Central Banking and Monetary Policy

Lecture 4b

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Two Financial Crises, Different Outcomes

Central question · A financial crash in 1929. By 1933 one worker in four had no job, and prices had fallen about 25 percent.

Then 2008: the largest financial shock since. Banks in trouble. Credit froze. The policy rate went to zero.

Yet no depression this time. Prices did not collapse. No quarter of the labor force lost its job.

Both crises began in finance. The macroeconomic outcomes were very different.

Why did 2008 not become 1933?

Lecture Outline

We proceed in seven steps.

1. **Aggregate Demand and Aggregate Supply** derive AD and AS
2. **Short-run Adjustment** price and demand shocks
3. **Inflation Expectations** credibility and time consistency
4. **Financial Frictions** risk premia and borrowing rates
5. **The zero lower bound and deflation** real rates at the policy floor
6. **Policy Responses in 2008** QE, bank capital and fiscal policy
7. **Summary** comparison of 1933 and 2008

Aggregate Demand and Aggregate Supply

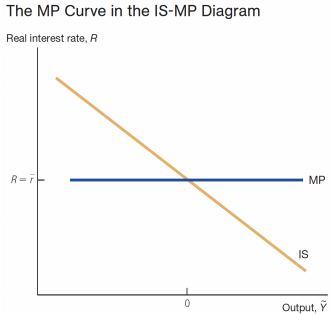
The Short-Run Model: Reminder

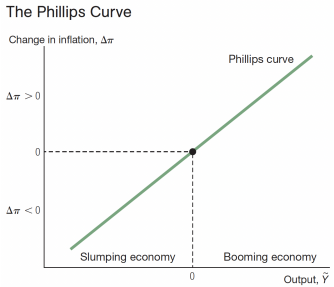
- The following diagram shows how monetary policy affects the economy using the three building blocks of the short-run model:

$$\text{MP curve: The central bank chooses : } R_t \rightarrow \quad \uparrow_{i_t} \Rightarrow \uparrow R_t$$

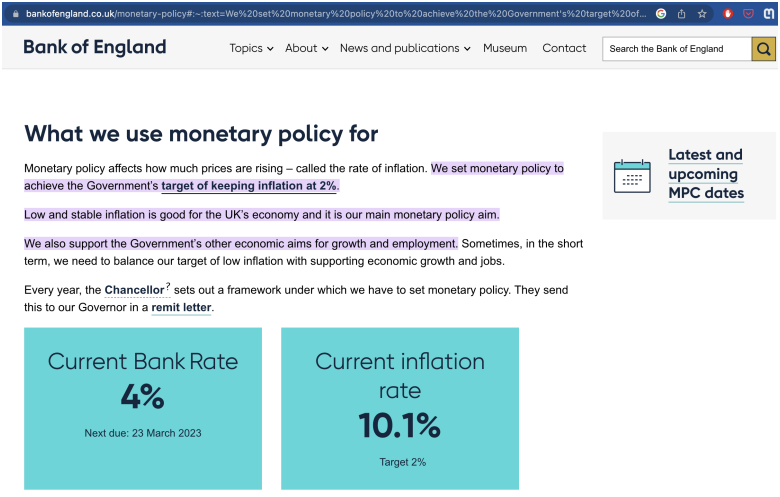
$$\text{IS curve} \ : \quad \tilde{Y}_t = \overline{a} - \overline{b}\,(R_t - \overline{r}) \quad \rightarrow \quad \uparrow R_t \Rightarrow \downarrow \tilde{Y}_t$$

$$\text{Phillips curve} \ : \quad \Delta\pi_t = \overline{v}\tilde{Y}_t + \overline{o} \quad \rightarrow \quad \downarrow \tilde{Y}_t \Rightarrow \downarrow \Delta\pi_t$$





Inflation Target



The monetary-policy rule

The model tracks two numbers. **Inflation** π_t is how fast prices rise this year; $\bar{\pi}$ is the central bank's **target**. **Short-run output** $\widetilde{Y}_t$ is how far output sits above or below potential, in percent.

Last lecture gave us the **IS curve**:

$$\widetilde{Y}_t = \bar{a} - \bar{b}(R_t - \bar{r}),$$

spending falls when the real borrowing rate R_t rises above the long-run rate $\bar{r}$.

The monetary-policy rule ·

$$R_t - \bar{r} = \bar{m}(\pi_t - \bar{\pi})$$

When inflation is above target, the bank raises its rate above $\bar{r}$. The number $\bar{m}$ says how aggressively it responds. With $\bar{m} = \frac{1}{2}$, inflation 2 points above target raises the real rate by 1 point. The US, the UK and many economies set $\bar{\pi} = 2\%$.

