EC106: Introduction to Economics
– Macroeconomics –

Fatih Kansoy

kansoy

Lecture - 9 -

* University of Warwick

This Week: Outline

1. Reminder
2. The AD Curve
3. The AS Curve
4. Important Economic Events and Policies
5. Taylor Rule!

Reminder

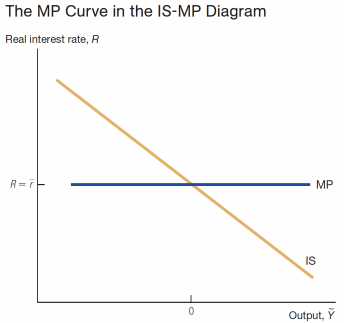
The Short-Run Model: Reminder

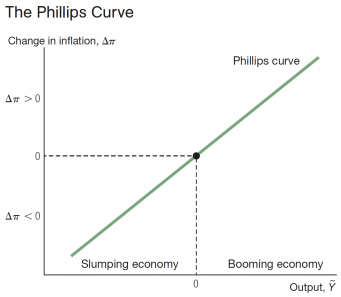
- The following diagram shows how monetary policy affects the economy using the three building blocks of the short-run model:

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

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

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





The Aggregate Demand Curve

AS - AD Framework

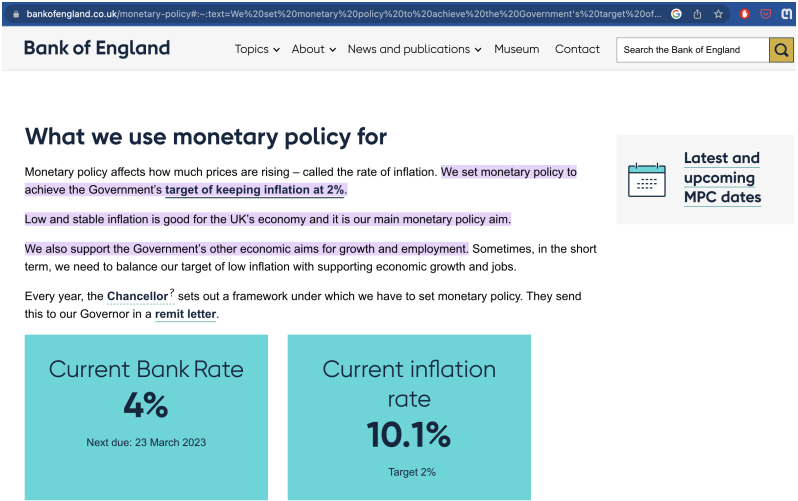
- High short- run output leads to an increase in inflation.
- As a monetary policy maker, the central bank decide the level of the real interest rate, R
- What is **the monetary policy rule?**

A monetary policy rule is a set of instructions that determines the stance of monetary policy for a given situation that might occur in the economy.

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

- If inflation is high, the interest rate should be raised by a certain amount.
- In this rule, the stance of monetary policy depends on current inflation $\overline{\pi}_t$, as well as on an inflation target $\overline{\pi}$.
- the US, the UK, and some other advanced economies have an explicit target rate of inflation of 2 percent; thus we'll take $\overline{\pi} = 2\%$

Inflation Target



AS/AD Framework

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

- The policy rule sets **the real interest rate** according to whether inflation is currently above or below the target.
- If inflation is above its target level, the rule says the real interest rate should be high, so policymakers should **tighten monetary policy**.
- Conversely, if inflation is below its target level, the rule says the real interest rate should be low, so as to stimulate the economy.
- The parameter $\overline{m}$ governs how aggressively monetary policy responds to inflation.
- If inflation is 1 percentage point higher than the target, the rule says the real interest rate should be raised above the marginal product of capital by $\overline{m}$ percentage points.
- For example, with $\overline{m} = 1/2$, an inflation rate that is 2 percentage points above the target would lead policymakers to raise the real interest rate by 1 percentage point.

The AD Curve

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

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

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

Monetary Policy Rule: $R_t - \bar{r} = \bar{m}\,(\pi_t - \bar{\pi})$

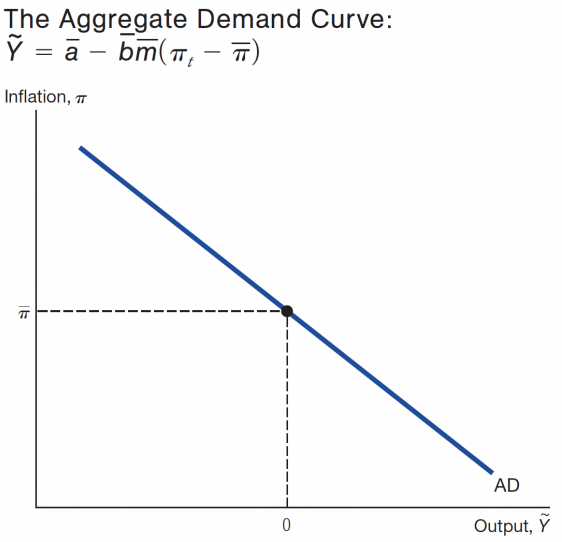
- We combine this monetary policy rule with the IS curve. We substitute for the $R_t - \bar{r}$ term in the IS curve with the rule itself, which says this interest rate gap depends on inflation.

$$\left.\begin{array}{l} \text{IS curve:} \quad \tilde{Y}_t = \bar{a} - \bar{b}\,(R_t - \bar{r}) \\ \text{Policy rule: } R_t - \bar{r} = \bar{m}\,(\pi_t - \bar{\pi}) \end{array}\right\} \Rightarrow \text{ AD curve: } \tilde{Y}_t = \bar{a} - \bar{b}\bar{m}\,(\pi_t - \bar{\pi})\,. \tag{1}$$

AD curve:

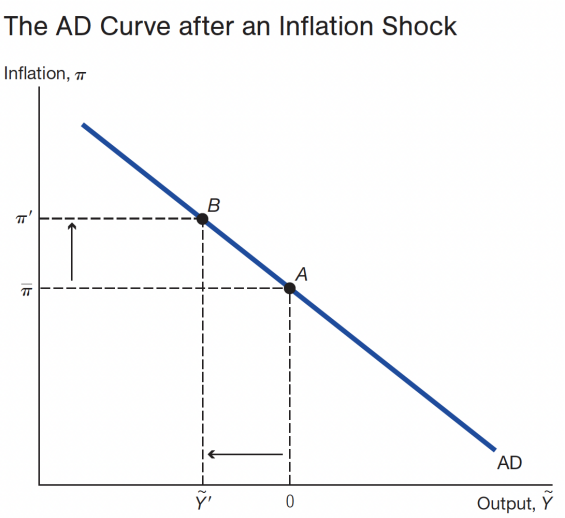
$$\tilde{Y}_t = \bar{a} - \bar{b}\overline{m}(\pi_t - \overline{\pi})$$

- The aggregate demand curve is shown in Figure.
- The AD curve describes how the central bank chooses short-run output based on the rate of inflation.
- If inflation is above its target level, then the central bank raises the interest rate to push output below potential. The reasoning is that as the economy softens, inflation will be restrained in the future.



