = r*.
- That is, the r that causes the PAE line to crosses the 45-degree line at Y = Y* is the long-run real interest rate, r*.

The Keynesian Cross When r = r*



When r = r*, the economy is in long-run equilibrium: The PAE line crosses the 45-degree line at Y*.

II. The Determinants of Inflation

Three forces driving Inflation

1. **Inflation expectations:** inflation has inertia and reflects expectations from past inflation:

   - If firms and workers expect a usual inflation (say 2%), firms tend to increase prices and wages by 2%

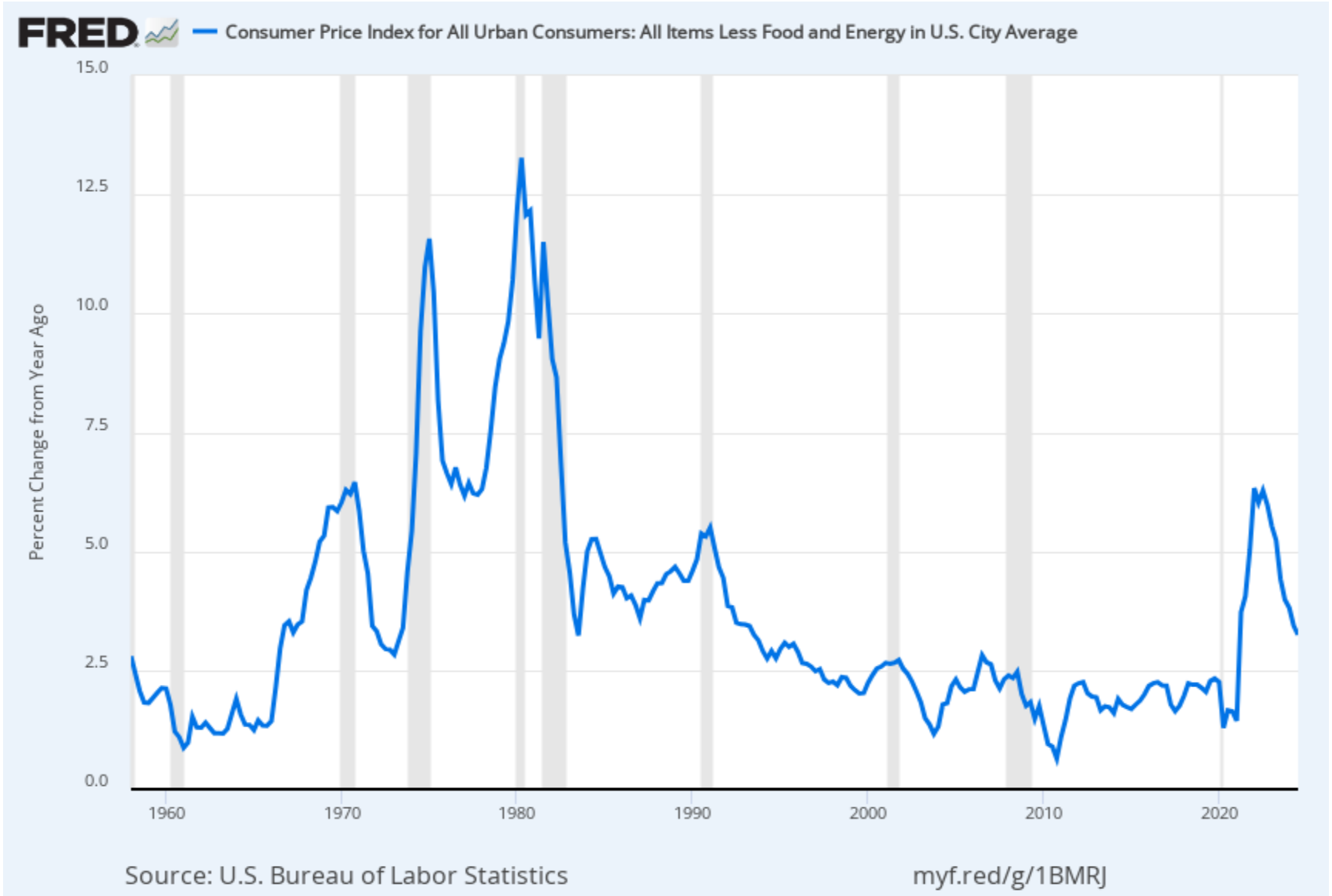
2. **Demand-pull inflation:** inflation rises when economy overheats ($Y>Y^*$) and falls when economy is depressed ($Y<Y^*$)

3. **Cost-push inflation:** Increase in prices of some goods, such as oil, leads to increases in prices of goods produced using oil

1. Inflation Expectations

- When Y = Y*, inflation tends to remain the same.
- Firms do not want the prices they charge and the wages they pay to either rise or fall relative to other firms' prices.
- So, they raise prices and wages to keep up with expected inflation.
- And past inflation is a crucial determinant of inflation expectations
- From 1995-2020, US inflation hovered around 2%

Core Inflation in the United States



Inflation is % change in price relative to the year before.

Inflation spiked in 1970s and 2022-2023. Stable around 2% in 1995-2020.

2. Demand-Pull inflation

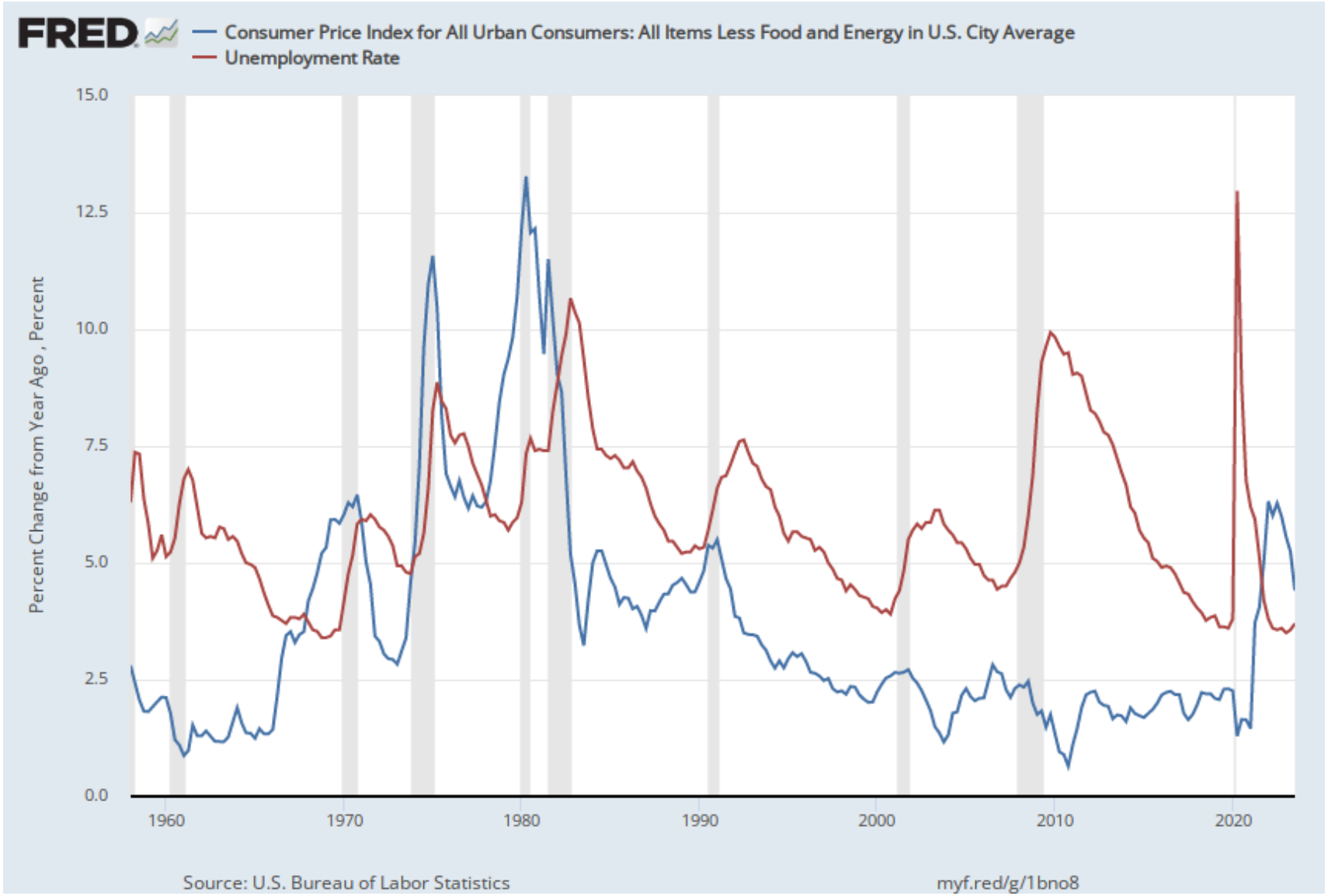
- With $Y > Y^*$, firms are operating above their comfortable capacity, and so want to raise their prices relative to other firms'.
- They therefore raise their prices by more than past inflation.
- Similarly, with $Y > Y^*$, hard for firms to find workers so each firm increases wages to attract workers
- With many firms doing this, inflation rises.

- Conversely, when $Y < Y^*$, inflation falls

Inflation over the business cycle: Phillips Curve

- Simplest way to see whether Y is above or below Y* is to look at the unemployment rate u:
- When unemployment rate u is high then Y<Y* (and conversely)
- Empirically: When unemployment is too high (recession), inflation tends to fall. When unemployment is too low (boom), inflation tends to increase.
- This relationship is called the Phillips Curve. It is far from perfect as other factors affect inflation

Inflation and unemployment



Source: FRED. When unemployment rate is too high, inflation tends to fall. When unemployment rate is too low, inflation tends to increase.

Summary: Inflation doesn't change in the short run, but over time, it responds to the difference between actual and potential output.

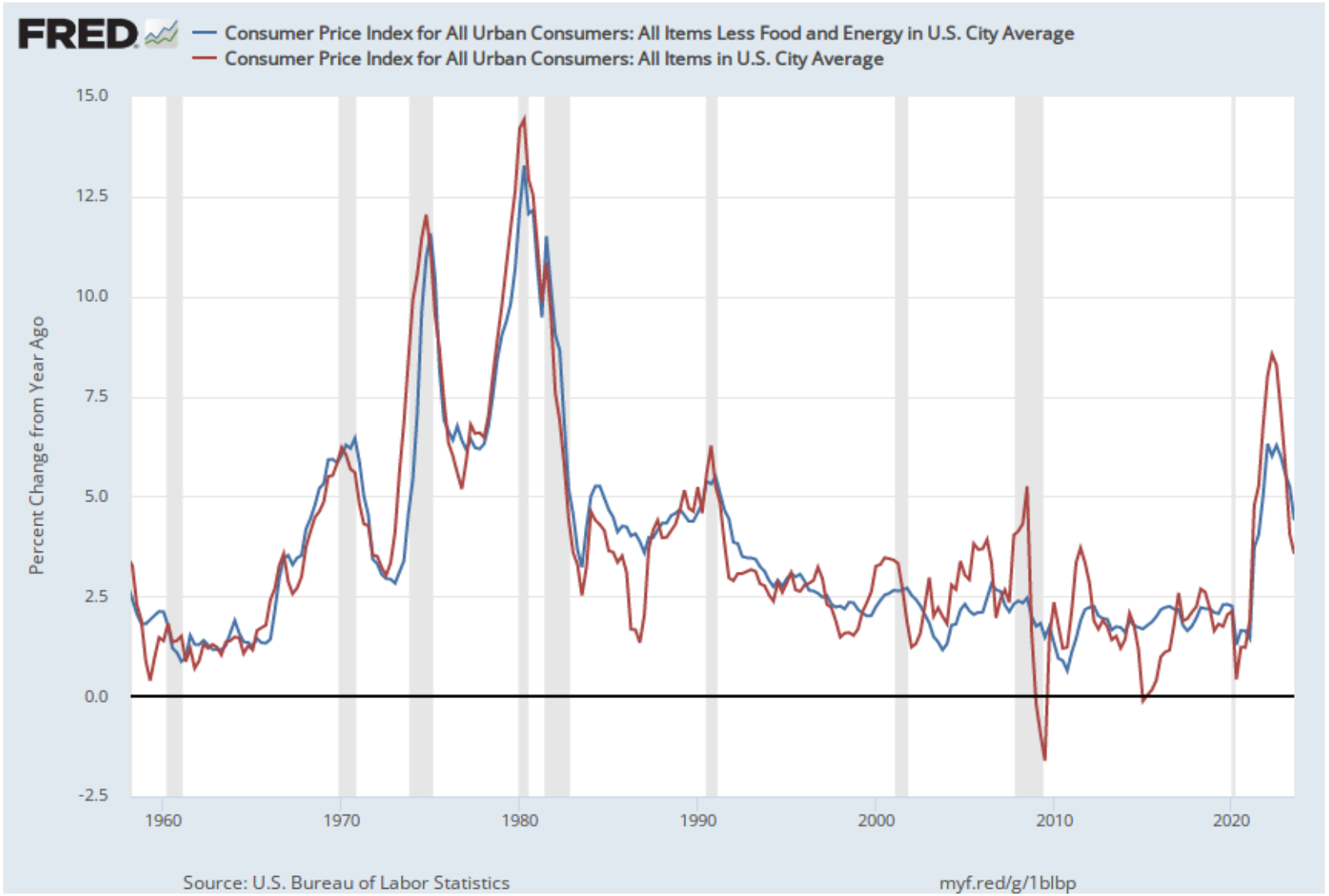
In the absence of other shocks:

- When $Y > Y^*$, inflation rises.
- When $Y < Y^*$, inflation falls.
- When $Y = Y^*$, inflation holds steady.