Deriving AD from IS and monetary policy

The policy rule gives the interest-rate gap $R_t - \bar{r}$. Substitute it into the IS curve.

Aggregate demand ·

$$\widetilde{Y}_t = \bar{a} - \bar{b}\,(\,R_t - \bar{r}\,) \qquad \text{spending falls when the rate rises}$$

$$R_t - \bar{r} = \bar{m}\,(\pi_t - \bar{\pi}) \qquad \text{the bank's response to inflation}$$

$$\widetilde{Y}_t = \bar{a} - \bar{b}\,\bar{m}\,(\pi_t - \bar{\pi}) \qquad \text{replace the bracket with the rule}$$

Reading it: when $\pi_t > \bar{\pi}$, the real rate rises and output falls below potential.

$\bar{a}$ demand shock, $\bar{m}$ policy aggressiveness (hawk = high), $\bar{b}$ rate sensitivity.

Why the AD curve slopes down

AD is drawn with inflation on the vertical axis and output on the horizontal axis. The slope comes from the monetary-policy rule.

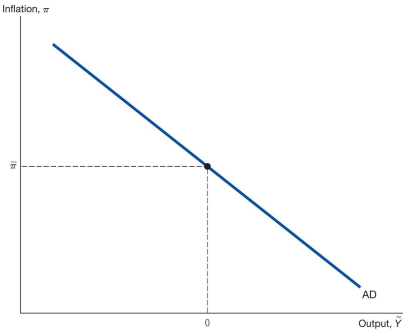


Figure 13.1. Source: Jones 6e (Norton, 2024).

- Higher inflation π_t leads the bank to **raise its rate**. More expensive credit lowers output $\tilde{Y}_t$, so AD slopes **down**.
- The slope comes from the **policy rule** (the bank's behavior), not a household demand curve.
- A change in $\bar{a}$ or the target $\bar{\pi}$ **shifts** the curve. A change in inflation is a **movement along** it, because inflation is on the axis.

Takeaway · AD summarizes the central bank's policy response: higher inflation raises the real rate and lowers output.

Policy aggressiveness and the AD slope

Two central banks face the same economy. One responds strongly to inflation; one responds weakly. The difference appears in the slope of AD.

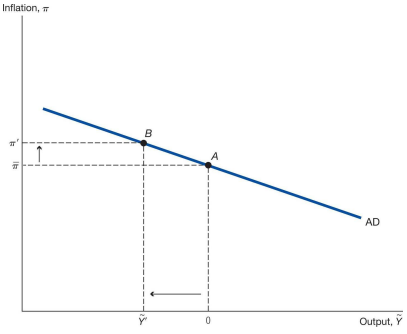


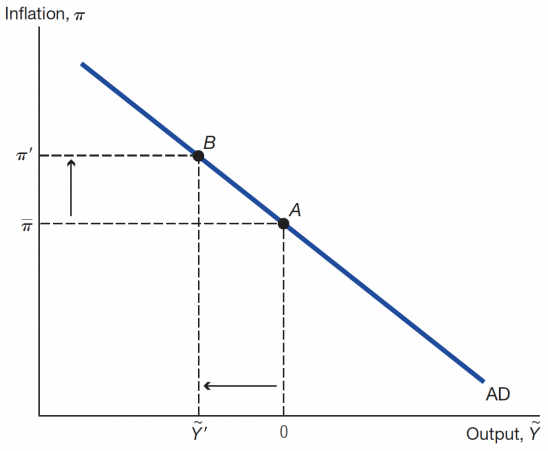
Figure 13.3. Source: Jones 6e (Norton, 2024).

- A bank that fights hard has a high $\bar{m}$. We call it **hawkish**: a small rise in inflation triggers a large fall in $\widetilde{Y}_t$, so its AD curve is **flatter**.
- A gentle bank has a low $\bar{m}$. We call it **dovish**: the same rise in inflation moves output only a little, so its AD curve is steeper.

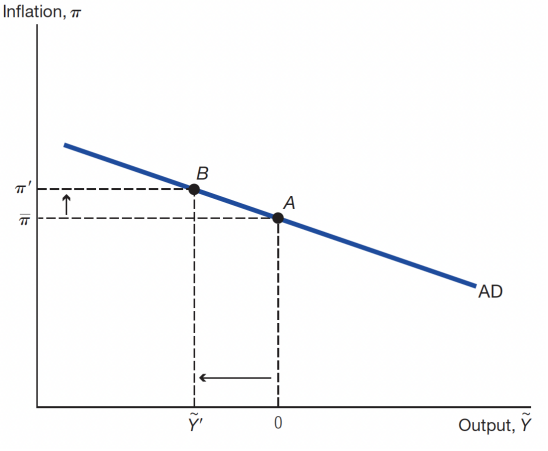
The parameter $\bar{m}$ measures the strength of the policy response to inflation.