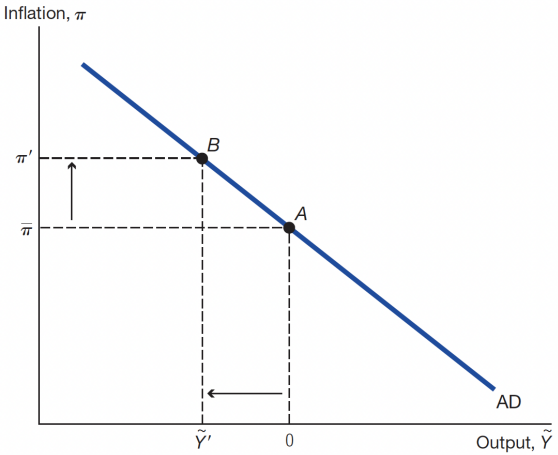
AS/AD Framework

- Suppose the economy begins in steady state which means $inflation = \overline{\pi}$ and $\tilde{Y} = 0$
- Then our economy is hit by a shock that raises the inflation rate from $\overline{\pi}$ to a higher value π'.
- What happens?
- If the central bank notices that inflation rate higher than its target $\overline{\pi}$, the monetary policy rule dictates an increase in interest rates.
- The higher interest rates cause a reduction in investment and a slowdown in economic activity-a movement along the AD curve.
- Again the parameter $\overline{m}$ measures how aggressive monetary policy is in fighting inflation.
- For example, a high value (hawkish) of $\overline{m}$ prescribes a sharp increase in interest rates if inflation rises, leading to a deep recession.
- In this case, the AD curve is relatively flat, a 1 percentage point increase in the inflation rate dictates a large decline in short-run output.

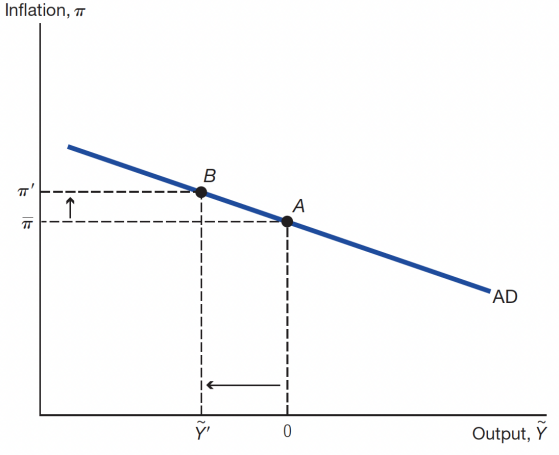


Hawkish vs Dowish

The AD Curve after an Inflation Shock



An Aggressive Monetary Policy Rule



Bank of England

Bank of England - Hawk/Dove Analysis

InTouch Capital Markets

Last Update: 08 February 2023

Name	Position	Hawk Scale	Vote Direction		
Most Dovish			02 Feb	15 Dec	03 Nov
Tenreyro	Ext Member		→	→	↑
Dhingra	Ext Member		→	→	↑
Cunliffe	Dep, Stability		↑	↑	↑
Broadbent	Dep Gov		↑	↑	↑
Bailey	Governor		↑	↑	↑
Pill	Chief Economist		↑	↑	↑
Ramsden	Dep Gov		↑	↑	↑
Haskel	Ext Member		↑	↑	↑
Mann	Ext Member		↑	↑	↑
Most Hawkish					

Notes

↑ vote to hike, → vote to keep rate unch, ↓ vote to cut

US vs EU

FOMC - Hawk/Dove Analysis

InTouch Capital Markets

Last Update: 08 February 2023

Name	Position	Hawk Scale	Voter?		
Most Dovish			2023	2024	2025
Brainard	**Vice Chair**		✓	✓	✓
Cook	**Board**		✓	✓	✓
Goolsbee	**Chicago**		✓	×	✓
George	Kansas City		×	×	✓
Harker	**Philadelphia**		✓	×	×
Bostic	Atlanta		×	✓	×
Logan	**Dallas**		✓	×	×
Collins	Boston		×	×	✓
Williams	**New York**		✓	✓	✓
Jefferson	**Board**		✓	✓	✓
Barr	**Board**		✓	✓	✓
Powell	**Chairman**		✓	✓	✓
Bowman	**Board**		✓	✓	✓
Daly	San Francisco		×	✓	×
Barkin	Richmond		×	✓	×
Mester	Cleveland		×	✓	×
Waller	**Board**		✓	✓	✓
Kashkari	**Minneapolis**		✓	×	×
Bullard	St Louis		×	×	✓
Most Hawkish					

ECB - Hawk/Dove Analysis

Prepared for ITC Markets by Econostream Media

Last Update: 08 February 2023

Name	Position	Hawk Scale	Voter?		
Most Dovish			16 Mar	04 May	15 Jun
Panetta	Exec Board		✓	✓	✓
Stournaras	Greece		×	✓	✓
Visco	Italy		✓	✓	✓
Lane	Exec Board		✓	✓	✓
Hernández de Cos	Spain		✓	×	✓
Herodotou	Cyprus		×	✓	✓
Centeno	Portugal		✓	✓	×
Makhlouf	Ireland		✓	✓	✓
de Guindos	Vice President		✓	✓	✓
Vujčić	Croatia		×	✓	✓
Lagarde	President		✓	✓	✓
Scicluna	Malta		✓	×	×
Villeroy	France		✓	✓	×
Rehn	Finland		✓	✓	✓
Reinesch	Luxembourg		✓	×	✓
Schnabel	Exec Board		✓	✓	✓
Elderson	Exec Board		✓	✓	✓
Vasle	Slovenia		✓	✓	×
Šimkus	Lithuania		✓	×	✓
Kazāks	Latvia		×	✓	✓
Kažimír	Slovakia		✓	✓	✓
Müller	Estonia		✓	✓	✓
Wunsch	Belgium		✓	✓	✓
Nagel	Germany		✓	✓	✓
Holzmann	Austria		✓	×	×
Knot	Netherlands		×	✓	✓
Most Hawkish					