3. Cost-push inflation (=inflation shocks)

- Inflation Shock: A sudden jump (usually upward) in a small set of prices (often the price of oil) for reasons unrelated to how Y compares with Y*.
- An inflation shock causes an immediate change in inflation.
- Policy makers like to look at Core Inflation (inflation excluding food and energy) as food and energy prices move a lot: core inflation filters out this noise
- But increase in price of oil may increase prices of goods produced using oil and hence affect core inflation eventually

Core inflation less volatile than Inflation



Core inflation is a better gauge of underlying inflation but oil shocks of 1973 and 1979 led within 1 year to much higher core inflation (cost-push inflation shock)

Quiz on Tariffs and Inflation

Suppose Trump administration imposes a 20% across the board tariff in early 2025 on all imported goods. Is this a positive or negative inflation shock?

A. A positive inflation shock as prices of imported good increase

B. A negative inflation shock as US will start producing domestically more cheaply than imports+tariffs

C. It's neither a positive nor negative inflation shock

III. The Federal Reserve's Reaction Function

Why Central Banks Care about Inflation

- Keeping inflation reasonably low and stable is a central part of the legal mandate and stated goals of almost every central bank.
- Sustained high inflation is harmful to the economy (people get upset and pricing more chaotic)
- Sustained negative inflation (deflation) limits ability of the Fed to lower the real interest rate $r=i-\pi$: even with $i=0$, $r=-\pi>0$ with deflation
- Consensus is that $\pi = 2\%$ is reasonable. People don't notice and zero lower bound $i=0\%$ implies $r=-2\%$

How a Central Bank Controls Inflation

- Central bank primary goal is to ensure that inflation expectations remain anchored around 2%

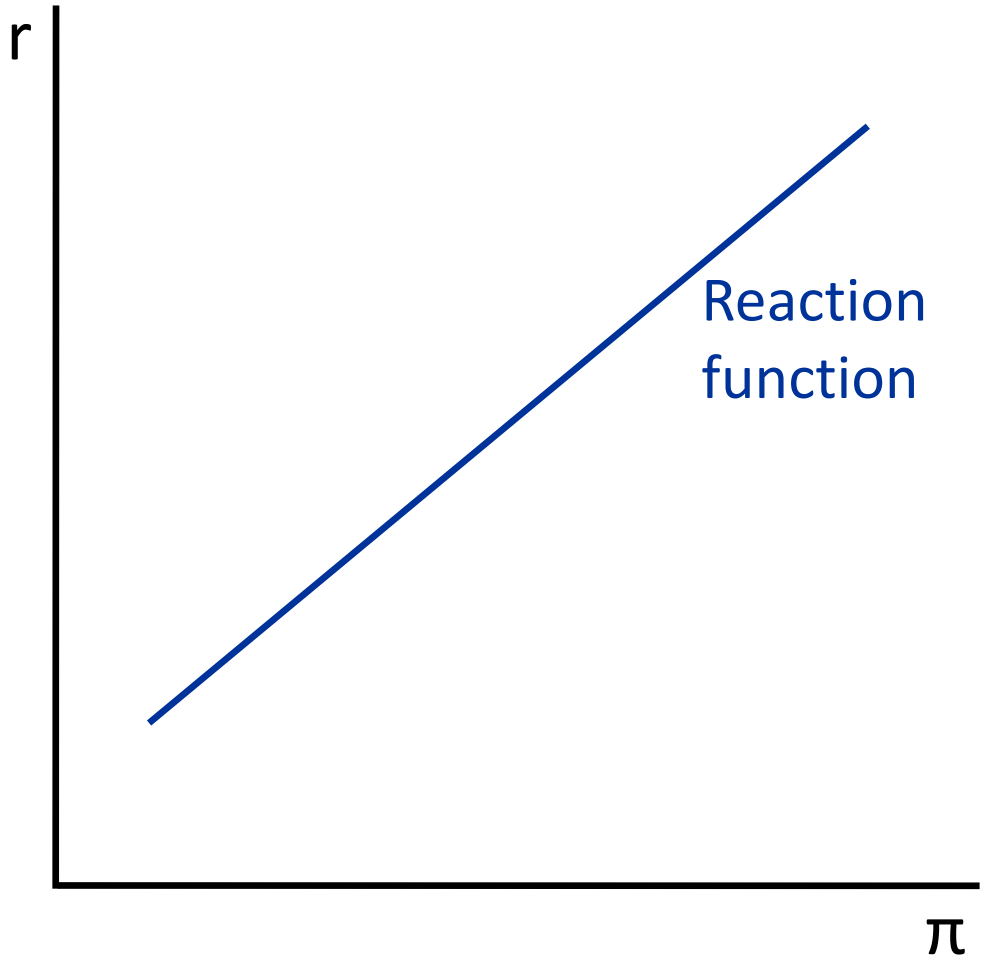
- When inflation rises above 2%, the central bank raises the real interest rate.
    - This reduces planned spending (PAE line), and so lowers output.
    - Because inflation responds to output over time, this helps keep inflation under control.

- When inflation falls below 2%, the central bank lowers the real interest rate, and the process works in reverse.

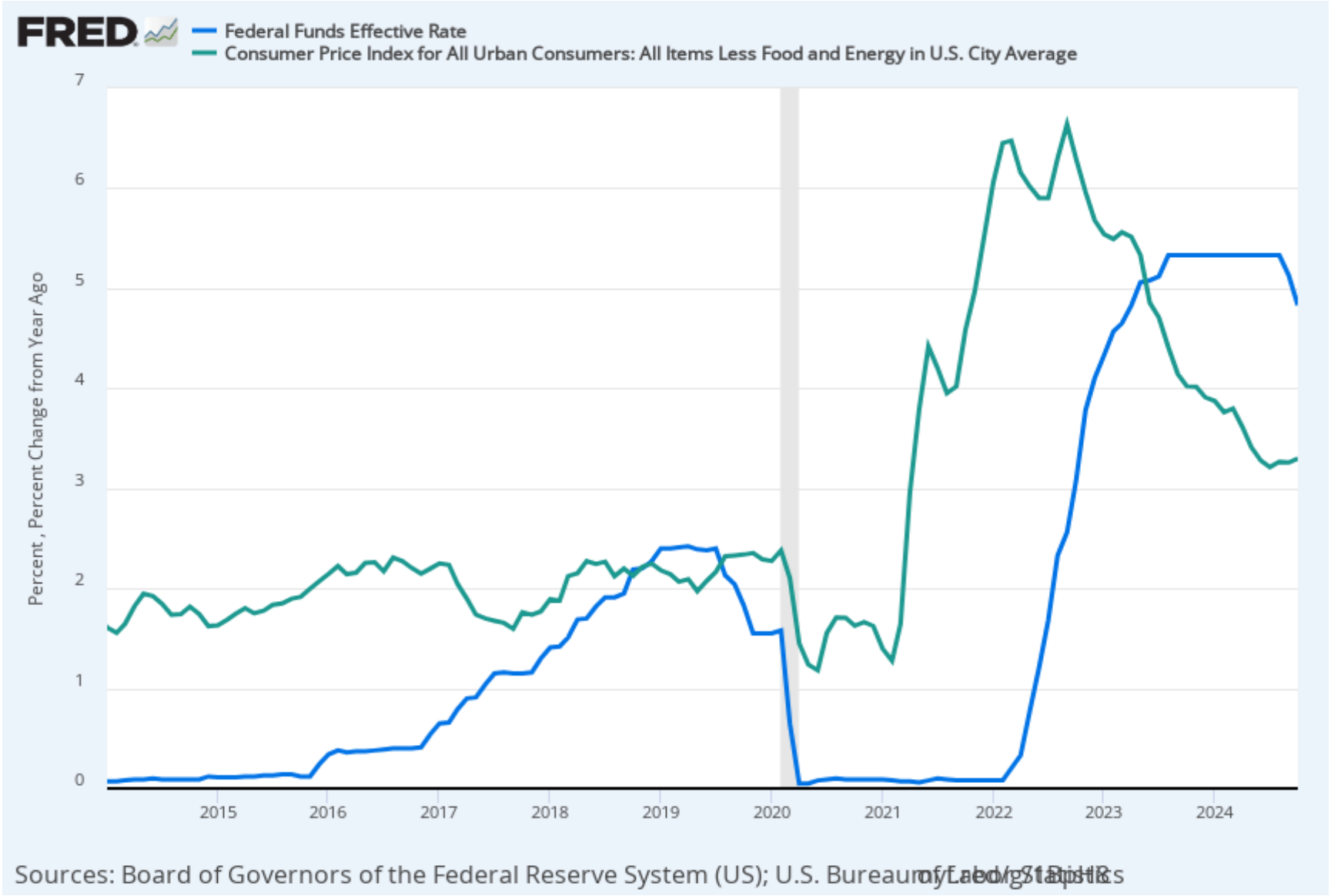
The Central Bank's Reaction Function

- In modern macro-economics, we do not look at money supply and just assume that the central bank directly controls the real interest rate
- We call the fact that the Fed raises the real interest rate when inflation rises, and reduces the real interest rate when inflation falls, its "reaction function."
- The motivation for the reaction function is to keep inflation from getting too low or too high.

