Macroeconomics After The Great Depression

- Given the difficulties for the classical model in presenting a plausible explanation of the Great Depression, it is not surprising that in the 1930s new theories were called for.

- By far the most important effort was:

    John Maynard Keynes (1936): "The General Theory of Employment, Interest + Money."

Keynes' book developed the basics of a macroeconomic theory that was to dominate the profession for the next 40 years or so.

See Keynes' bio on the web site

The Keynesian research program

- Construct a theory of economic fluctuations based on aggregate demand.
    - classical determination of output purely on the supply side (labor & production) was unsatisfactory.
    - when prices and wages are flexible, however, aggregate demand plays no role in determining output or employment.
    - the natural solution, which Keynesian economics adopted, assumes that prices and/or wages do not readily adjust in the short-run.

- The assumption of sticky prices has some additional important consequences, as we will see:
    - changes in M, G and T will affect output.
    - unemployment can be involuntary.

Outline of this section.

- In order to highlight the role of aggregate demand shocks in the Keynesian system, we will initially,
  - assume P and w are completely fixed in the short run.
  - not attempt to model the labor market or aggregate supply (implicitly, we are assuming AS is horizontal at the fixed price level).
  - we will ignore the dependency of C and I on the interest rate.

  This will allow us to derive very simply the effect of demand shocks on output.

- We will then explain the Keynesian theory of the interest rate. In contrast to the classical model, the money market plays a key role in determining the interest rate.
- We then put the interest rate back into the C and I functions to analyze the full Keynesian system of aggregate demand.

- Of course, it is unrealistic to assume that prices never change. So we will then introduce some partial flexibility into the model. This is equivalent to assuming that the AS curve is neither vertical (classical) nor horizontal (complete rigidity).

NOTE: This breakdown is partly pedagogical.

But there are two distinct final products:

- The "IS-LM model", a version where prices are completely fixed in the short-run
- The "AS-AD model", a version with partial flexibility.

Both of these models are useful for policy evaluation.

An Aggregate Demand Theory.

- Recall the national income accounting identity:

$$\underbrace{Y}_{\text{income}} = \underbrace{E}_{\text{expenditure}} = C + I + G$$

- Recall that we have said that

$$C = C(r, Y - t)$$
$$I = I(r).$$

- For the moment (because we have not yet explained Keyne's theory of the interest rate), let us suppress the role of r, in the determination of I.
  - Instead, we will focus on the idea that the level of I depends on investors' views about the prospects for profitable returns to new investment project.

- Keynes concluded that consumption was in fact not very sensitive to changes in r, so he decided to permanently suppress any effect of r on C.

This modeling decision led Keynes to write a consumption function of the form

$$C = a + \underbrace{b}(\underbrace{Y-T}_{\text{disposable income}}).$$

$\frac{dC}{d(Y-T)} = b$ is the marginal propensity to consume.

$0 < b < 1$, is the amount of increase in consumption for each \$1 increase in disposable income.

By extension:

$(1-b)$ is the marginal propensity to save.

Given this Keynesian assumption about the consumption function we can write

$$\begin{aligned} Y &= C + I + G \\ &= a + b(Y-T) + I + G \end{aligned}$$

or, rearranging:

$$Y = \frac{a}{1-b} - \left(\frac{b}{1-b}\right)T + \left(\frac{1}{1-b}\right)(I+G).$$

Implications for fiscal policy.

a) Increase in government expenditure:

$$\frac{dY}{dG} = \underbrace{\frac{1}{1-b}}_{\text{expenditure multiplier.}}$$

If MPC = 0.9, then a \$1 increase in G raises national income by \$10.

b) Increase in taxes.

$$\frac{dY}{dG} = -\frac{b}{1-b} \sim \text{tax multiplier.}$$

c) Balanced-budget increase in G and T.

Let $dZ = dG = dT$.

Then
$$\frac{dY}{dZ} = \left[\frac{-b}{1-b} + \frac{1}{1-b}\right]$$
$$= 1.$$

A \$1 increase in G and T raises Y by \$1.