US vs EU

FINANCIAL TIMES

HOME WORLD UK COMPANIES TECH MARKETS CLIMATE OPINION WORK & CAREERS LIFE & ARTS HTSI

Federal Reserve + Add to myFT

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

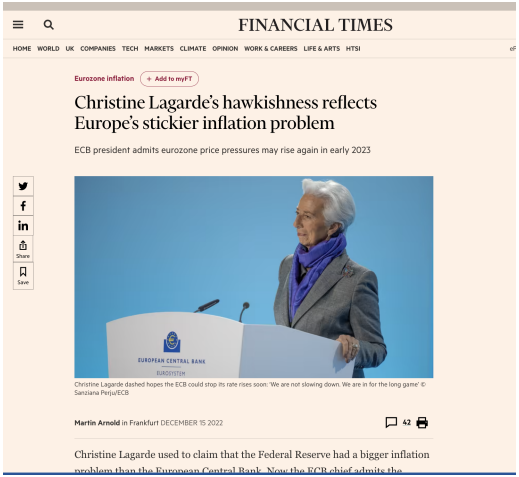
Fed chair tries to manage investor expectations following shift down to half-point rate rises

Share Save

‘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



FINANCIAL TIMES

HOME WORLD UK COMPANIES TECH MARKETS CLIMATE OPINION WORK & CAREERS LIFE & ARTS HTSI

Eurozone inflation + Add to myFT

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

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

Share Save

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

Hawks vs Dove

In general, **hawks** are the members who tend to want tighter monetary policy to temper inflation and growth whilst **doves** tend to want looser monetary policy to support growth and inflation.

Shifts of the AD Curve

- π_t represent movements along the AD curve, and changes in $\overline{m}$ alter its slope.
- What about changes in the other parameters?
- The most important are changes in the aggregate demand parameter $\overline{a}$ and changes in the target rate of inflation $\overline{\pi}$.
- Changes in these parameter values shift the AD curve. That is, they change the level of short-run output that the central bank desires at any given inflation rate.
- To summarize, changes in inflation move the economy along the AD curve.
- Aggregate demand shocks and changes in the central bank's target for inflation shift the AD curve.

The Aggregate Supply Curve

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:

$$\pi_t = \pi_{t-1} + \overline{v}\tilde{Y}_t + \overline{o} \tag{2}$$

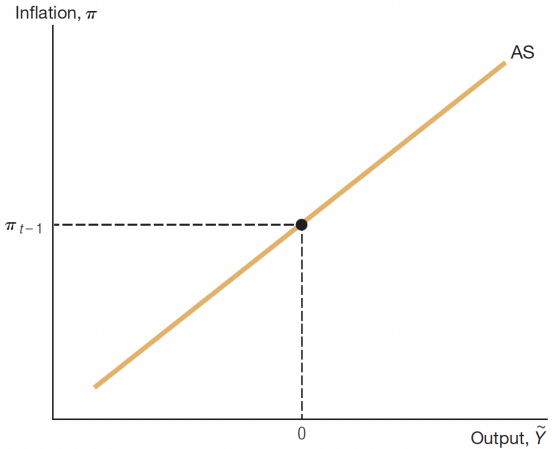
- Notice the following: holding π_{t-1} fixed (after all, it has already been determined by the time period t begins),
- the Phillips curve is an equation that relates the current rate of inflation π_t to short-run output.

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 $\bar{o}$ becomes positive for a period.

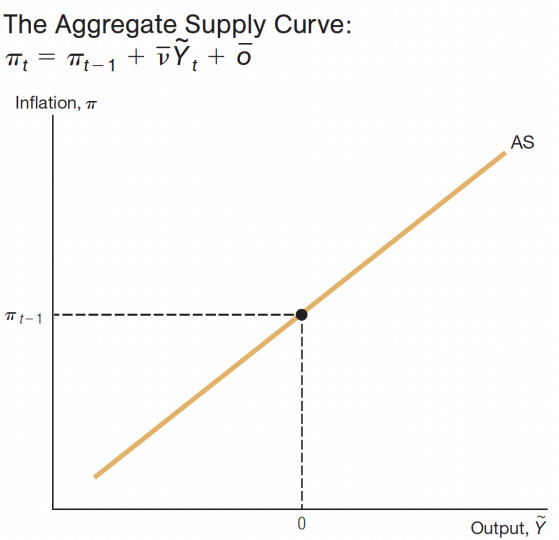
The Aggregate Supply Curve:

$$\pi_t = \pi_{t-1} + \bar{\nu}\tilde{Y}_t + \bar{o}$$



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.



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

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

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

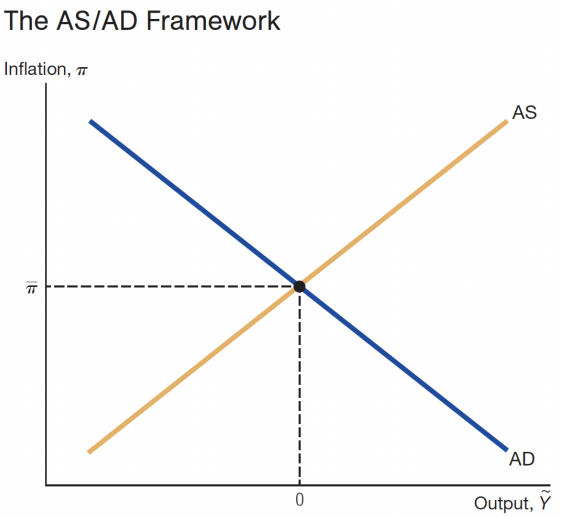
- We have two equations and two unknowns, π_t and $\tilde{Y}_t$.
- Be carefull that this is **a dynamic model**, solving it is more complicated than just solving two equations-there's also the π_{t-1} term to worry about.

AS/AD Framework: The Steady State

- Consider the steady state of this dynamic model.
- Recall that in steady state, the endogenous variables are constant over time and there are no shocks to the economy ($\overline{a} = 0$ and $\overline{o} = 0$).
- Since the inflation rate must be constant, we have $\pi_t = \pi_{t-1} = \pi^*$.
- From the AS curve, we see that this implies that short-run output must be zero in steady state: $\tilde{Y}^* = 0$.
- Then, substituting this solution into the AD curve, we see that when output is at potential, $\pi^* = \overline{\pi}$.
- Intuitively, then, the steady state of our $\mathrm{AS/AD}$ model is the point where the inflation rate is equal to the central bank's target and actual output is at potential.
- Everything is alright, no problem no monetary policy, no action. But!