The Fed's Reaction Function

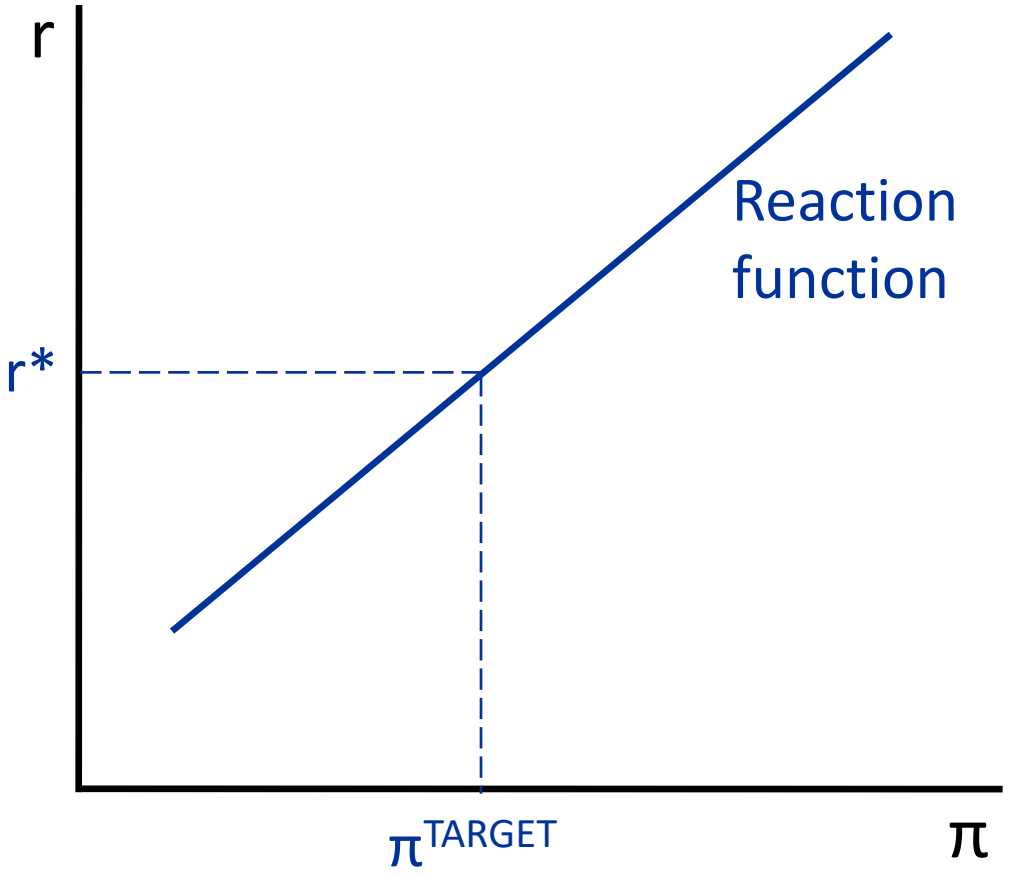


Inflation and the Federal Funds Rate, 2014–2024



In 2021, core inflation started increasing and the Fed then increased the nominal interest starting in 2022 and will keep it high until inflation comes back to around 2%

The Long-Run Inflation Rate Implied by the Reaction Function



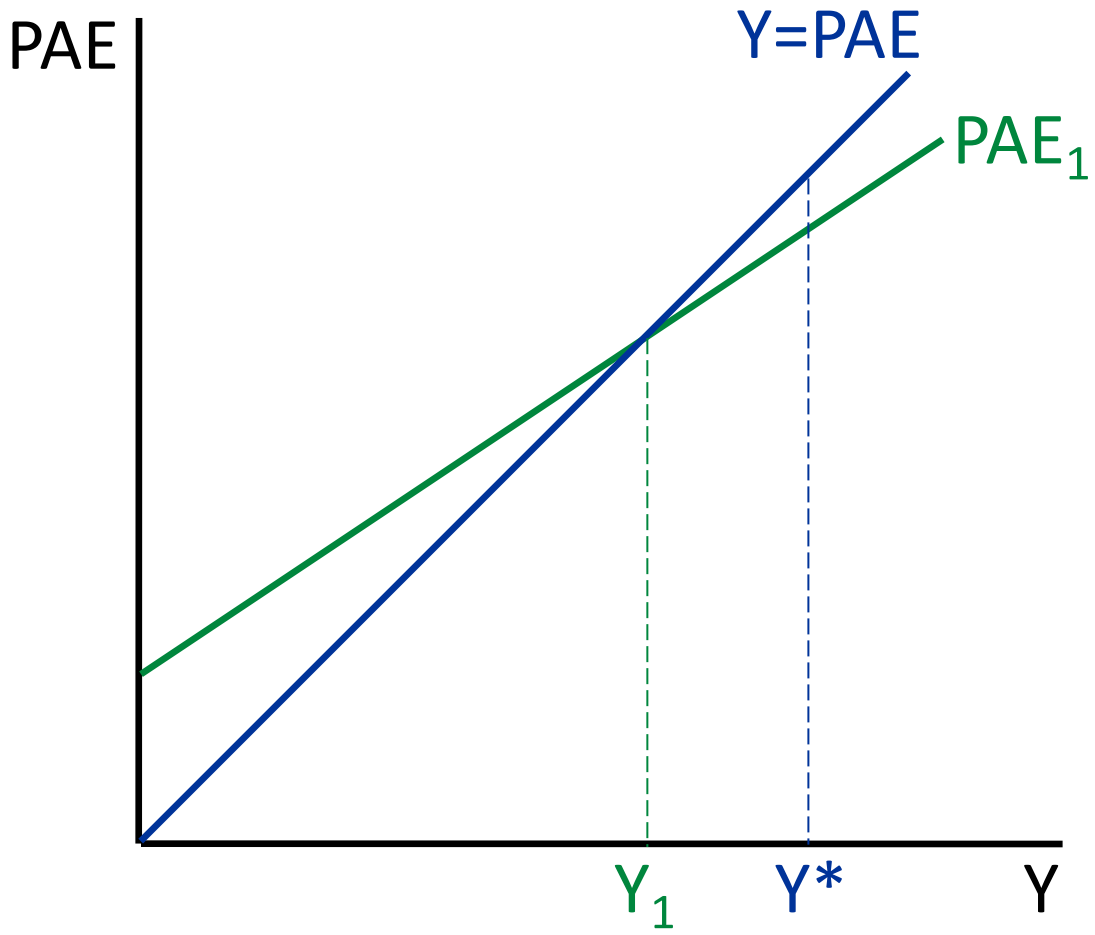
Recall that the Fed has no choice about what r is in the long run.
r* is the normal interest rate such that Y=Y* on Y=PAE diagram

IV. The Return to Potential Output

How the Economy Gets to Long-Run Equilibrium: Overview

- Over time, inflation responds to the difference between actual output Y and potential output Y*.
- The central bank responds to changes in inflation by changing the real interest rate r
- The central bank's response to changes in inflation feeds back to the economy
- Reminder from Keynesian cross: increasing r depresses Y and decreasing r boosts Y

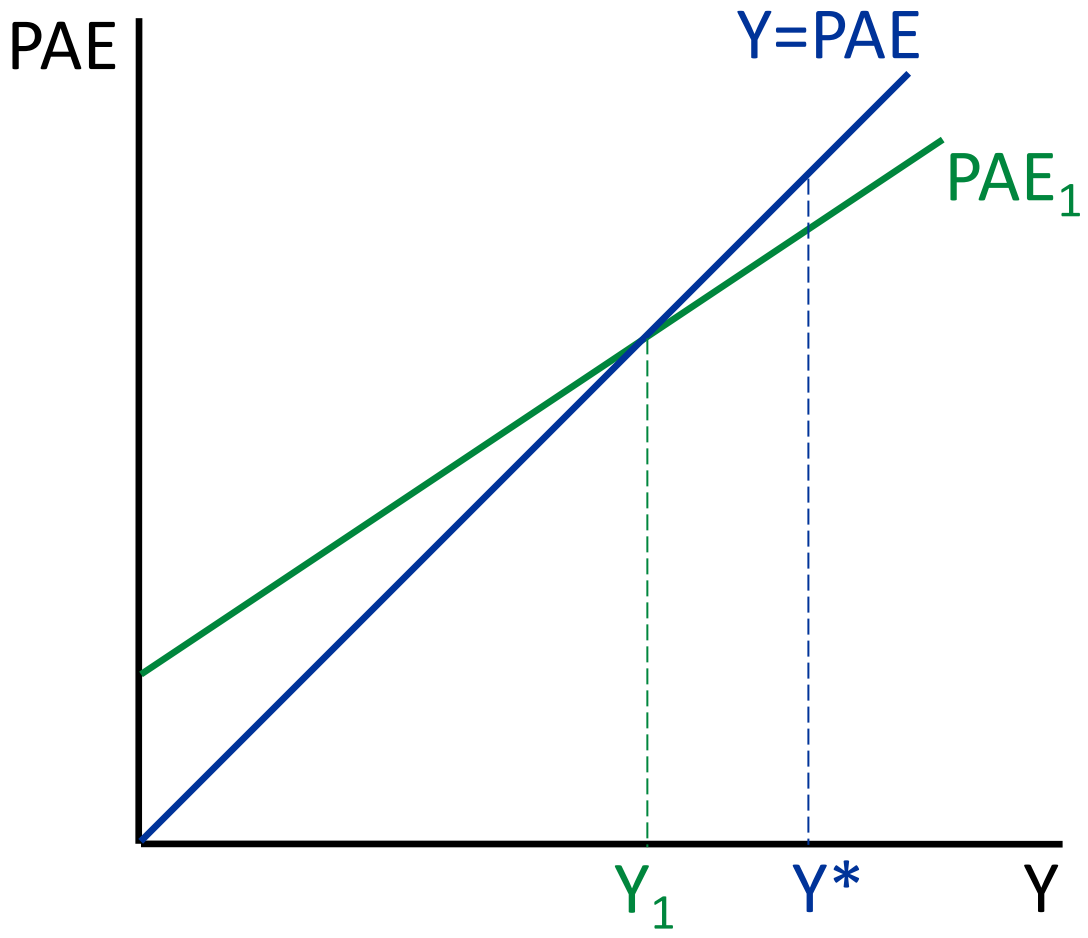
Getting to long-run equilibrium: An initial situation with depressed output Y_1



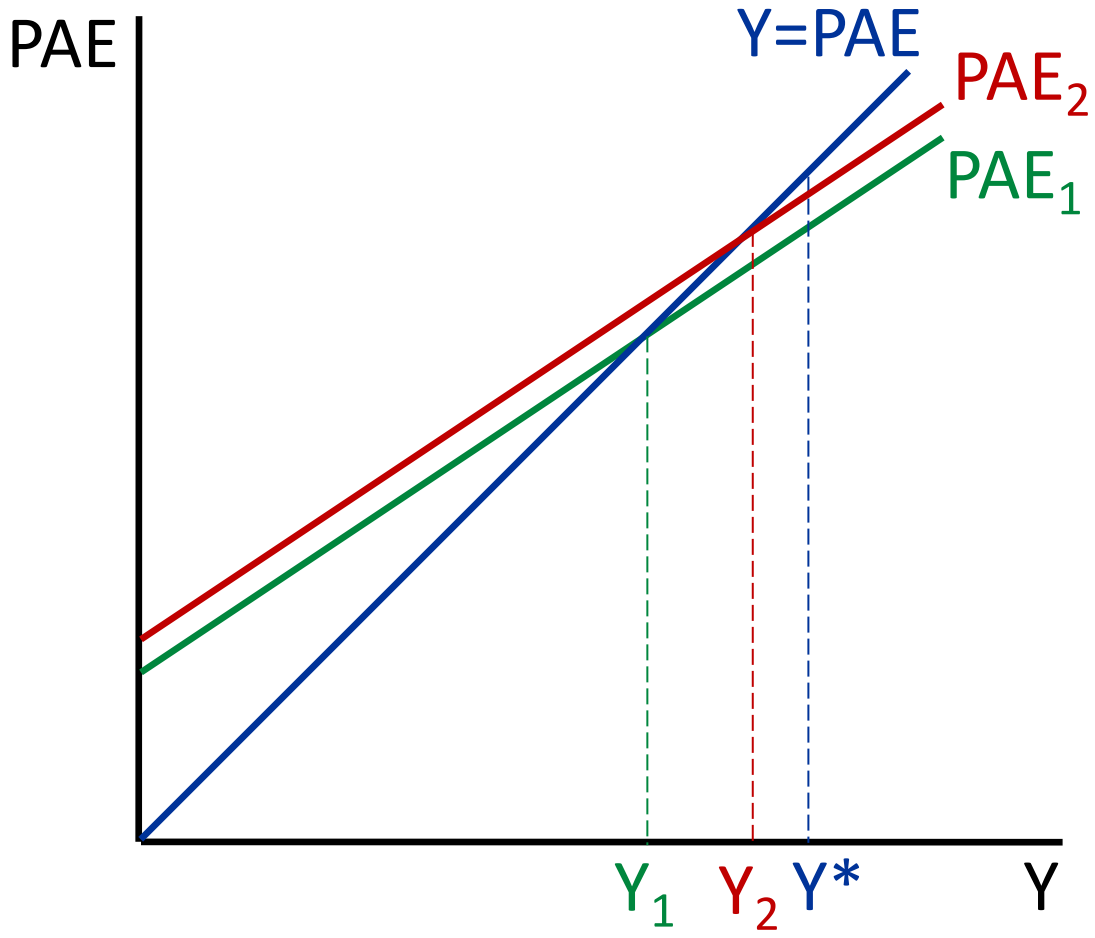
What Happens over Time?