Hawkish vs Dowish

The AD Curve after an Inflation Shock



An Aggressive Monetary Policy Rule



US vs EU

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‘Emphasise the pain’: Jay Powell keeps hawkish tone even as inflation eases

Fed chair tries to manage investor expectations following shift down to half-point rate rises

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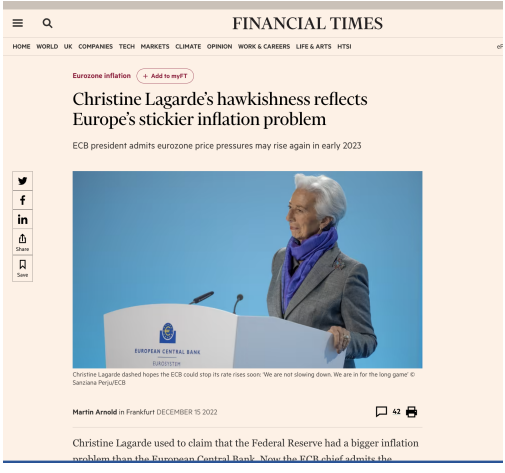
It’s good to see progress, but let’s just understand we have a long way to go to get back to price stability,’ Fed chair Jay Powell told reporters on Wednesday © Evelyn Hockstein/Reuters

Colby Smith in Washington DECEMBER 15 2022 55

As Federal Reserve officials prepared to kick off their final policy meeting of 2022 on Tuesday, they received some welcome news: inflation, which has been running at multi-decade highs for more than a year, fell decisively in



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Christine Lagarde’s hawkishness reflects Europe’s stickier inflation problem

ECB president admits eurozone price pressures may rise again in early 2023

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Christine Lagarde dashed hopes the ECB could stop its rate rises soon: ‘We are not slowing down. We are in for the long game’ © Sanziana Perju/ECB

Martin Arnold in Frankfurt DECEMBER 15 2022 42

Christine Lagarde used to claim that the Federal Reserve had a bigger inflation problem than the European Central Bank. Now the ECB chief admits the

The Aggregate Supply Curve

- Having looked at the demand side of the economy, it is time to look at the supply side of the economy
- Aggregate supply (AS) curve is simply the price-setting equation used by firms in the economy:
- Remember the Phillips curve :

$$\Delta\pi_t = \overline{v}\tilde{Y}_t + \overline{o} \quad \rightarrow \quad \downarrow \tilde{Y}_t \Rightarrow \downarrow \Delta\pi_t$$

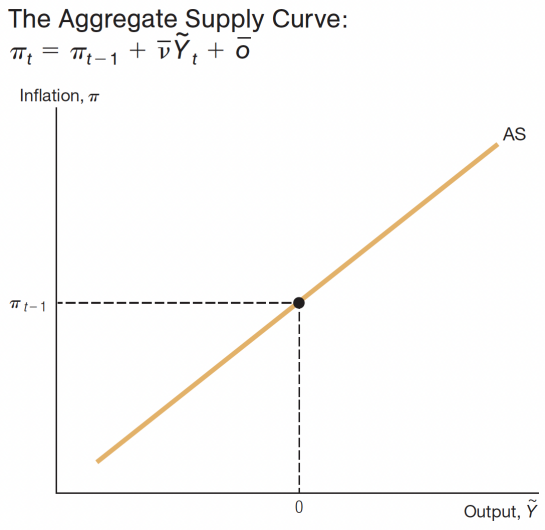
- By relabeling existing the Phillips curve. That is, our AS curve:

$$\pi_t = \pi_{t-1} + \overline{v}\tilde{Y}_t + \overline{o} \tag{1}$$

- Notice the following: holding π_{t-1} fixed (after all, it has already been determined by the time period t begins),
- the Phillips curve is an equation that relates the current rate of inflation π_t to short-run output.

The Aggregate Supply Curve

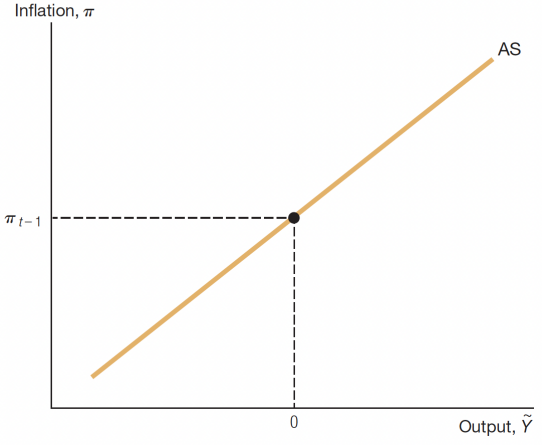
- Thus the relation is upward-sloping, the aggregate supply curve is shown in Figure .
- Note that the AS curve is that the intercept-the point in the graph where short-run output is equal to zero-is equal to π_{t-1}.
- This means that if the inflation rate is changing over time, the aggregate supply curve will shift over time, an important feature of our model.
- The curve may also shift because of inflation shocks-for example, if $\overline{o}$ becomes positive for a period.