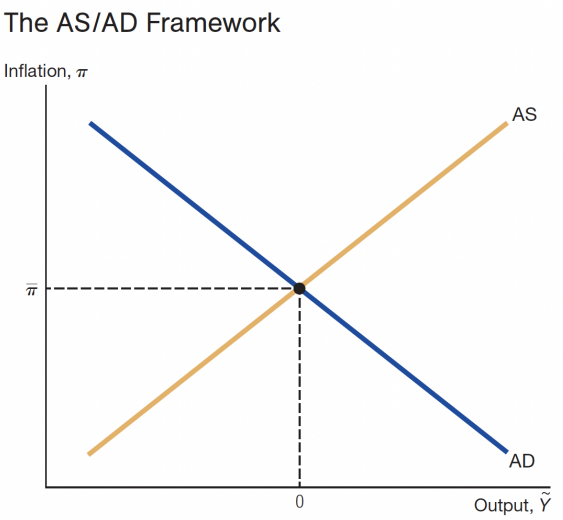
AS/AD Framework

- The economy begins in steady state thus the inflation rate is $\overline{\pi}$, and it has been at this level for several years.
- The π_{t-1} term in our AS curve is therefore also equal to $\overline{\pi}$.
- The aggregate supply curve slopes upward, the aggregate demand curve slopes downward.
- The vertical axis represents the inflation rate (the percentage change in the price level), and the horizontal axis measures short-run output.
- Be sure you understand why the AD curve slopes downward and the AS curve slopes upward.



AS/AD Framework

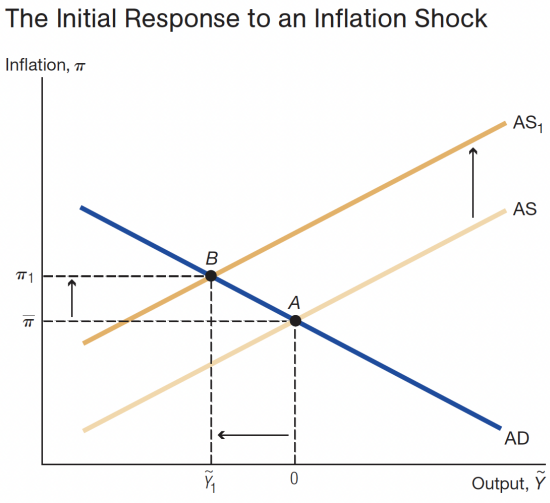
- The AD curve slopes downward because of the response of policymakers to inflation.
- If the CB observes a high rate of inflation, the monetary policy rule dictates an increase in the real interest rate and this reduces output by reducing investment demand in the economy.
- The AS curve slopes upward as an implication of the price-setting behavior of firms embodied in the Phillips curve.
- When actual output exceeds potential, firms struggle to keep production in line with the high demand
- Firms therefore raise their prices by more than the usual amount in an attempt to cover increased production costs, like overtime pay.
- When all firms raise their prices this way, inflation increases.



Important Economic Events and Policies

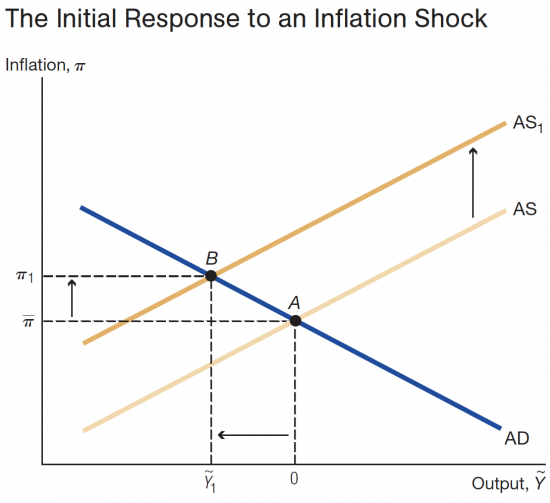
An Inflation Shock

- Suppose the economy begins with the inflation rate and output at their steady state values.
- Then the economy gets hit with a shock, such as the price of oil, that raises the inflation rate.
- Mathematically, $\overline{o}$ is positive for one period, and this inflation shock raises the price level permanently.
- In response to the increase in $\overline{o}$ the AS curve shifts up.
- This can be seen from the equation for aggregate supply: $\pi_t = \pi_{t-1} + \overline{v}\tilde{Y}_t + \overline{o}$.
- For any given level of output, the rate of inflation is increased because of the inflation shock.



An Inflation Shock

- If there were no change in short-run output in response to the inflation shock, the inflation rate would increase one-for-one.
- However, the monetary policy rule dictates that the increase in inflation be fought by an increase in the real interest rate, leading short-run output to decline.
- Therefore, the economy jumps from point A in the graph to point B, leading to both high inflation and a softening of the economy.
- This stagflation (stagnation + inflation) - stagnation of economic activity accompanied by inflation.



An Inflation Shock

What happens in the period following the inflation shock? Shock lasts only one period, $\bar{o}$ is equal to zero from now on. Will the AS curve shift back to its original position? No. Why not?

- Recall that the AS curve is given by the equation

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

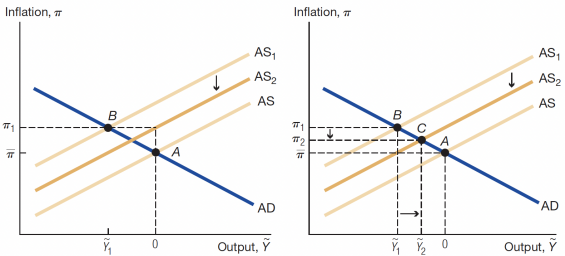
where initially $\pi_{t-1} = \bar{\pi}$, since the economy started in steady state.

- Now, however, $\pi_1 > \bar{\pi}$, so the AS curve in period 2 is

$$\pi_2 = \pi_1 + \bar{v}\tilde{Y}_2 + \bar{o}.$$

- Since $\bar{o} = 0$, if $\tilde{Y}_2$ were equal to zero, inflation would continue at the higher rate π_1; that is, the AS curve for period 2 crosses the $\tilde{Y} = 0$ point at an inflation rate of π_1, which is larger than $\bar{\pi}$.

Two Periods after an Inflation Shock



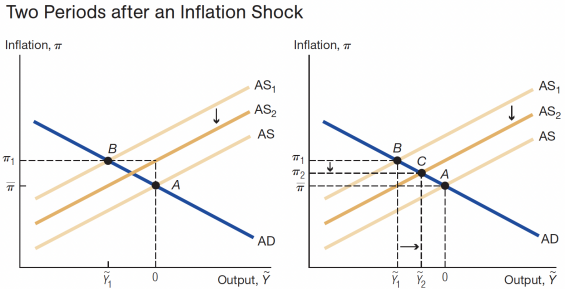
(a) The new AS curve, AS_2, is such that inflation would equal π_1 if short-run output were zero.

(b) Since inflation remains high, the Fed keeps output below potential, moving the economy to point *C*.