- If Y_1 is not equal to Y*, after a while inflation starts to change.
- In our example, $Y_1 < Y^*$, so inflation falls.
- As inflation falls, the Fed, following its reaction function, lowers r.
- The reduction in r increases C at a given Y and increases I^p, and so shifts the PAE line up and raises Y.

Moving toward Y*

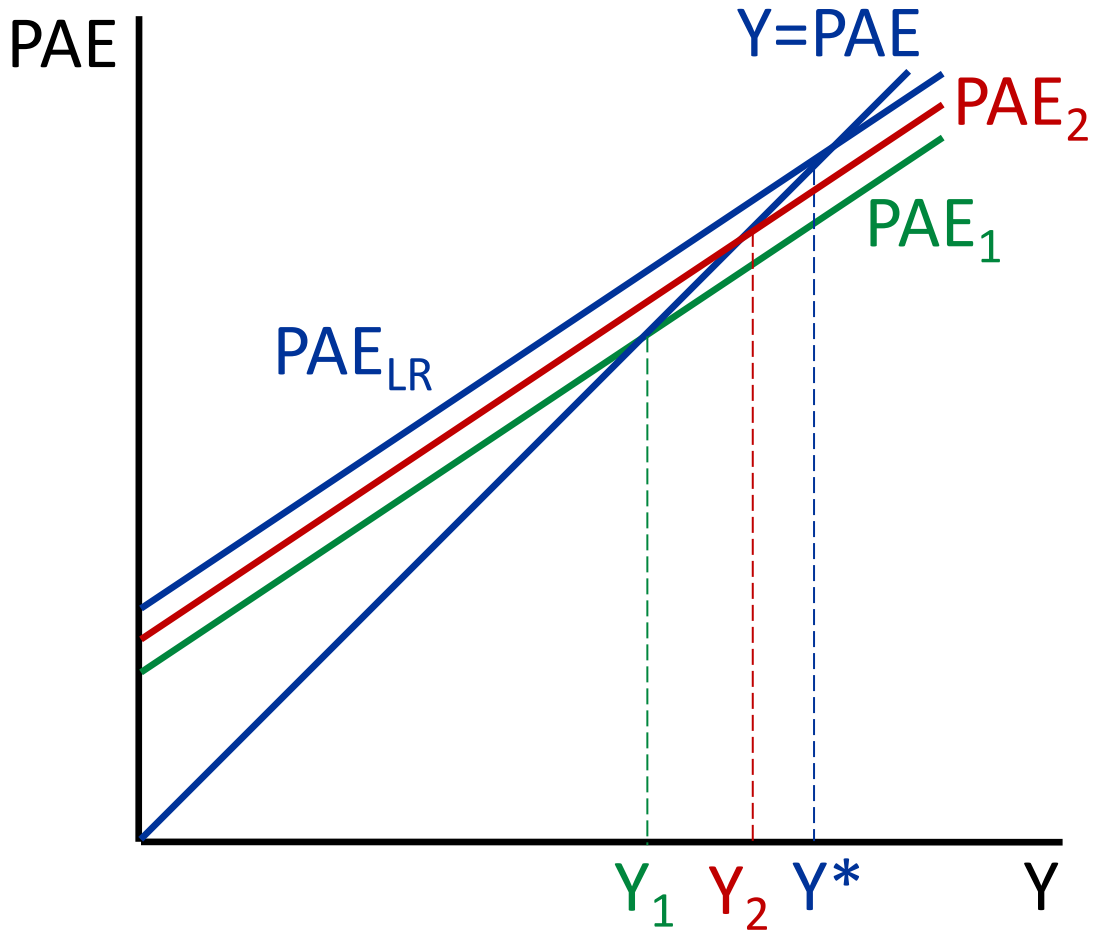


Moving toward Y*



As the Fed lowers r as inflation falls, the PAE line shifts up.

Reaching Long-Run Equilibrium



The economy is in long-run equilibrium when the PAE line intersects the 45 degree line at Y=Y*.

Reaching Long-Run Equilibrium

- As long as $Y \neq Y^*$, inflation continues to change, so the Fed continues to change r, and so Y continues to change.
- In our example, $Y < Y^*$, so inflation continues to fall, so the Fed continues to lower r, so the PAE continues to shift up, so Y continues to rise.
- The process continues until $Y = Y^*$.

Getting to Long-Run Equilibrium: Summary

- If $Y \neq Y^*$, over time, inflation changes.
- When inflation changes, the Fed changes the real interest rate.
- The changes in r shift the PAE line, and so change Y.
- The process continues until $Y = Y^*$ (and $r = r^*$).

Targeting Inflation vs. Output

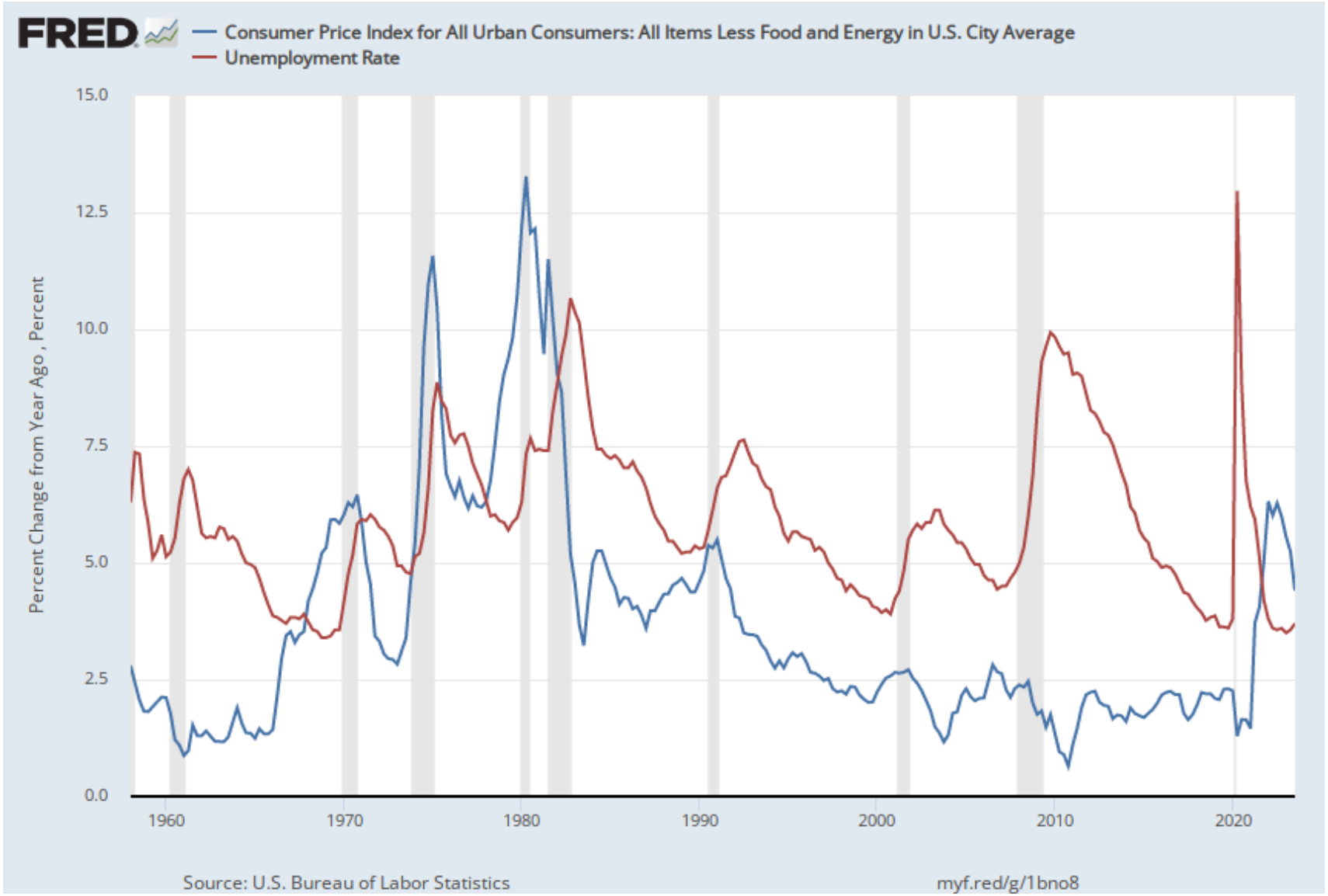
- In monetary policy lecture: Fed chooses r to bring Y back to Y* (short-run assuming π is fixed)
- In this inflation lecture: Fed chooses r to bring π to π^{TARGET} (medium-run where π responds to Y)
- In practice, central bank targets both Y* and π^{TARGET} typically focusing on Y unless π gets too much away from π^{TARGET}
- As $r(\pi^{TARGET})=r^*$, targeting π^{TARGET} and targeting Y* is equivalent (called divine coincidence)

V. Example: The Fed Reduces Inflation

The Development We Want to Analyze

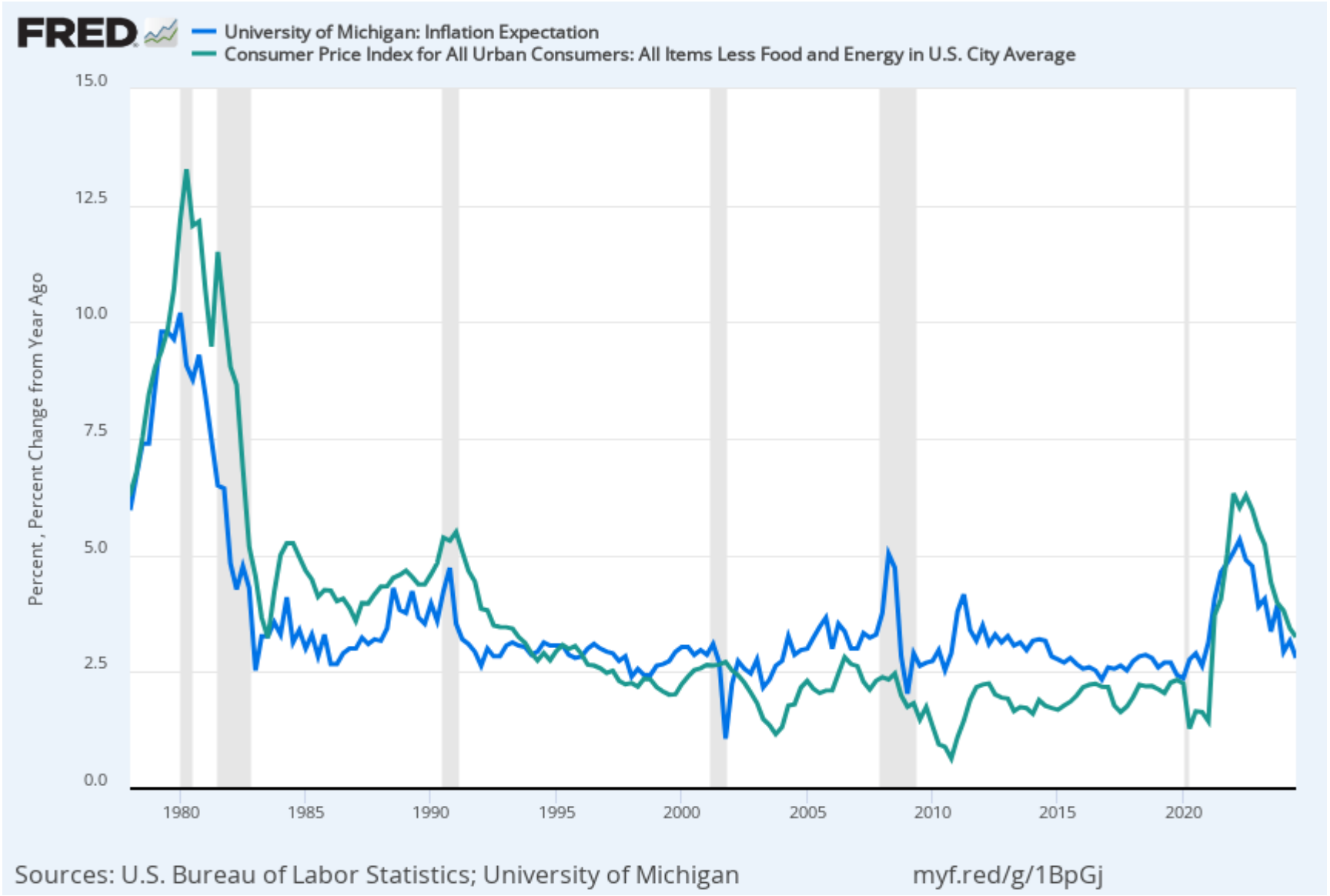
- The economy starts in long-run equilibrium.
- As a result, inflation is steady.
- The Fed decides it wants inflation to be lower in the long run
- This is the problem Argentina faces today
- This was the problem the US (and most other Western countries) faced in the late 1970s after oil shocks led to higher core expected inflation
  - Paul Volcker was appointed as Fed Chair by President Carter in 1979 to tame inflation

Inflation and unemployment



Source: FRED. When unemployment rate is too high, inflation tends to fall. When unemployment rate is too low, inflation tends to increase.