Investment volatility as a source of instability.

Compared with consumption, investment has been highly volatile:

YEAR	$\frac{I}{Y}$ (%)	$\frac{C}{Y}$ (%)
1955	17.1	63.5
1958	13.8	64.5
1973	16.1	62.6
1975	12.5	64.0
1979	16.0	62.7

And, because

$$\frac{dY}{dI} = \frac{1}{1-b},$$

shocks to investment demand have large multiplier effects on national income.

Keynes believed that shocks to investors' beliefs about the profitability of investment was the major source of business cycles.

NOTE: $\begin{cases} 1929: & I/Y \text{ was } 15.7\% \\ 1933: & I/Y \text{ was only } 2.5\%! \end{cases}$

Policy Responses to shocks.

- G and T can be adjusted to offset changes in I.
- In the Great Depression, I dropped through the floor. The Keynesian policy implication is to lower taxes and raise government expenditure.
    - In 1932, President Hoover raised taxes.
    - In the 1932 election, Roosevelt argued for cuts in expenditure.

These policies in 1932 made sense from the perspective of the classical model: changes in G and T have no effect on output. Tax revenues had declined because of the recession, so the classical policy prescription was to raise the tax rate and reduce the government's outlays, thus balancing the budget.

A note on crowding out

- What happened to the crowding out of investment when government expenditure rises? In the classical model, an increase in G raises r and lowers I. The expenditure multiplier calculated above assumed I was constant. What was missing?

- Answer: we had suppressed the effect of r on I. (Keynes didn't think it was important).

The full multiplier can be written as

$$\frac{dY}{dG} = \frac{1}{1-b} + \frac{1}{1-b}\,\frac{dI}{dr}\cdot\frac{dr}{dG}$$

we assumed this was zero.

$$= \frac{1}{1-b}\left(1 + \underset{(-)}{\frac{dI}{dG}}\right)$$

so final size of fiscal multiplier depends on the degree of crowding out.

But to address the crowding out question, we first need to develop the Keynesian theory of interest rates.

Money and Interest Rates under Keynes.

- Recall, from the classical model
  - In the money demand equation, a version of the quantity theory is used:

$$M = kP\bar{Y}$$

So, given a policy choice of M, the money market equilibrium determines the price level.

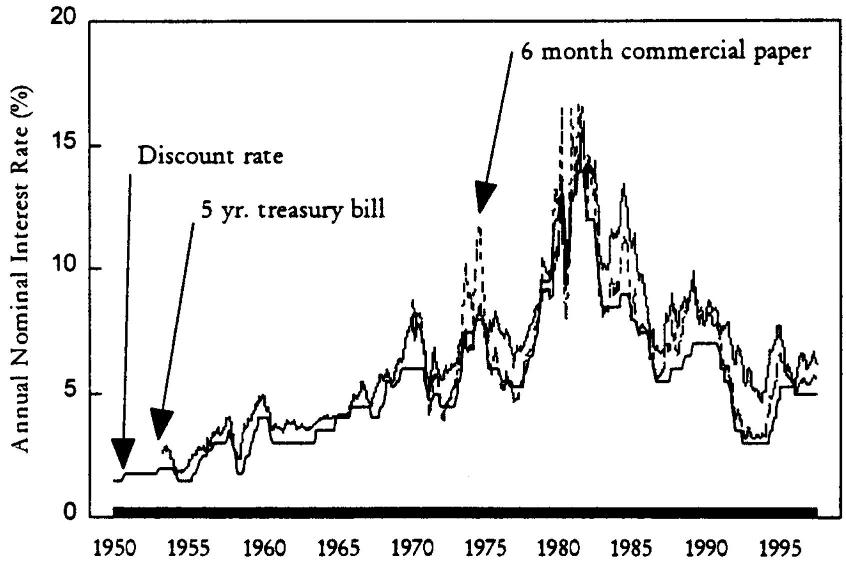
given in labor market equilibrium

  - In the classical model, the money market is not related to the interest rate.
  - The real rate of interest was determined in the market for loans – it adjusted to makes sure savings equals investment.