The Aggregate Supply Curve

- Finally, recall why there is a π_{t-1} term in the Phillips curve.
- This term reflects expected inflation. $\pi^e = \pi_{t-1}$
- The expected inflation rate in the coming period is equal to last period's inflation rate.
- When there are no inflation shocks and when output is at potential, firms simply expect the current rate of inflation to continue.
- This interpretation of π_{t-1} as expected inflation plays a crucial role in what follows.

The Aggregate Supply Curve:
$\pi_t = \pi_{t-1} + \overline{\nu}\tilde{Y}_t + \overline{o}$



AS/AD Framework

- Now combine the aggregate demand and aggregate supply curves to create a more elegant version of our short-run model.
- Mathematically, the two curves are AD curve: $\tilde{Y}_t = \bar{a} - \bar{b}\bar{m}\,(\pi_t - \bar{\pi})$

$$\text{AD curve: } \tilde{Y}_t = \overline{a} - \overline{b}\overline{m}\,(\pi_t - \overline{\pi})$$

$$\text{AS curve: } \pi_t = \pi_{t-1} + \overline{v}\tilde{Y}_t + \overline{o}$$

- We have two equations and two unknowns, π_t and $\tilde{Y}_t$.
- Be carefull that this is **a dynamic model**, solving it is more complicated than just solving two equations-there's also the π_{t-1} term to worry about.

Short-run equilibrium in AS/AD

AS rises, AD falls, and their intersection determines inflation and the output gap in the current period.

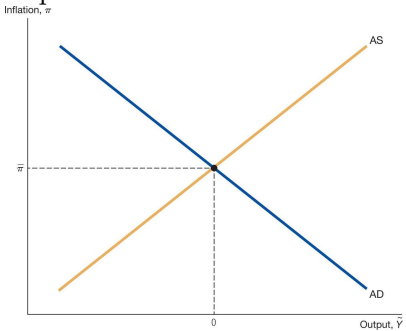


Figure 13.5. Source: Jones 6e (Norton, 2024).

- Two things are unknown: inflation π_t and short-run output $\widetilde{Y}_t$. The crossing point gives you both at once.
- With no shocks, the economy rests at its **steady state**: output sits at potential ($\widetilde{Y}_t = 0$) and inflation sits at target $\bar{\pi}$.

This benchmark is the starting point for studying shocks and adjustment.

Short-run Adjustment

Oil shock: impact

Start at the steady state A. An oil-price increase is a temporary price shock:

$$\bar{o} > 0.$$

- In AS,

$$\pi_t = \pi_{t-1} + \bar{v}\widetilde{Y}_t + \bar{o},$$

  a higher $\bar{o}$ raises inflation at each output level.

- AS shifts up. Along AD, the economy moves from A to B.

- The outcome is **stagflation**: higher inflation and output below potential.

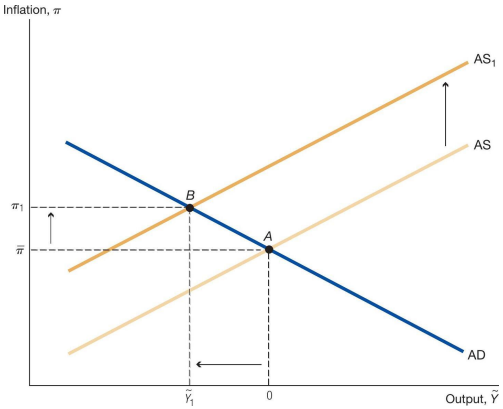


Figure 13.6. Source: Jones 6e (Norton, 2024).

Oil shock: persistence

The oil shock itself lasts one period. Inflation does not immediately return to target because expectations are adaptive:

$$\pi_t^e = \pi_{t-1}.$$

- High inflation at B becomes next period's expected inflation.
- AS remains above its original position.
- A negative output gap gradually brings inflation back down.

The path $B \to C \to D \to A$ is the cost of inflation persistence.

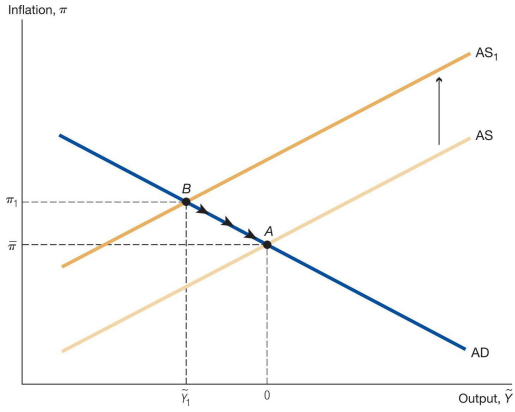


Figure 13.9. Source: Jones 6e (Norton, 2024).