Expected inflation (next year) and core inflation

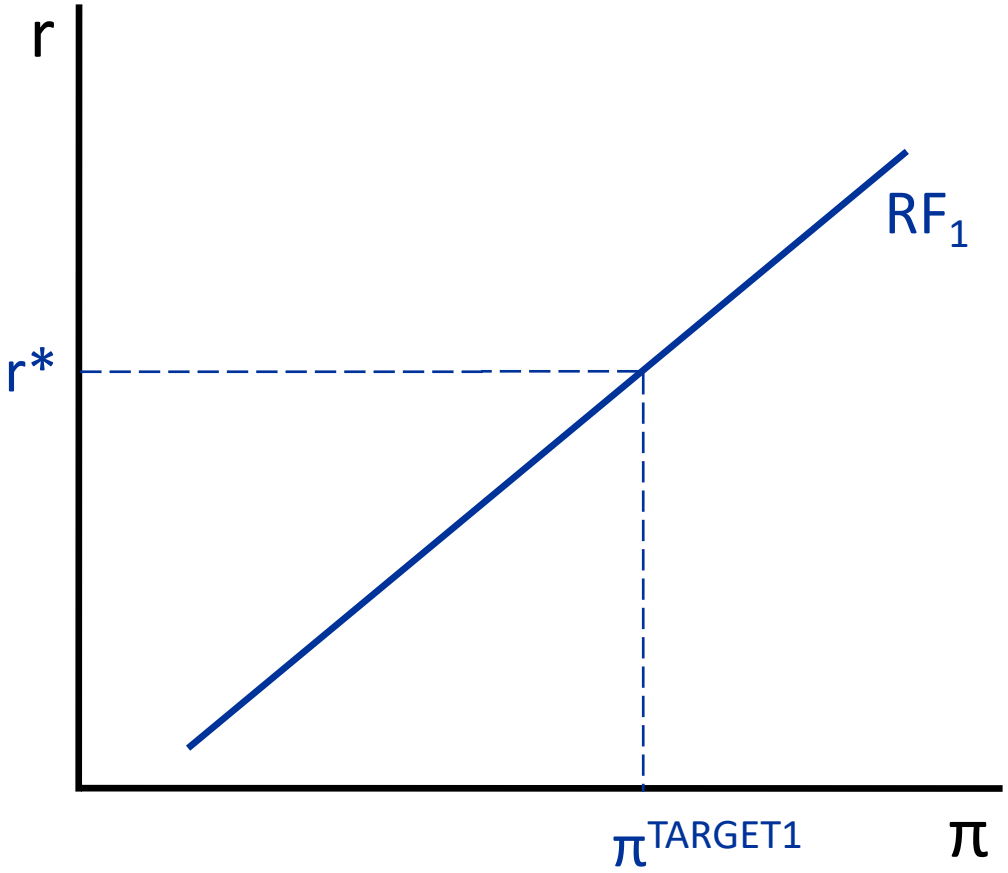


University of Michigan survey tracks inflation expectations (for next year). Inflation expectations were high in the late 1970s.

What the Fed Needs to Do to Make Inflation Be Lower in the Long Run

- Recall: When the Fed chooses its reaction function, it is (implicitly or explicitly) choosing what inflation will be in the long run.
- Thus, to lower inflation in the long run, the Fed needs to shifts its reaction function up.

Shifting the Reaction Function in order to Reduce Inflation in the Long Run



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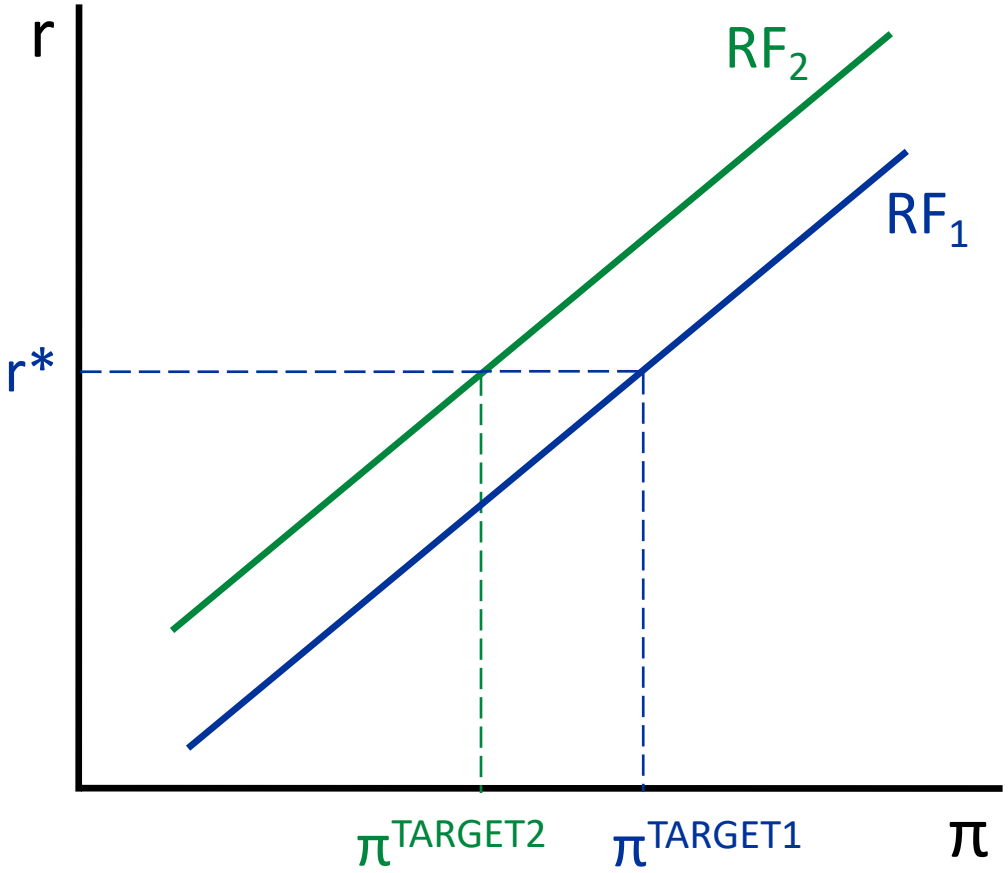
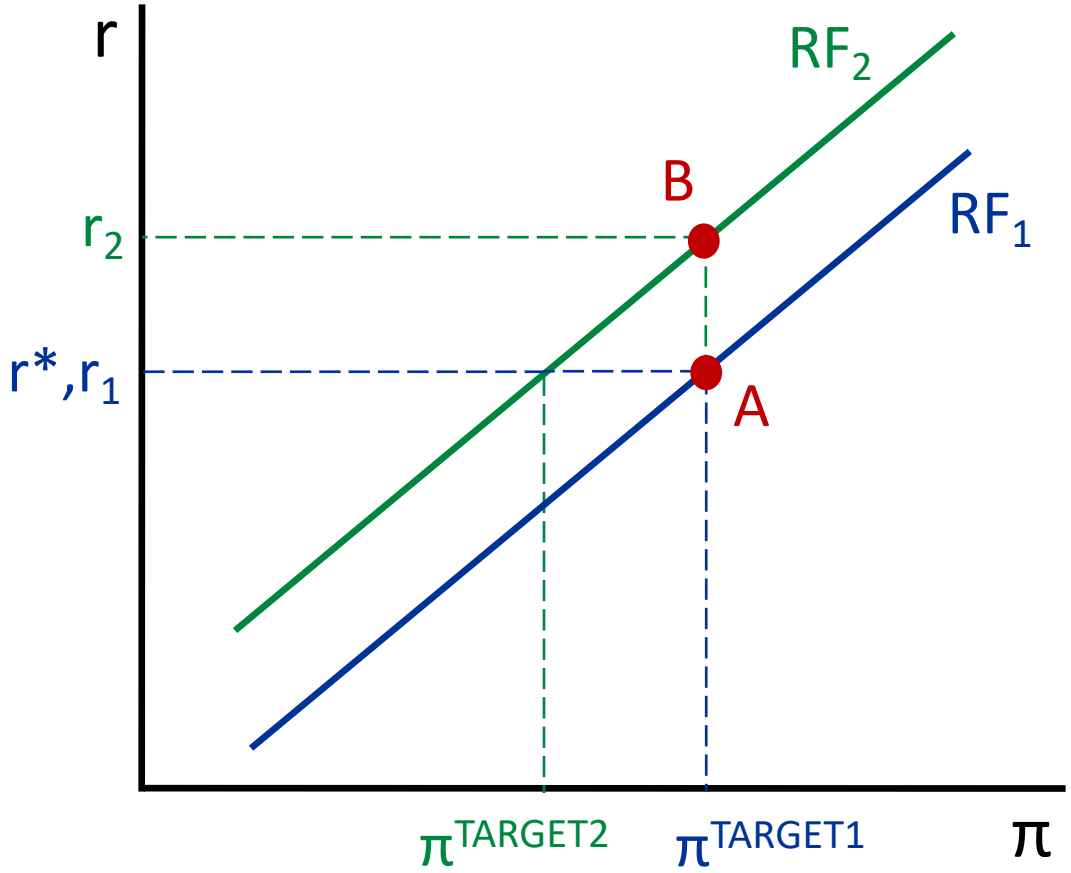