- The Keynesian view:
  - money market equilibrium determines the interest rate, <u>simultaneously</u> with the market for loans.
  - This leaves no equation to determine prices, so for the moment, we will assume P is fixed.

The Behavior of Interest Rates

- There are many rates of interest. The figure below plots a small selection
  - The discount rate (the rate the Fed lends to banks)
  - 5-year Treasury bonds (rate at which government borrows from the public for 5-year loans
  - 6-month commercial paper (rate at which highly rated firms get 6-month loans from the public)



U.S. Nominal Interest Rates 1950-97

- There are many other rates: "federal funds rate", credit card, municipal bonds, etc.
- Despite persistent differences in levels (mostly due to differences in risk), these different rates tend to move together.
- So, we will generally talk about "the" interest rate, as though there were only one.

Real and Nominal Interest Rates

- Previous figure shows a massive rise in the interest rate during the early 1980s, followed by a rapid decline. What caused this dramatic change?

  Answer: A peak of inflation in the early 1980s.

- To understand significance of inflation, we must distinguish between two types of interest: nominal interest rate and real interest rate.

  i – nominal rate
  r – real rate.

  They are related by

$$i = r + \pi$$

  π ~ inflation rate.

- Nominal rate: measures how many dollars one will receive back in a year's time – in addition to the principal – in exchange for lending $1 now.

- Real rate: what can I buy with this $\$(1+i)$? If a loaf of bread costs $1 today and inflation is π, then next year I can buy

$$\underbrace{1+r}_{\text{quantity this year}} = \frac{1+i \ \sim \text{cash next year}}{1+\pi \ \sim \text{price next year}} = \text{quantity next year}.$$

So, given

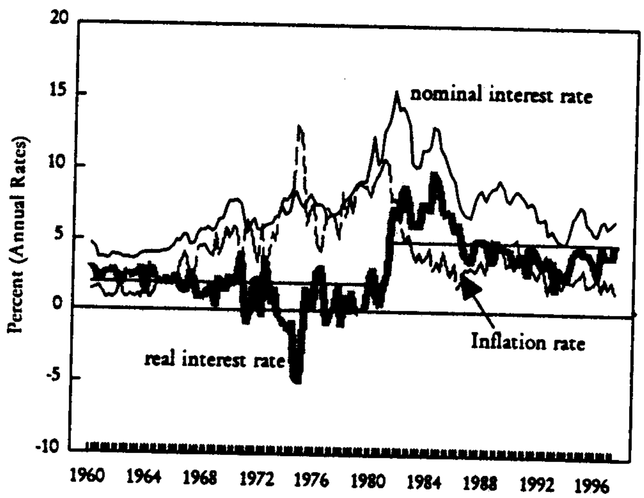
$$1+r = \frac{1+i}{1+\pi},$$

we can rearrange to get

$$i = r + \pi + \underbrace{r\pi}$$

this is a very small number (e.g. $0.03 \times 0.03 = .0009$) so we can ignore it.

$$\boxed{i \approx r + \pi}$$



5-yr. treasury bills - nominal and real interest rates. 1960-1997

Note two distinct periods:

1960 — 1982, average $r \approx 0.03$

1982 — , average $r \approx 0.05$

The high real interest rate of post-1982 is part of the crowding-out effect of the Reagan-era deficit.

Ex post and ex ante rates

- Puzzling feature – in some periods, especially mid 70s, real interest rates were negative.

- Does not mean that people were willing to give up consumption today in exchange for less consumption in the future.

- It does mean that people guessed inflation wrong.

There are two types of real interest:

ex-post or realized interest rate $\Rightarrow$ $r = i - \pi$

both of which we can measure

ex-ante or expected interest rate $\Rightarrow$ $r^e = i - \pi^e$

expected inflation rate (which we cannot easily measure).

People make decisions on the basis of r^e, but we can only measure r. This makes for some awkwardness between theory and data.

A) Why do people hold money?