Demand shock: impact

Now consider a temporary increase in demand, for example stronger foreign demand for domestic goods:

$$\bar{a} > 0.$$

- In AD,

$$\widetilde{Y}_t = \bar{a} - \bar{b}\bar{m}(\pi_t - \bar{\pi}),$$

  a higher $\bar{a}$ raises demand at each inflation rate.

- AD shifts out. The economy moves from A to B.

- Output rises above potential and inflation increases.

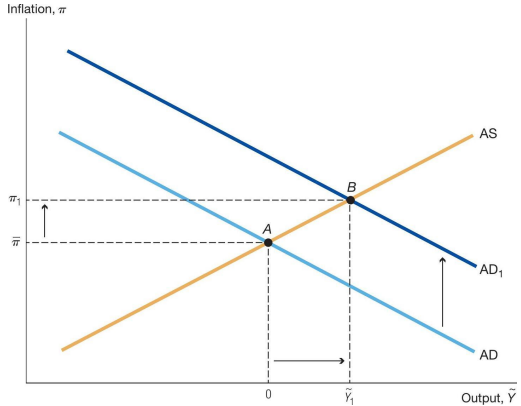


Figure 13.12. Source: Jones 6e (Norton, 2024).

Demand shock: adjustment

When the demand shock ends, $\bar{a}$ returns to zero and AD shifts back.

- Inflation is now above target because of the earlier boom.
- Higher lagged inflation shifts AS up.
- Output must fall below potential while inflation returns to target.

The steady state is unchanged, but the transition includes a temporary recession.

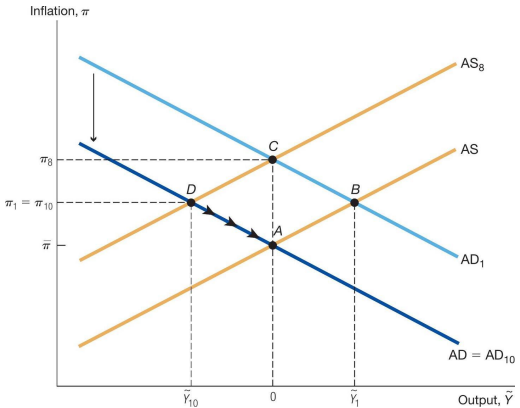


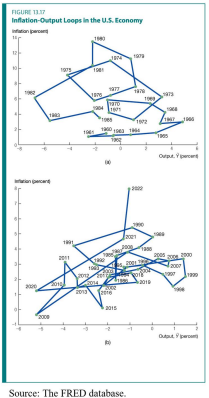
Figure 13.14. Source: Jones 6e (Norton, 2024).

AS/AD dynamics in the data

The model predicts a repeated pattern in inflation-output space.

- High output raises inflation through AS.
- High inflation induces tighter policy through AD.
- The typical path is a **counterclockwise loop**.

The US data broadly match this pattern. The 2009–2011 period is an exception: inflation rose despite weak output.



Source: The FRED database.

Figure 13.17. Source: Jones 6e (Norton, 2024).

> **Takeaway** · Short-run adjustment is gradual because expected inflation depends on past inflation.

Financial Frictions

Risk premia and borrowing rates

Firms and households do not borrow at the central bank's rate. Lenders charge extra to cover the risk that a loan is not repaid. That extra is the **risk premium** $\bar{f}$ (a financial friction, the gap between the policy rate and what you actually pay).

The interest-rate wedge ·

$$R = R_{ff} + \bar{f}$$

- R_{ff} is the rate the bank sets (the federal funds rate). R is what borrowers actually pay, and R is what moves spending. Both are **real** rates (measured in goods), made precise at the zero lower bound.
- In normal times $\bar{f}$ is small and steady, so changes in R_{ff} pass through to R.
- In a crisis $\bar{f}$ can **increase sharply**. The rate that matters for spending can rise even while the bank cuts.

A large increase in $\bar{f}$ weakens the central bank's control over borrowing rates.

2008: credit spreads widen

The figure shows the yield (the interest rate a bond pays) on corporate bonds and on government bonds, called Treasuries. The gap between the two lines measures the risk premium $\bar{f}$.