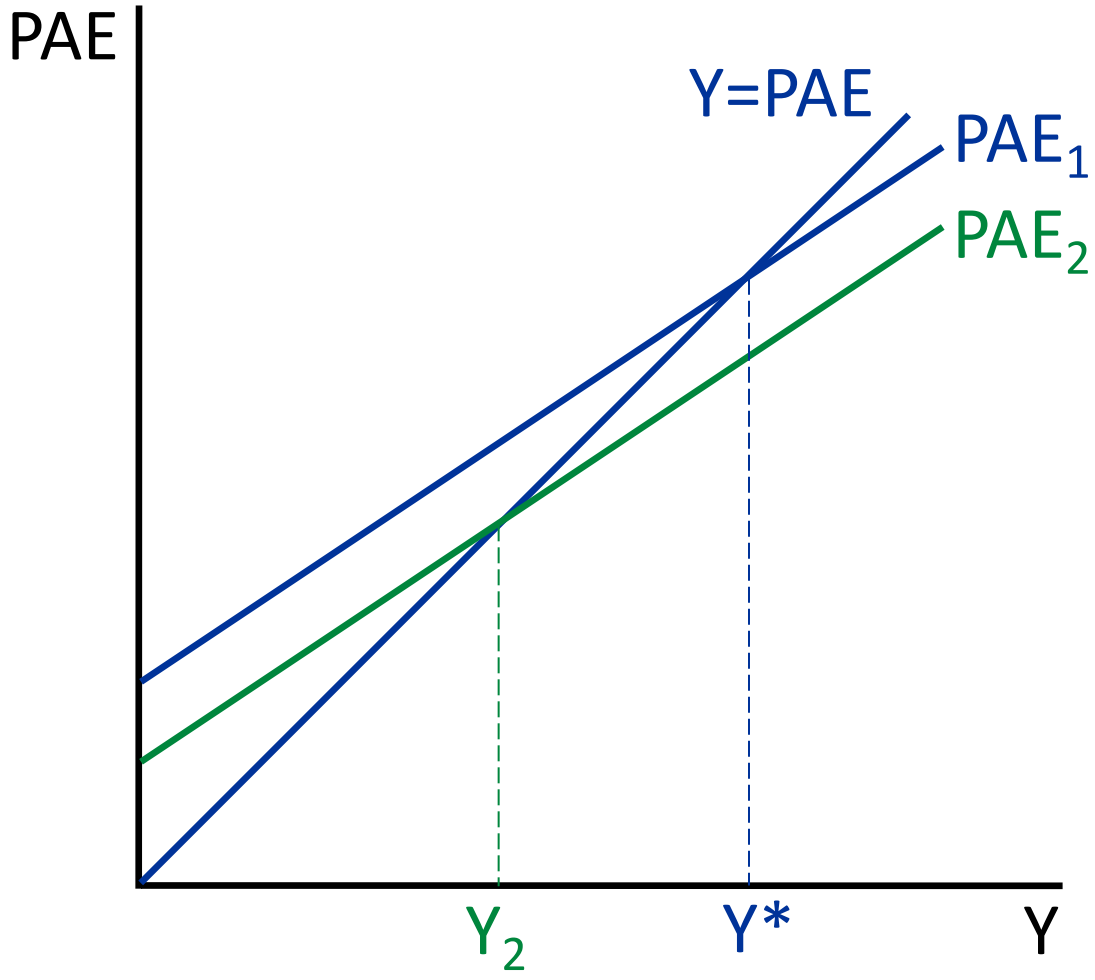
Thus: We want to analyze the effects of an upward shift of the Fed's reaction function.

The Short-Run Effect on the Real Interest Rate



Recall: There is “nominal rigidity” or “inflation inertia” so we move from A to B in the short-run

The Short Run

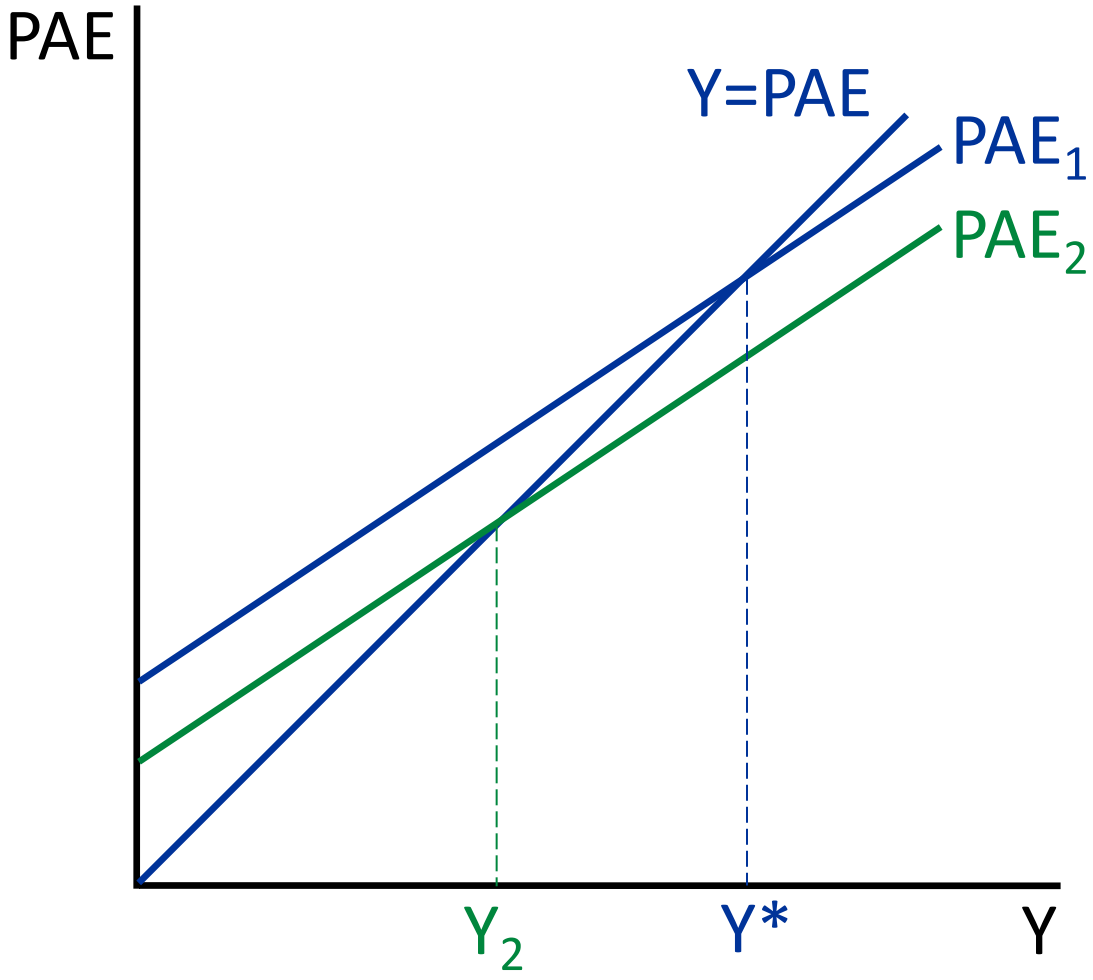


PAE shifts down in the short-run because the real interest goes up which depresses output (while inflation stays high)

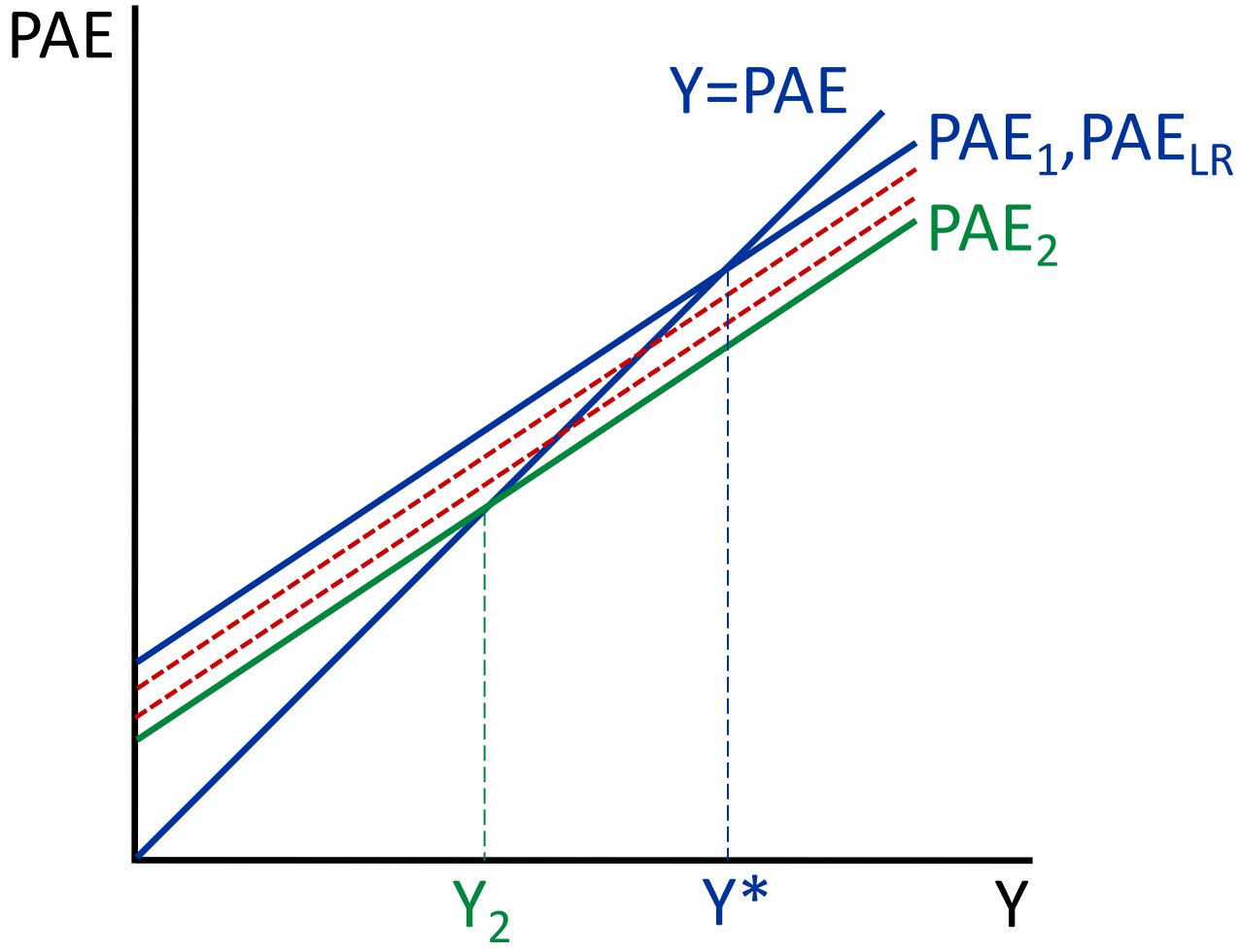
Returning to Potential Output

- $Y < Y^*$, so after a while inflation starts to fall.
- As inflation falls, the Fed, following its new reaction function, lowers r.
- The decreases in r shift the PAE line up and raise Y.
- The process continues until we are back at Y^*.
- Disinflation is a painful process: requires the Fed to engineer a recession to push inflation down