An Inflation Shock

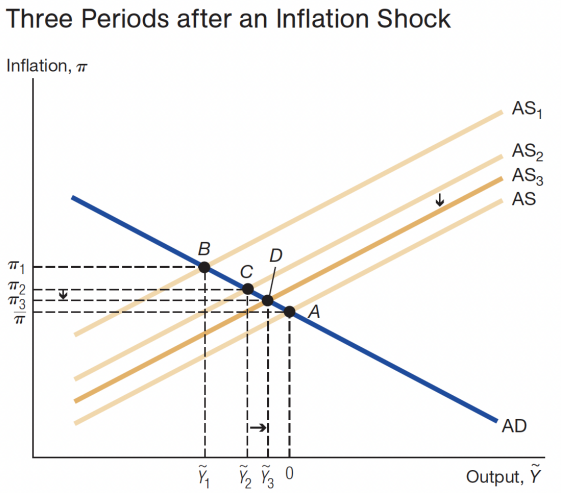
What is the economics of the situation?

- First, recall that expected inflation in this setup is given by last period's inflation: $\pi_t^e = \pi_{t-1}$.
- The high inflation created by the oil shock raises expected inflation.
- These high expectations adjust only slowly because of our assumption of sticky inflation, which slows down the return of the AS curve to its original position.
- In period 2, the economy moves from point B to point C, shown in panel (b).
- The slumping economy leads inflation to fall, but only gradually. As a result of the decline in inflation, the monetary policy rule increases output somewhat (leaving it below potential), so the economy is improving.



An Inflation Shock

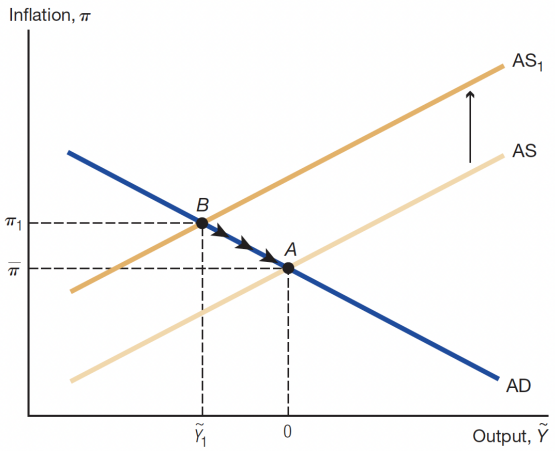
- Figure shows the situation in period 3.
- Once again, the AS curve shifts back toward its original position.
- However, the presence of an inflation rate greater than $\bar{\pi}$ leads expected inflation to exceed the target rate.
- The economy gradually adjusts toward steady state, moving to point D.



An Inflation Shock

- Figure provides a way of summarizing the dynamics of inflation and output in the AS/AD framework.
- The economy initially jumps from point A to point B when the inflation shock hits, and then it moves gradually over time back toward the steady state at point A.
- This makes perfect sense if you think about it.
- The steady state of this AS/AD model is point A, where inflation is $\bar{\pi}$ and output is at potential.
- So it is quite natural that the economy moves back to this steady state.
- The adjustment occurs as expected inflation declines gradually, causing the AS curve to shift back toward its original position. Our sticky inflation assumption is at the heart of this gradual adjustment.

The Effects of an Inflation Shock: Summary



An Inflation Shock

- Notice that he movement back toward the steady state is fastest when the economy is furthest from its steady state.
- The movement back gets slower as the economy approaches its steady state.
- The lesson from this event is that price shocks that raise inflation are especially insidious.
- First, they raise inflation directly.
- Next, the central bank induces a recession to bring the inflation rate back to its long-run target.
- Even though the shock lasts for only a single period, inflation remains higher for an extended period of time, because of sticky inflation.
- The shock raises expected inflation, and it takes a prolonged slump in the economy to get these expectations back to normal.
- The economy suffers stagflation-stagnation and inflation simultaneously-just as it did in the 1970s.

Change in Monetary Policy Stance: Disinflation

- Suppose the economy begins in a steady state that features a moderately high rate of inflation $\bar{\pi}$.
- Policymakers then decide to reduce the inflation target to a new, lower level $\bar{\pi}'$. How does the economy respond over time?
- To analyze this event, first recall the AS and AD equations:

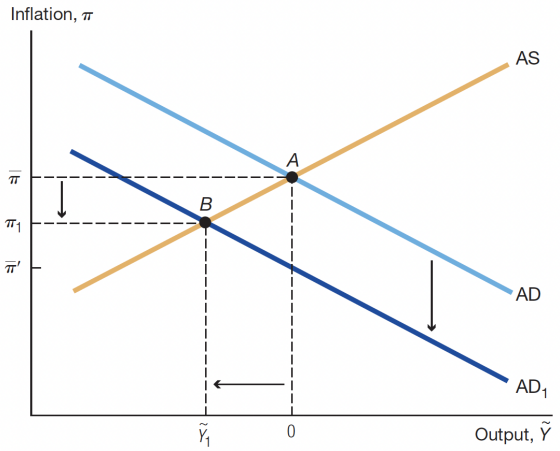
$$\begin{aligned} &\text{AS curve:} \quad \pi_t = \pi_{t-1} + \bar{v}\tilde{Y}_t + \bar{o}. \\ &\text{AD curve:} \quad \tilde{Y}_t = \bar{a} - \bar{b}\bar{m}\left(\pi_t - \bar{\pi}\right). \end{aligned}$$

- The only place that the inflation target $\bar{\pi}$ appears in the model is in the AD curve, so whatever change occurs will initially involve this curve.

Change in Monetary Policy Stance: Disinflation

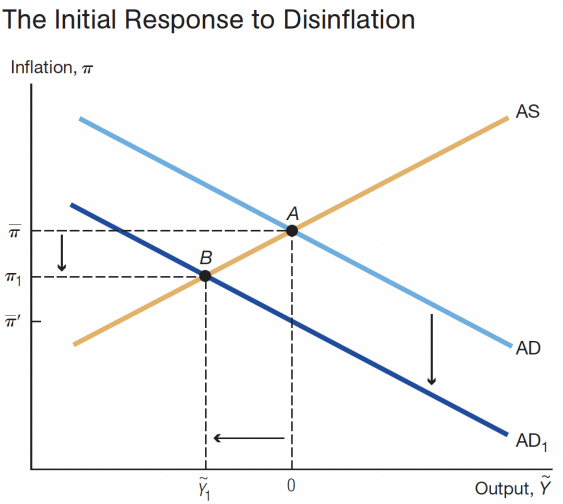
- Does the AD curve shift? : The answer is yes. But how?
- At any given inflation rate π_t, the output level associated with the policy rule is reduced.
- This means that the AD curve shifts down immediately following the policy change, as shown in Figure.
- With the new monetary policy rule in place, the initial rate of inflation, the old target rate of $\bar{\pi}$, is viewed as being too high.
- The new rule then calls for an increase in interest rates, causing a slowdown and a reduction in inflation.
- The economy jumps from point A to point B, leading to an inflation rate of π_1. This rate is somewhere in between the old target and the new one.