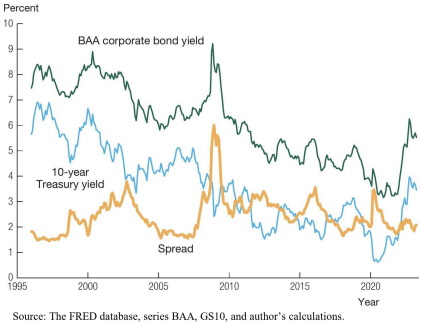
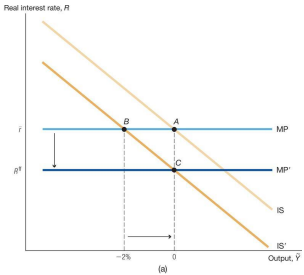


Figure 14.1. Source: Jones 6e (Norton, 2024).

- The spread is usually about **2 percentage points**.
- In 2008 it rose **above 6 points**: as the Fed cut, Treasury yields fell but corporate yields rose.
- So businesses faced more expensive credit even as the Fed cut its own rate toward zero.

Takeaway · During the crisis, the policy rate fell but private borrowing rates rose. Financial frictions shifted aggregate demand left.

The crisis in the IS-MP picture



Here we trace the crisis in the spending-and-rate picture: the IS curve (planned spending at each rate) and the policy rate. There are two channels.

- **First channel.** Falling house prices cut household wealth and consumption. The IS curve shifts left, so the Fed cuts its rate to support output.
- **Second channel.** The increase in $\bar{f}$ (the risk premium) raises the borrowing rate anyway, and that deepens the recession.
- The Fed wants to cut further and **cannot**: its rate is already near zero.

The wedge pushes borrowing costs up while the zero lower bound limits further conventional rate cuts.

Figure 14.2. Source: Jones 6e (Norton, 2024).

Financial crisis in AS/AD

Same 2008 crisis, now in AS/AD. The wedge enters through IS: borrowers pay $R = R_{ff} + \bar{f}$, and the rule now sets R_{ff}, so

$$\widetilde{Y}_t = \bar{a} - \bar{b}(R_{ff} + \bar{f} - \bar{r}) = (\,\bar{a} - \bar{b}\,\bar{f}\,) - \bar{b}\,\bar{m}(\pi_t - \bar{\pi}).$$

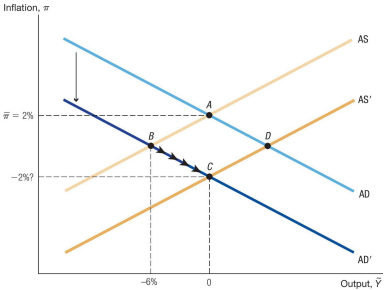


Figure 14.3. Source: Jones 6e (Norton, 2024).

- A jump in $\bar{f}$ shrinks the intercept $\bar{a} - \bar{b}\,\bar{f}$. It acts exactly like a **negative demand shock**.
- AD shifts down and left: a deep recession, with inflation *below* target.
- If inflation falls far enough, prices fall outright: **deflation**, the next section.

The risk premium enters AD as a negative demand disturbance.

Appendix: derivation

The zero lower bound and deflation

The zero lower bound

The zero lower bound

- The **nominal** interest rate (the rate as quoted, in money) cannot fall much below **zero**. If a bank charged -3% on your deposit, you would empty the account and hold cash instead, and cash pays exactly zero.
- So once the nominal policy rate reaches zero, cutting further stops being available. This limit is the **zero lower bound**.
- A few central banks did go slightly negative, around -0.3%: Denmark, Switzerland, Japan, and the euro area. They moved only by small amounts, so the floor sits a little below zero, not far below.

At the zero lower bound, conventional rate cuts are exhausted. The key variable is the *real* interest rate.

Expected inflation and the real rate

Spending responds to the **real interest rate** (the nominal rate minus expected inflation), the cost of borrowing measured in goods. It is the R in the wedge equation.

The zero lower bound binds the *nominal* rate; expectations link it to the real rate.

> **The Fisher relation at the zero bound** · When the nominal rate is stuck at zero, the real rate is
>
> $$R = -\pi^e.$$

- π^e is **expected inflation**, the same expectations that set the AS intercept, where last year's inflation π_{t-1} was the forecast.
- If you expect prices to **fall**, π^e is negative, so the real rate R is **positive**.

At the zero lower bound, expected inflation determines the real rate relevant for spending.

The deflationary spiral

A positive real rate at the floor is not just bad luck. It feeds on itself.

- Deflation raises the real rate. At the floor the nominal rate is zero, so $R = -\pi^e$ (from the last slide): falling prices make $\pi^e < 0$, so R is positive. A higher real rate cuts investment, so $\widetilde{Y}_t$ falls further and the recession deepens.
- The weaker economy pushes inflation lower still. In $\pi_t = \pi_{t-1} + \bar{v}\,\widetilde{Y}_t + \bar{o}$, a negative $\widetilde{Y}_t$ drags π_t down, the real rate rises again, and the loop repeats: the **deflationary spiral**.
- The usual stabilizing forces run backward. Irving Fisher described this debt-deflation mechanism in 1933, in the depths of the Great Depression.