Returning to Potential Output



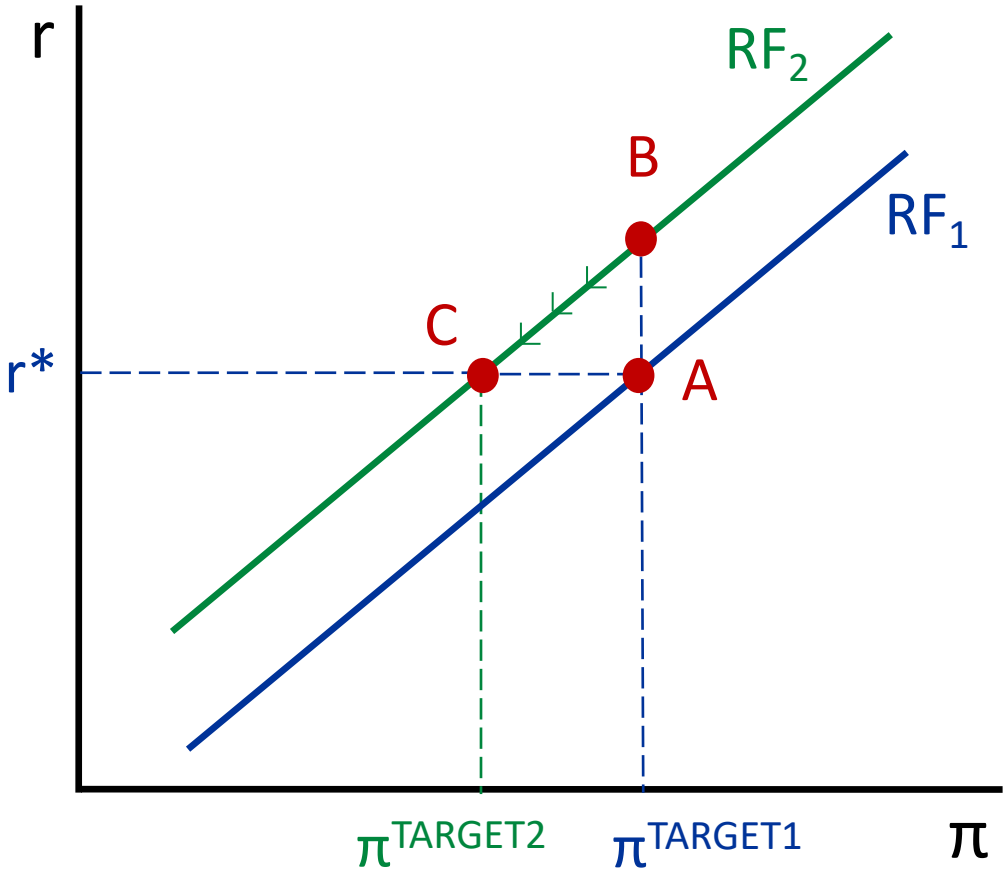
Returning to Potential Output



The Long-Run Effect on Inflation

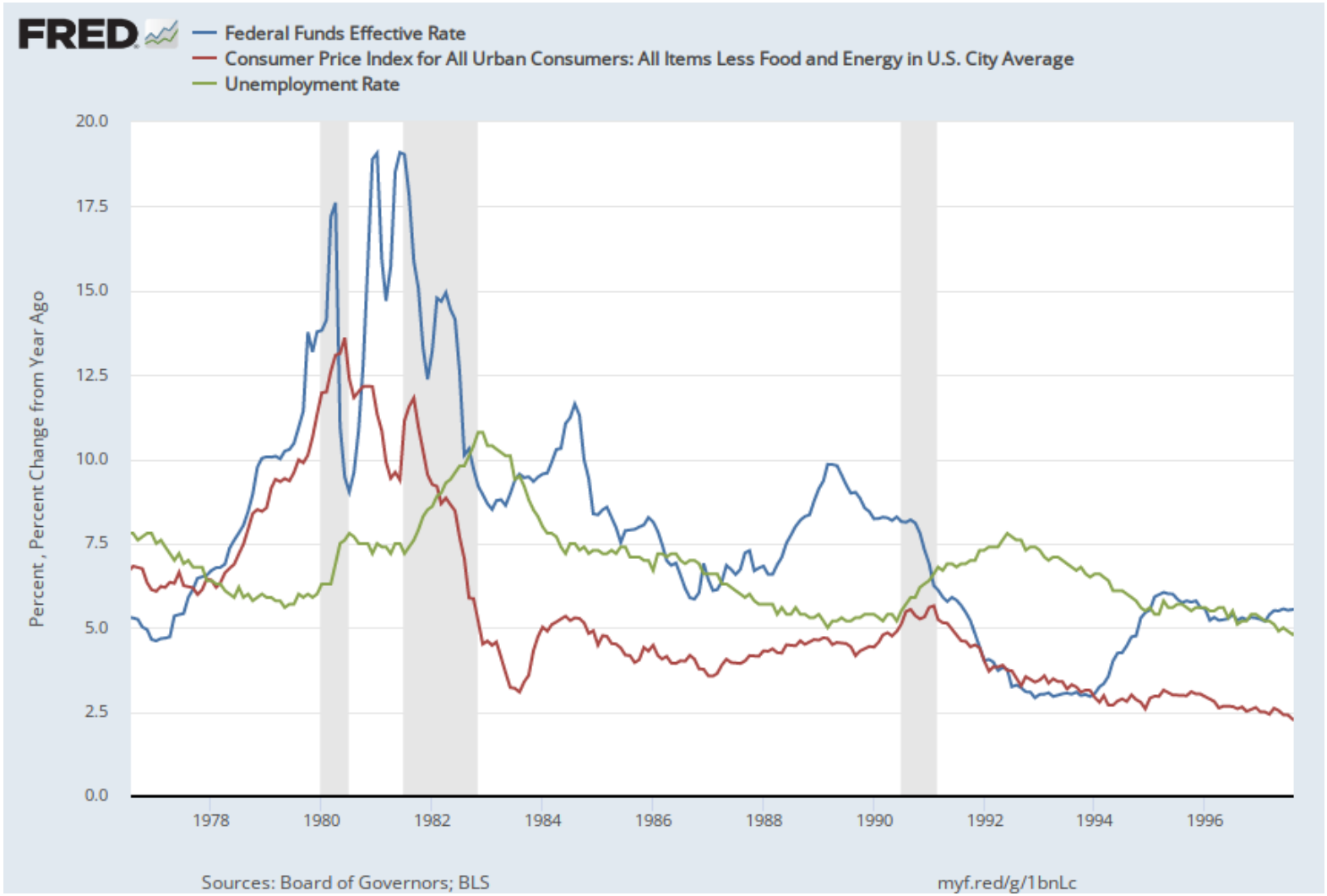
- Y is back at Y*.
- Inflation was falling the whole time Y was below Y*, and there was never a period when Y was above Y*.
- Thus, inflation is lower in the long run.
- We can also see this from the reaction function.
- After the disinflation episode: inflation expectations are now down to $\pi^{TARGET2}$
- Disinflation requires engineering a recession

Seeing from the Reaction Function How Inflation Must Change in the Long Run



Short-run: move from A to B. Higher r depresses output below Y* which then slowly reduces inflation until C is reached in the long-run

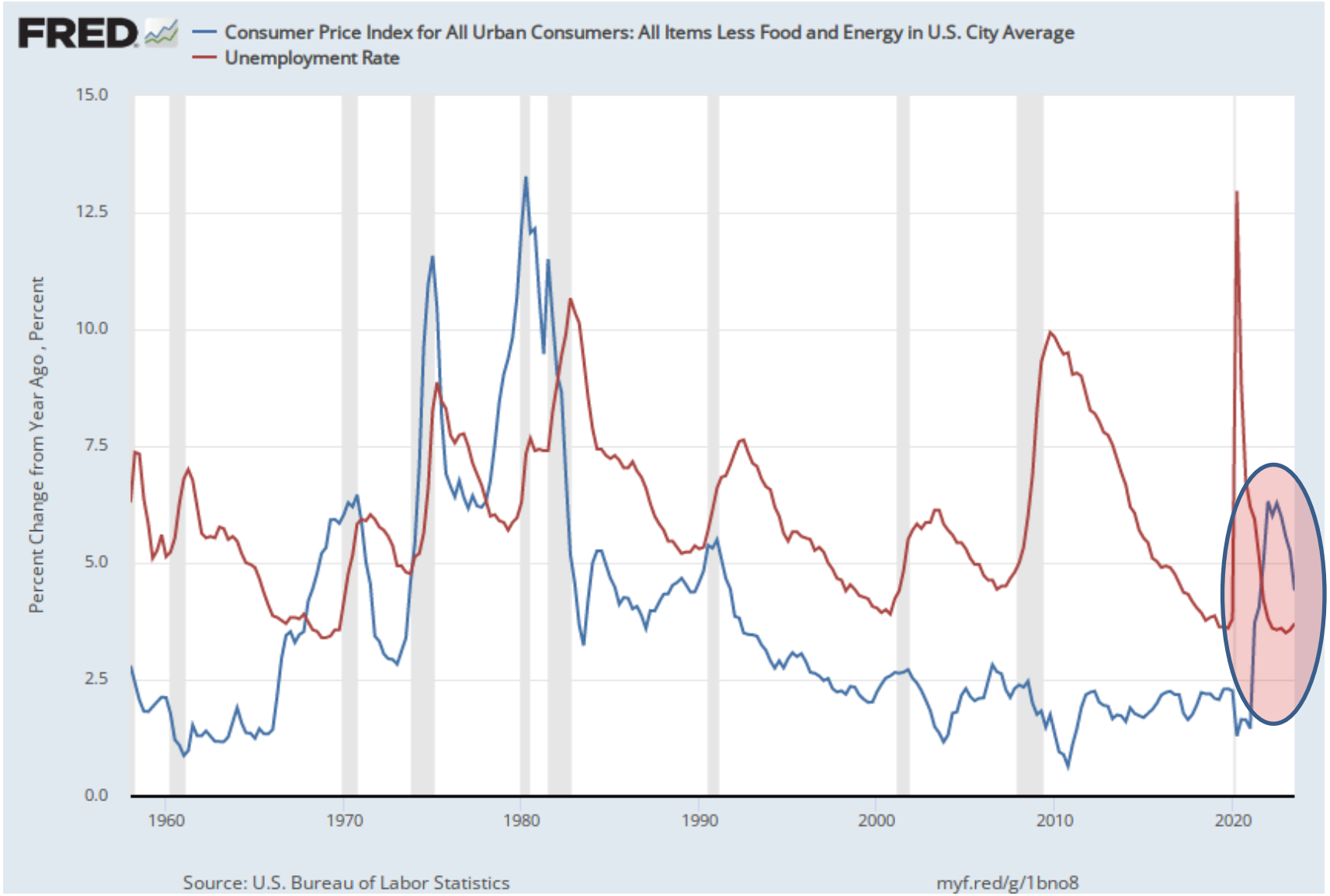
The nominal interest rate, unemployment, and inflation: The Volcker Disinflation



Source is Fred. In 1979, Volcker increased interest i sharply and kept it high even with high unemployment in 1980-1982 until inflation abated down to 4%.

VI. The Current State of the Economy and the Recent Behavior of Inflation

Inflation and unemployment

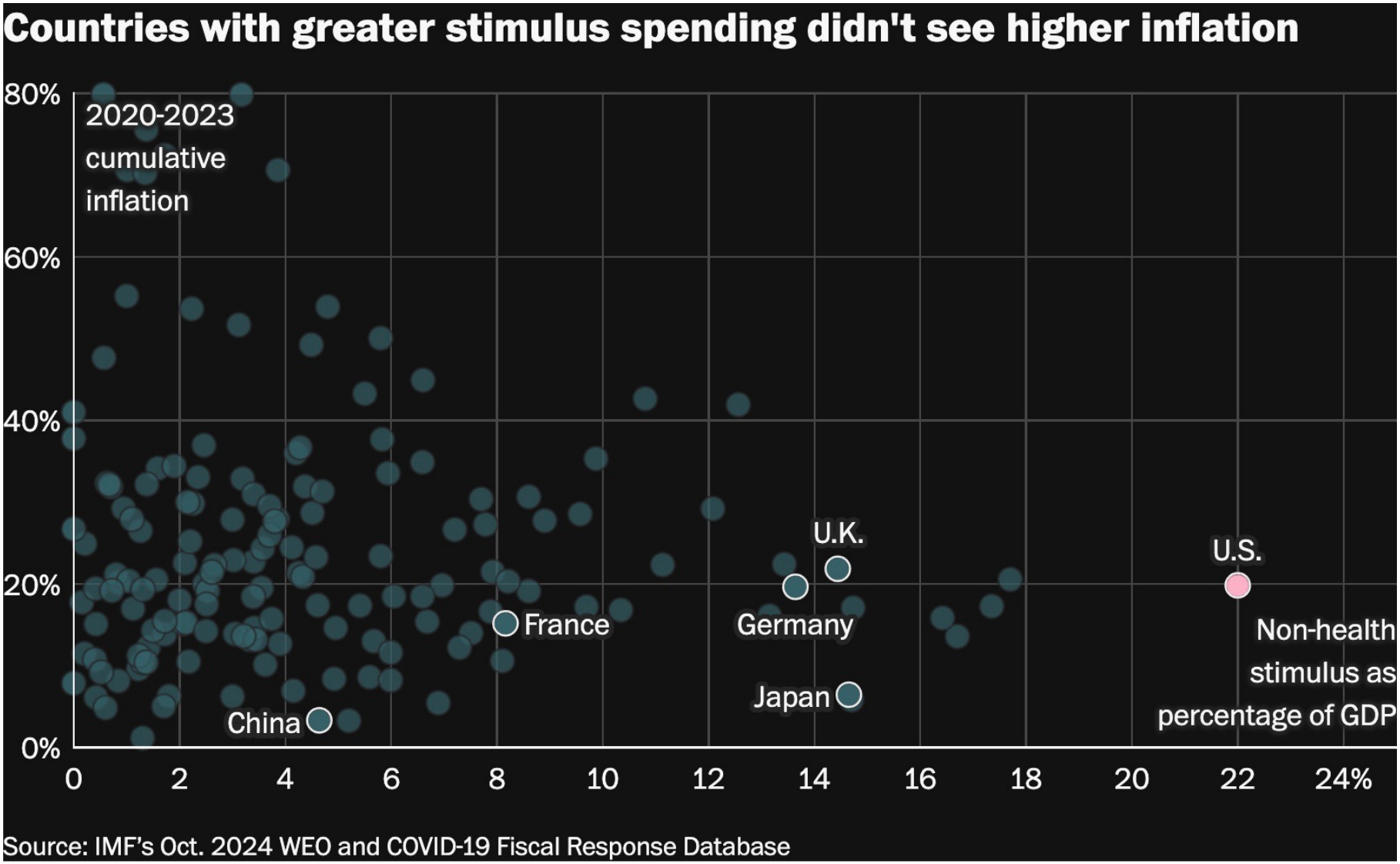


After COVID, unemployment fell quickly and core inflation shot up.
Inflation has come back down in 2024.