The Initial Response to Disinflation



Change in Monetary Policy Stance: Disinflation

- After a shock that moves the economy away from its steady state, it will transit back gradually to its steady state.
- The only subtlety here is that the change in the monetary policy rule means that the steady-state rate of inflation has now changed: the new steady-state rate is the lower target $\bar{\pi}'$.
- Look at Figure: By how much did the AD curve shift when the new policy rule was adopted?

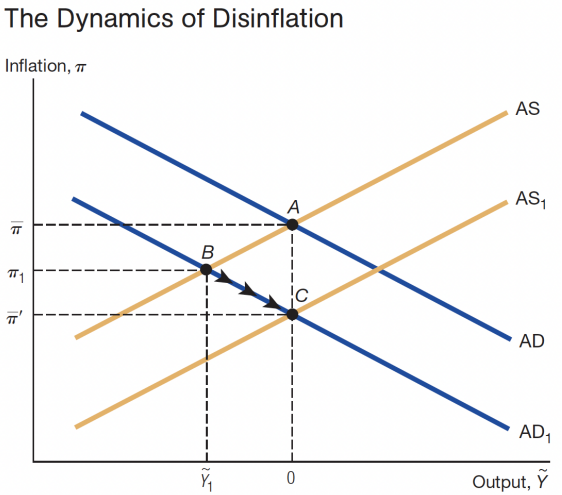


Change in Monetary Policy Stance: Disinflation

- Look at Figure: By how much did the AD curve shift when the new policy rule was adopted?

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

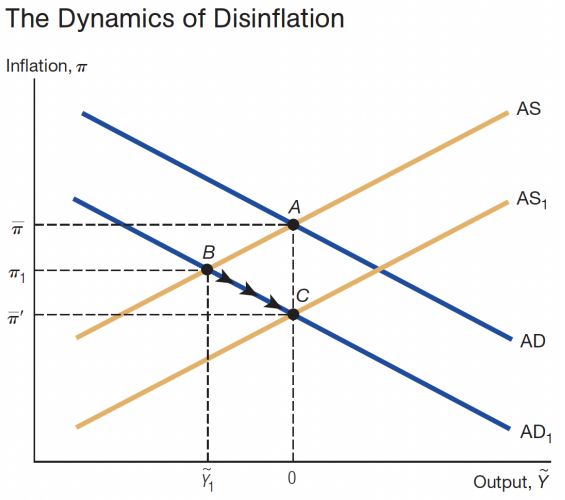
- The new AD curve is such that when actual output is at potential, inflation is $\bar{\pi}'$.
- This new steady state is labeled as point C in Figure, which also shows the transition to the new steady state.
- When you are solving economic problems in general, the intuition of transition dynamics is an extremely helpful guide to how the economy will evolve.
- This intuition suggests that the economy will move gradually over time, in Figure , from point B to point C.
- But how do we know that this is really what occurs?



Change in Monetary Policy Stance: Disinflation

The answer can seen by studying the AS curve: $\pi_t = \pi_{t-1} + \bar{v}\tilde{Y}_t + \bar{o}$

- Just as in the first event, the change in the rate of inflation from $\bar{\pi}$ to π_1 causes the AS curve to shift in the following period.
- Firms adjust their expectations for inflation to take into account the new, lower rate; their expected rate of inflation now becomes π_1 rather than $\bar{\pi}$, so the AS curve shifts down.
- Since inflation is still above the target, the CB keeps actual output below potential, leading the inflation rate to fall further.
- The arrows show this transition dynamics.
- These dynamics occur over time until the economy moves to its new steady state at point C.
- Inflation is permanently reduced from $\bar{\pi}$ to $\bar{\pi}'$, and short-run output returns to zero.

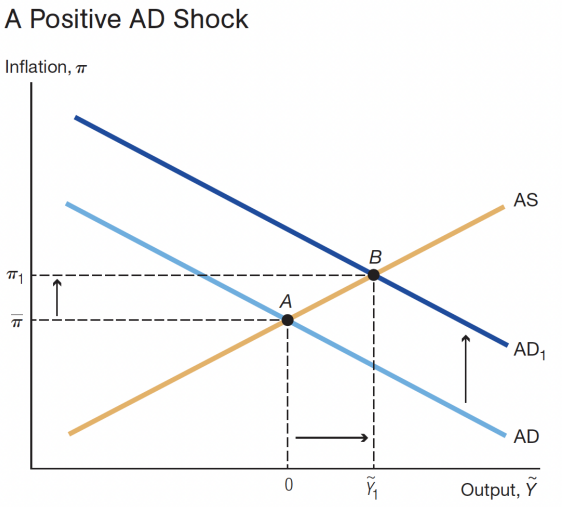


A Positive AD Shock

- For example, an economic boom in Europe could create an increase in demand there for UK goods.
- Or the discovery of a new technology could make British richer and improve production in the future, raising consumption today.
- Either situation would lead to a temporary increase in $\bar{a}$.
- The initial response of the economy to such a shock is shown in Figure in the next slide.

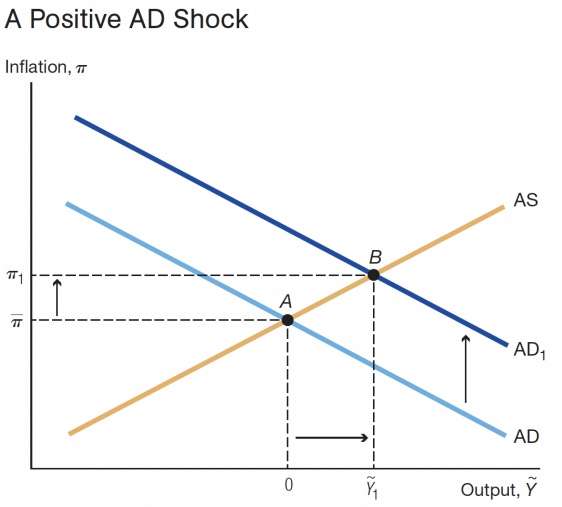
A Positive AD Shock

- Recall the equation for the AD curve: $\tilde{Y}_t = \bar{a} - \bar{b}\bar{m}\,(\pi_t - \bar{\pi})$.
- The initial effect of an increase in $\bar{a}$ is to shift the AD curve out: at any given level of inflation, the output level associated with the higher value of $\bar{a}$ has increased.
- This means the economy jumps from point A to point B.
- Seeing the increase in demand for their goods, firms increase prices, so inflation picks up to some extent.
- Some of the aggregate demand shock appears in the form of higher output and some in the form of higher inflation.