Below zero inflation, the normal adjustment mechanism can become destabilizing.

Exercise: zero nominal rates, different real rates

Your turn · In 2009 the policy rate sat at zero. Suppose a borrower in 1933 also faced a nominal rate near zero. Between 1929 and 1933 the price level fell about 25%, and people expected the fall to continue at that pace. In 2009 the Fed kept expected inflation near 2%. Find the real interest rate in each case. Then say which economy receives monetary stimulus from its near-zero nominal rate.

Work through the calculation before reading the solution.

1933:	$\pi^e \approx -25\%/4 \approx -6\%$ a year	prices fell about 25% over four years
	$R \approx 0 - (-6\%) \approx +\mathbf{6}\%$	Fisher: nominal rate minus expected inflation
2009:	$R = 0 - 2\% = -\mathbf{2}\%$	expectations anchored near the 2% target

A near-zero nominal rate was contractionary in 1933 and expansionary in 2009. The gap $6 - (-2) = 8$ points is made entirely of expectations.

The Great Depression in the short-run model

The Great Depression sits inside our model: IS-MP on the left, the Phillips curve on the right.

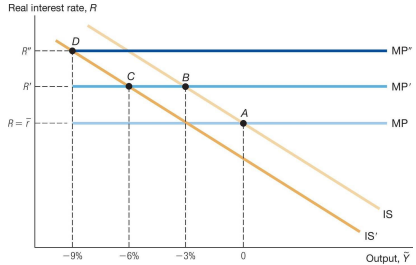


Figure 14.12: IS-MP.

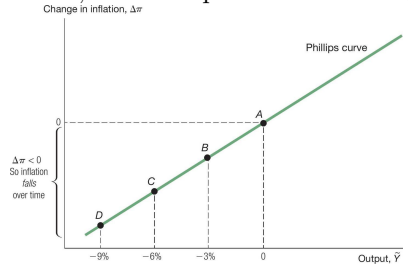


Figure 14.13: Phillips curve. Source: Jones 6e (Norton, 2024).

- In 1933 unemployment reached **25%** and the price level fell about **25%**.
- Friedman and Schwartz (1963) argued the deep cause was **tight money**: banks failed widely, the money supply fell sharply from 1929 to 1933, and the deflation followed.

With prices falling, the near-zero nominal rate corresponded to an approximately $+6\%$ real rate.

Ending deflation in the 1930s

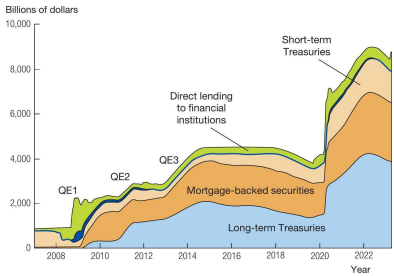
- Under the **gold standard** a dollar was a fixed weight of gold, so the money supply was chained to the gold stock. In 1933 the United States left it and devalued the dollar from about **\$20.67 to \$35** for an ounce of gold.
- That was a large monetary expansion, and it raised **inflation expectations**: with a higher π^e the real rate fell and the spiral reversed.
- Bernanke (1995) showed that countries which left gold **earlier** recovered earlier, and the United Kingdom left in 1931.

The relevant policy channel was not a lower nominal rate, impossible at the floor, but a change in expected inflation. This distinction is central to the comparison with 2008.

Policy Responses in 2008

Quantitative easing

With its policy rate at zero, the Fed began buying assets other than short-term government bonds. The figure reports the scale of the balance sheet (everything the Fed owns and owes).



Source: Credit Easing. Federal Reserve Bank of Cleveland. clevelandfed.org/en/our-research/indicators-and-data/credit-easing.aspx. Reprinted with permission.

Figure 14.9. Source: Jones 6e (Norton, 2024).

Buying assets in large amounts while the rate sits at the floor is **quantitative easing** (QE).

- The Fed's assets grew about **fivefold**, from \$900 billion in 2007 to \$4.5 trillion by 2015, through three rounds (QE1 to QE3).
- The purchases were paid for by crediting banks' reserve accounts, not by issuing currency directly.
- The objective was to keep credit flowing after conventional rate cuts had reached the zero lower bound.

Zero is the floor for the interest rate, not the end of monetary policy.

Bank recapitalization and fiscal stimulus

- **TARP** (the Troubled Asset Relief Program, 2008): a **$700 billion** fund. The Treasury injected capital into banks, guaranteed loans, and helped some automakers. By the end of 2012 about **97%** had been repaid.
- **ARRA** (the American Recovery and Reinvestment Act, 2009): a **$787 billion** fiscal stimulus, roughly $250 billion in tax cuts and $500 billion in new spending. The federal deficit rose to about **10% of GDP**.