Candidate Explanations of the post-COVID Recent Rise in Inflation

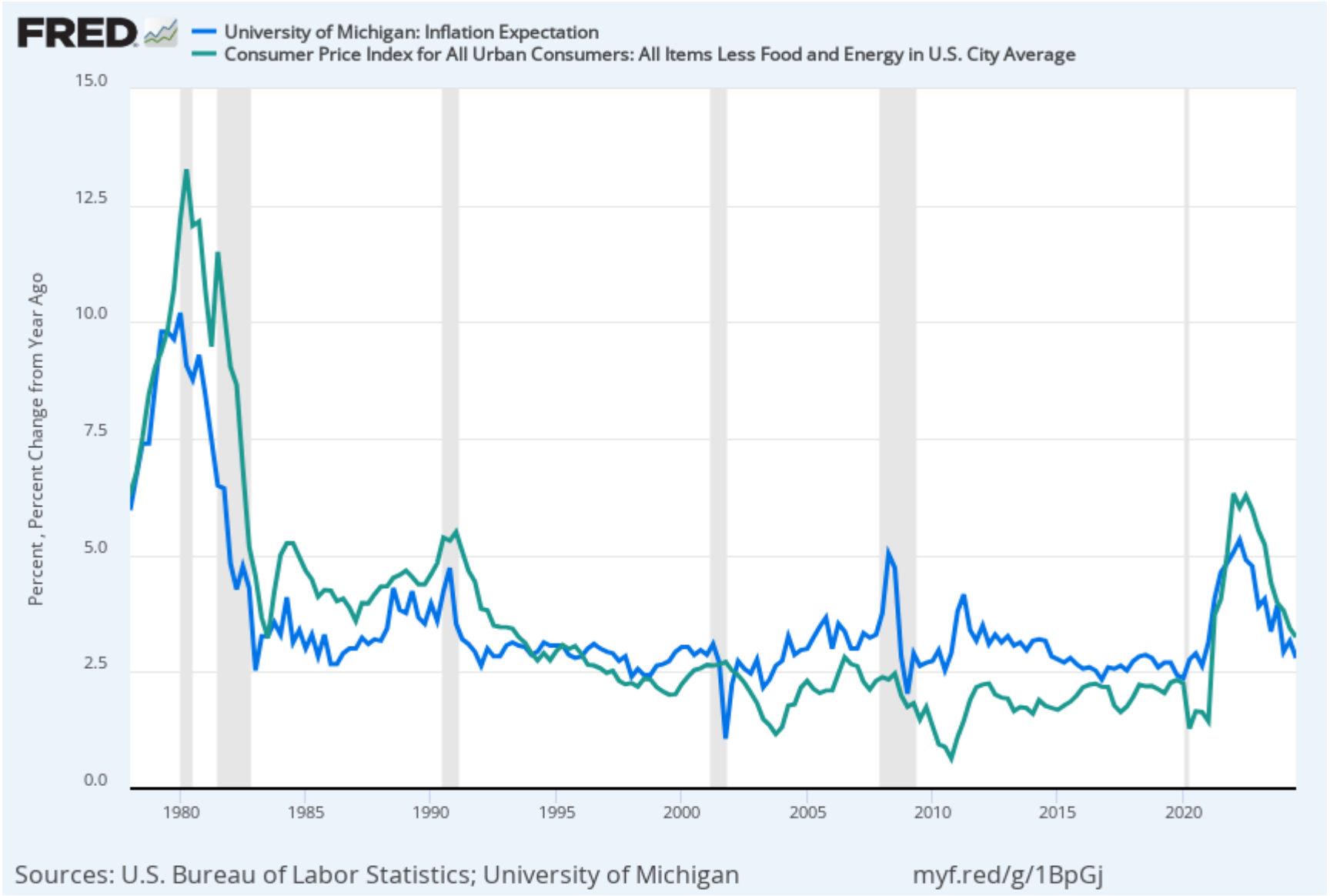
- Cost-push: Transport disruptions created inflation shock
- Demand-pull: $Y > Y^*$ (fiscal stimulus too big) caused a rise in inflation
- Expectations of high inflation
  - Survey of respondents strongly suggests that most people believe that inflation is going to come down
  - This suggests that higher inflation is not anchored in people's views (in contrast to US 1970s or Argentina today)

Excess inflation vs. size of Fiscal Stimulus



Orzag WAPO 2024: Countries with less fiscal stimulus than US also experienced excess inflation suggesting that fiscal stimulus is not the main culprit

Expected inflation (next year) and core inflation



University of Michigan survey tracks inflation expectations (for next year). Inflation expectations were high in the late 1970s.

Proposed Interpretation of post-COVID recovery

- By mid-2021, Y was probably back around Y*
- Starting around September 2021, Y has been somewhat above Y*
- Fed has increased nominal interest rate from 0% to 5% in 2022-3 and continues to monitor inflation
- Inflation is now getting back to normal 2%: so far we are having a soft landing (no recession needed to make inflation come down)

Quiz on Inflation and COVID

Inflation went down from 6-7% in 2021-23 down to about 2.5% in 2024 but Y stayed above or at Y* (no recession). Using the model from this lecture, what does it imply?

A. The high inflation post-COVID was driven primarily by cost-push inflation shock (COVID disruptions)

B. The high inflation post-COVID did not become entrenched as the new normal expected inflation

C. The high inflation post-COVID was driven primarily by excessive fiscal-monetary response to COVID recession

D. All of the above

The Fed's View

- May 2022 (Fed "Minutes"): "members agreed that, with appropriate firming in the stance of monetary policy, they expected inflation to return to the Committee's 2 percent objective and the labor market to remain strong."

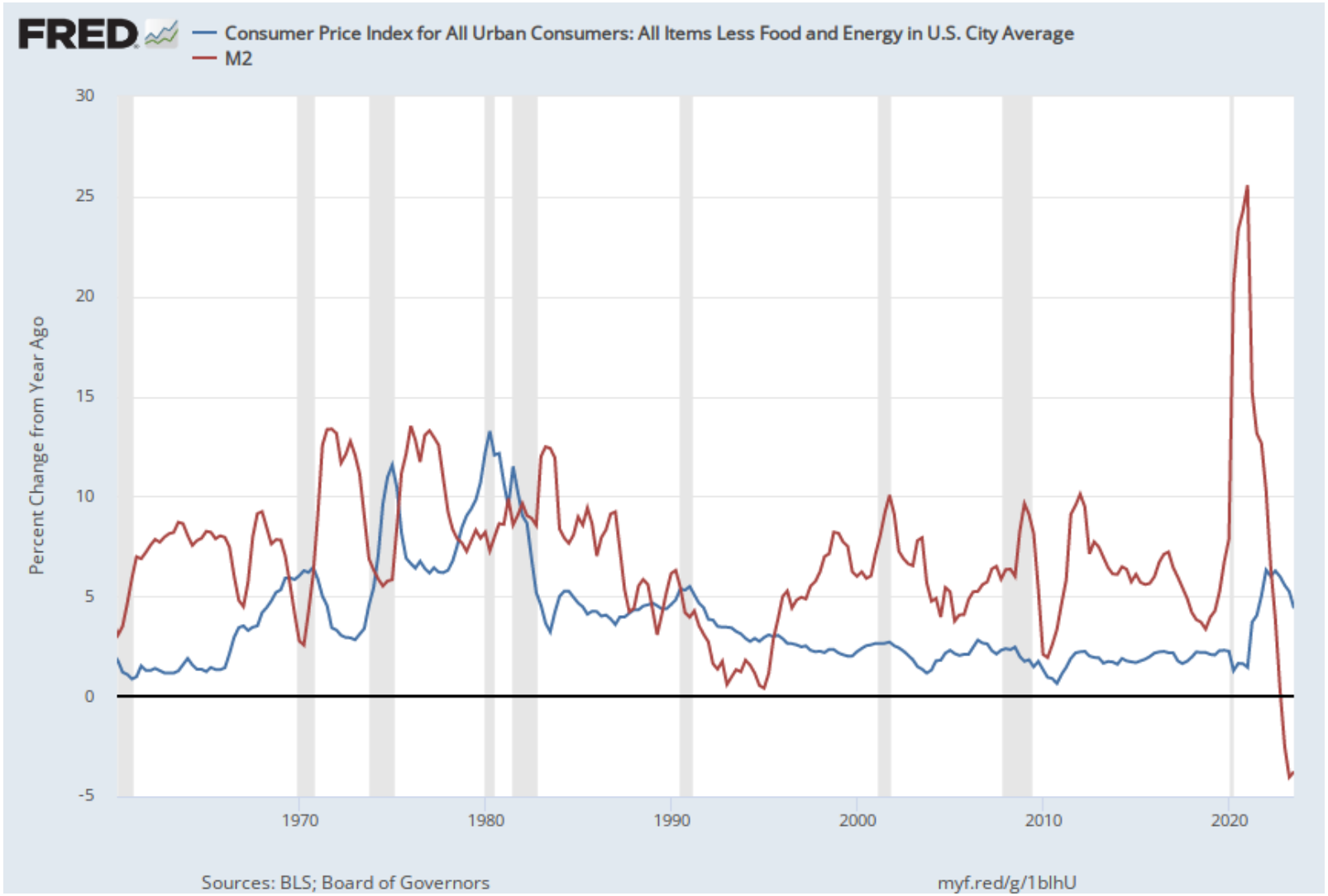
- August 2022 (Fed Chair Jerome Powell): "While higher interest rates, slower growth, and softer labor market conditions will bring down inflation, they will also bring some pain to households and businesses. These are the unfortunate costs of reducing inflation."

VII. When Inflation gets out of hand: Hyperinflation and Money

Money and Inflation

- Rapid growth of the money stock can cause high inflation (and *very* high inflation is *almost always* caused by *very* rapid money growth).
- However, outside hyperinflation episodes, there is not a *direct* link from high money growth to inflation.
- Rather: Higher money growth => a lower real interest rate => PAE shifts up => Y > Y* => over time, inflation rises.
- If prices were fully flexible, more money supply would immediately translate into price increases

Price inflation is not closely related to the growth in money for moderate inflation levels



Source: FRED. M2 is broad money aggregate that includes currency, checking accounts, and also savings accounts. Money and prices not closely related due to price rigidities

Hyperinflation = inflation over 50%/month

- Huge psychological and economic costs
- Money ceases to function as a store of value, unit of account, and medium of exchange: people use foreign currency (like $)
- Hyperinflation always caused by runaway money growth to fund government debt (monetization of debt): central bank prints money for govt
- Can only be solved by fiscal stabilization (cut spending or raise taxes) which is challenging

Price inflation is always closely related to the growth in money for very high inflation levels

EXAMPLES OF HYPERINFLATION

country	***period***	***CPI Inflation*** *% per year*	***M2 Growth*** *% per year*
Israel	1983-85	338	305
Brazil	1987-94	1,256	1,451
Bolivia	1983-86	1,818	1,727
Ukraine	1992-94	2,089	1,029
Argentina	1988-90	2,671	1,583
Dem. Republic of Congo / Zaire	1990-96	3,039	2,373
Angola	1995-96	4,145	4,106
Peru	1988-90	5,050	3,517
Zimbabwe	2005-07	5,316	9,914

M2 is broad money aggregate that includes currency, checking accounts, and also savings accounts. Money and prices are closely related with very high inflation

References

- CORE-The Economy, Chapter 15.
- Principles of Economics, Chapters 26, 27.