A Positive AD Shock

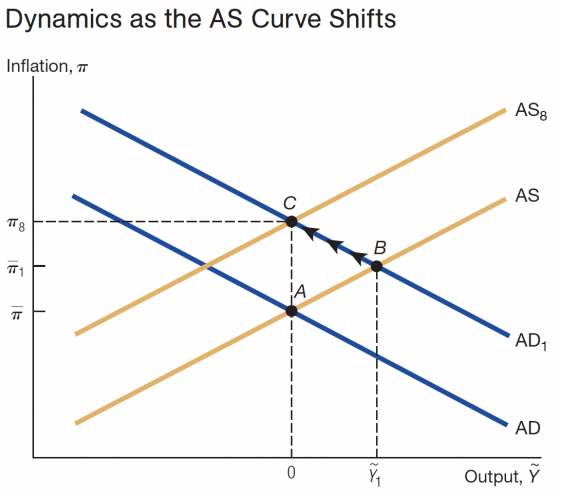
- How does the economy evolve over time after the initial impact of the shock?
- It can be expected that the AS curve will gradually shift until the economy moves back to its original steady state.
- But if you take a close look at Figure, you'll see that this isn't possible.
- If the AS curve shifts to the right, the inflation rate will decline but output will increase. If it shifts to the left, output will decline toward zero, but inflation will rise.



A Positive AD Shock

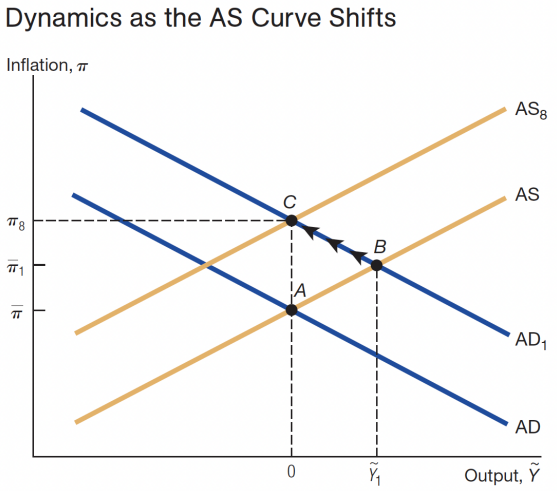
So what happens?

- First, consider the equation for the AS curve: $\pi_t = \pi_{t-1} + \bar{v}\tilde{Y}_t + \bar{o}$
- The level of inflation associated with zero output (and no inflation shocks) is given by π_{t-1}.
- Since inflation is above $\bar{\pi}$ in period 1, firms expect higher inflation in the future, so the AS curve shifts upward over time.
- And since firms expect higher inflation, the inflation rate associated with zero output rises.
- Transition dynamics thus push the economy toward a higher level of inflation and reduce output toward zero.
- These dynamics are shown graphically in Figure.
- The economy moves gradually over time from point B to point C.



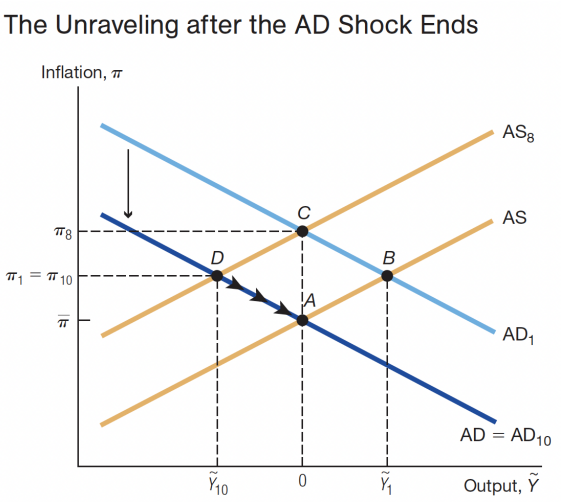
A Positive AD Shock

- At point C, short-run output is zero, thus the inflation rate is stable: $\pi_t = \pi_{t-1} + 0 + 0$.
- If nothing changes, the economy will remain at point C.
- Next, from the AD equation, we see that $0 = \tilde{Y}_t = \bar{a} + \bar{b}\bar{m}(\pi - \bar{\pi})$.
- Solving this equation for the level of inflation, we find that $\pi^C = \bar{\pi} + \bar{a}/\bar{b}\bar{m}$.
- Inflation rate exceeds its steady-state rate by an amount that depends on the aggregate demand shock.
- Point C features an inflation rate that exceeds the central bank's target rate of $\bar{\pi}$.
- The economy is therefore not in steady state here, so this can't be the end of the story.



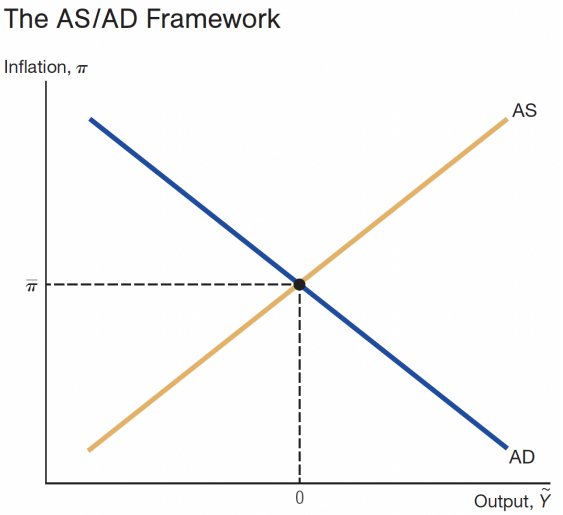
A Positive AD Shock

- But then what can change to move the economy back to the steady state at point A ?
- Aggregate demand shocks are by their very nature temporary; the long-run value of $\tilde{a}$ is equal to zero.
- If a European boom stimulates UK. exports, for example, the shock will end when the European boom subsides.
- When this happens, the AD curve shifts back to its original position, and the economy jumps from point C to point D, as shown in Figure.
- Notice that since output was already zero, this is like a negative shock, and it causes output to fall below zero-there is a recession.
- This change in turn puts downward pressure on inflation. The standard transition dynamics then take the economy back to steady state as lower inflation reduces expected inflation and causes the AS curve to shift back gradually to its original position. Over time, the economy moves back to point A, slowly sliding down the original AD curve.