Fiscal policy is not constrained by the zero lower bound on nominal interest rates. The next lecture asks what limits it: government debt.

Why 2008 was not 1933

Now we can answer the question from the first slide.

> **Comparison** · In 1933 money was allowed to collapse. Prices fell about 25%. A near-zero rate became about a +6% real rate. The spiral ran for four years, until the gold exit reversed it.
>
> In 2008 the Fed acted quickly. It kept credit flowing with QE and avoided widespread bank failures of the 1930s kind. It also kept expected inflation **anchored near 2%**, so the real rate stayed low and no deflationary spiral began.

The recession was still the largest since the Depression: a balance-sheet crisis with a slow recovery. Two candidate explanations for that slow recovery are **secular stagnation** (weak demand and very low real rates) and a productivity slowdown since about 2004.

Yet, like the Depression, it left the long-run path of GDP largely unchanged.

Japan and persistent zero-bound conditions

Japan provides a third case: not a depression, but a long period of weak recovery and low inflation.

- A property and stock **bubble** in the late 1980s burst around 1990. At the peak, land in central Tokyo reached extraordinary prices.
- Growth in GDP per person fell from about **3.2%** a year (1970 to 1990) to about **0.7%** (1991 to 2005), with mild deflation for years.
- Japan avoided a full spiral, with QE (quantitative easing) from **2001** and large fiscal deficits, but never got the recovery it hoped for.
- Government debt rose from about **67% of GDP** in 1990 to well over **200%** today.

A zero-bound economy does not have to become 1933. It can also remain weak for a long period with mild deflation.

Summary

Recap

- The short run is summarized by AS/AD. **AD** $\widetilde{Y}_t = \bar{a} - \bar{b}\,\bar{m}(\pi_t - \bar{\pi})$ comes from the policy rule, slopes down, and is flatter for a hawk. **AS** $\pi_t = \pi_{t-1} + \bar{v}\,\widetilde{Y}_t + \bar{o}$ slopes up, and its intercept moves with last year's inflation.
- A price shock brings **stagflation** and a slow, costly return. A demand boom is paid for by a later recession. The economy loops counterclockwise.
- **Credibility** moves expectations directly. Anchored expectations made disinflation cheap and delivered the Great Moderation.
- A crisis is a **wedge**: $\bar{f}$ enters AD as $\bar{a} - \bar{b}\bar{f}$, a negative demand shock. In 2008 the spread jumped from about 2 to above 6 points.
- At the zero lower bound $R = -\pi^e$: deflation meant about $+6\%$ real in 1933, while the 2% inflation target meant about -2% real in 2009. QE, TARP and fiscal stimulus reinforced that difference.

> In normal times, monetary policy works through the real interest rate. At the zero lower bound, expected inflation and financial frictions determine whether policy remains expansionary or becomes ineffective.

Appendix: Risk Premium in AD

Start from the IS curve and the borrowing-rate wedge:

$$\widetilde{Y}_t = \bar{a} - \bar{b}(R_t - \bar{r}), \qquad R_t = R_{ff} + \bar{f}.$$

The policy rule applies to the policy-rate gap:

$$R_{ff} - \bar{r} = \bar{m}(\pi_t - \bar{\pi}).$$

$$\begin{aligned}
\widetilde{Y}_t &= \bar{a} - \bar{b}(R_{ff} + \bar{f} - \bar{r}) \\
&= \bar{a} - \bar{b}\left[(R_{ff} - \bar{r}) + \bar{f}\right] \\
&= \bar{a} - \bar{b}\left[\bar{m}(\pi_t - \bar{\pi}) + \bar{f}\right] \\
&= (\bar{a} - \bar{b}\bar{f}) - \bar{b}\bar{m}(\pi_t - \bar{\pi}).
\end{aligned}$$

$$\bar{a} - \bar{b}\bar{f}$$

is the AD intercept. A higher risk premium $\bar{f}$ lowers this intercept, so AD shifts left.

Back to AS/AD crisis

Sources

This lecture follows, and reproduces figures and examples from, the work of **Charles I. Jones**.

- Charles I. Jones, *Macroeconomics*, 6th edition, W. W. Norton, 2024, Chapters 13 and 14; all figures © W. W. Norton.
- Norton instructor lecture slides for Chapters 13 and 14, and Jones's Stanford GSB lectures (2023), Sessions 11, 12, and 13.
- Background classics cited in the text: Kydland and Prescott (1977); Lucas (1976); Friedman and Schwartz (1963); Fisher (1933); Bernanke (1995).