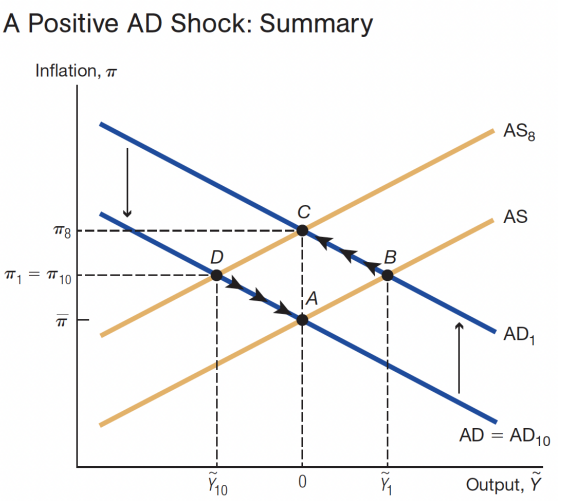
A Positive AD Shock

- The complete behavior of the economy in response to the positive aggregate demand shock is summarized in Figure 13.15.
- An important assumption here is that the AD shock remains positive for several periods.
- As soon as the shock ends, the AD curve will shift back to its original position.
- In this example, we've allowed the economy to get all the way back to potential (at point C) before the shock ends, but the shift back could possibly occur sooner.
- For example, the European boom that increases demand for U.S. exports could end before the U.S. economy reaches point C.



A Positive AD Shock

- The main lesson from this study of an aggregate demand shock is that booms are matched by recessions.
- The economy initially benefits from a boom. But it causes inflation to rise, and the only way inflation is brought back down is by a recession.
- In some "average" sense, the economy doesn't really gain in terms of output: the boom and recession offset each other.
- But the costs associated with the higher inflation are real and represent a net loss to the economy.
- People would be better off staying at point A forever, rather than going through this cycle and suffering from temporarily high inflation.
- It is for this fundamental reason that central banks seek to stabilize short- run output.



Taylor Rule!

Empirical Evidence: Taylor Rule

- The empirical predictions of our short-run model when monetary policy is dictated by the simple inflation-based policy rule.
- We consider two pieces of evidence: the implied path for the fed funds rate and the time paths for inflation and output.
- Can we predict the interest rate ?
- Can you answer your friends/parents question: "So, where do you think interest rates are headed?"
- Not exact answer but the simple monetary policy rule, $R_t - \bar{r} = \bar{m}\,(\pi_t - \bar{\pi})$, does provide some guidance.

Empirical Evidence: Taylor Rule

Read: The Taylor Rule: A benchmark for monetary policy? Ben S. Bernanke Tuesday, April 28, 2015

- The first thing to notice is that our policy rule applies to the real interest rate, not the nominal interest rate.
- Fortunately, the Fisher equation tells us how to go back and forth between these two; we just need to add the rate of inflation to the real interest rate to get the nominal rate.
- Then, the monetary policy rule implies that the nominal interest rate is

$$i_t = R_t + \pi_t = \bar{r} + \pi_t + \bar{m}\left(\pi_t - \bar{\pi}\right).$$

- Next, to implement this equation, we need to pick values for the parameters.

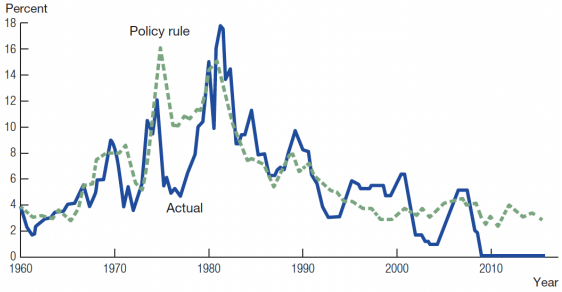
Empirical Evidence: Taylor Rule

- In the early 1990s, John Taylor of Stanford University suggested picking parameter values that were all functions of the number $2 : \bar{r} = 2\%, \bar{m} = 1/2$, and $\bar{\pi} = 2\%$. [1]
- That is, we assume the real interest rate is constant at 2 percent, and that an increase in inflation of 1 percentage point causes the central bank to raise the real interest rate by $1/2$ a percentage point. .
- This means the nominal interest rate rises by $1\frac{1}{2}$ percentage points-more than one-for-one with inflation-so that the real interest rate rises with inflation.
- And we assume the target rate of inflation $\bar{\pi}$ is also equal to 2 percent.
- If we take these parameter values along with data on the inflation rate, we can compute the fed funds rate predicted by our monetary policy rule.

Empirical Evidence: Taylor Rule

- Simple policy rule produces a surprisingly accurate picture of the actual behavior of the fed funds rate.
- A key place where the policy rule and the actual fed funds rate give different answers is the period from the late 1960 s until 1980.
- During this period, the fed funds rate was substantially less than the rate implied by the policy rule.
- One interpretation of this gap is that monetary policy was excessively loose during this period, which contributed to rising inflation during the 1970 s.

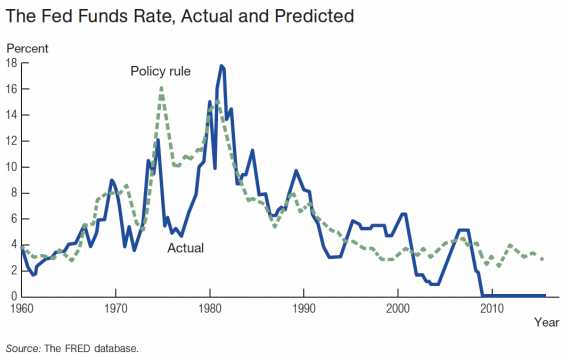
The Fed Funds Rate, Actual and Predicted



Source: The FRED database.

Empirical Evidence: Taylor Rule

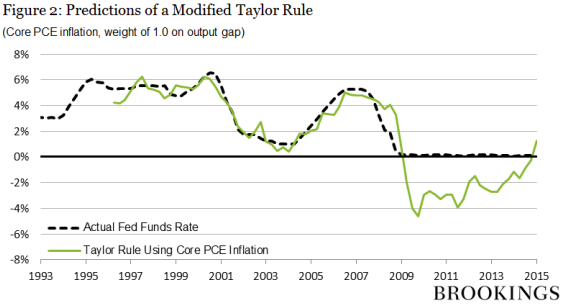
- If you look closely, you will also see that the Fed also departs from this very simple policy rule during recessions: in the early 1990s, in the early 2000s, and most dramatically since 2008, the Fed set interest rates much lower than our simple policy rule predicts.
- There is a good explanation for this. The actual version of the Taylor rule includes a short-run output term as well as an inflation term.
- That is, when the economy is in a recession, the Taylor rule dictates that the fed funds rate be lowered even further.



Source: The FRED database.

Empirical Evidence: Taylor Rule

- Bernanke uses core PCE (food and energy – are left out to make underlying inflation easier to see)
- Figure shows the predictions for the federal funds rate of this of the Taylor rule, which measures inflation using the core PCE deflator and assumes that the weight on the output gap is 1.0 rather than 0.5.
- As you can see in the figure, the predictions of my updated Taylor rule (green line) and actual Fed policy (dashed black line) are generally quite close over the past two decades



Empirical Evidence: Taylor Rule

Figure 2: Predictions of a Modified Taylor Rule

(Core PCE inflation, weight of 1.0 on output gap)