- Because it is more convenient than interest-earning assets to make purchases.
- The higher my income in real terms, the more purchases I make. By extension, the higher is national income, the greater the demand for money.
- The higher the price level, the more money I hold to make purchases.
- So the demand for money depends positively on Y and P.

B) Why don't people hold <u>all</u> their wealth in the form of money?

- Because they could earn real interest $i - \pi$ on interest earning assets.
- Because inflation reduces the value of money at the rate $-\pi$.

- the difference, $(i-\pi) - (-\pi) = i$ is the opportunity cost of holding money. The higher i is, the lower the demand for money.

So, we write the demand for money as

$$M^D = P\, m(y, i)$$

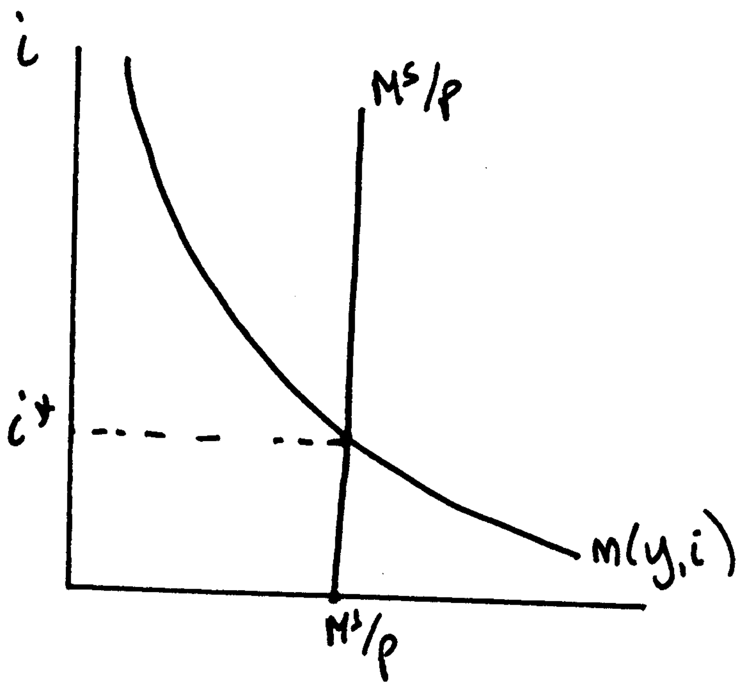
or

$$\frac{M^D}{P} = m(y, i)$$

and in equilibrium:

$$\text{chosen by policy maker} \rightarrow \frac{M^s}{P} = \underset{(+)\ (-)}{m(y, i)} \text{ the 'demand for real balance'}$$

assumed fixed in short-run



equilibrium interest rate clears money market for any given P and M^s.

Assuming Completely Fixed Prices
The IS-LM Model.

- Keynes' "General Theory" is a long, difficult book. People still argue about 'what Keynes meant'.
- In 1937, Sir John Hicks ("Mr. Keynes and the Classics") published an interpretation of Keynes' theory that was compact, accessible, and very useful. His model is known as the <u>IS-LM model</u>.

  Strictly speaking, it is not <u>Keynes' theory</u>, but it is a <u>Keynesian theory</u>. Moreover, it is the interpretation of Keynes that most economists know.

- The IS-LM model consists of two curves plotted in $\{i, y\}$ space.

  LM curve: plots all the pairs of i and y consistent with money market equilibrium

  IS curve: plots all the pairs of i and y consistent with goods market equilibrium.

We will derive each of these curves in turn:

Derivation of LM curve.

Money market equilibrium:

$$\frac{M^s}{P} = m(y,i)$$

For any M^s and P, this equation defines a relationship between y and i.

- Holding M^s and P constant, differentiate:

$$0 = \frac{\partial m}{\partial y} \cdot dy + \frac{\partial m}{\partial i} di$$

$$= m_y \, dy + m_i \, di$$

m_y: change in money demand per unit change in y [positive]

m_i: change in money demand per unit change in i [negative]

- Rearranging:

$$\frac{di}{dy} = -\frac{m_y}{m_i} > 0.$$

LM curve has a <u>positive</u> slope.

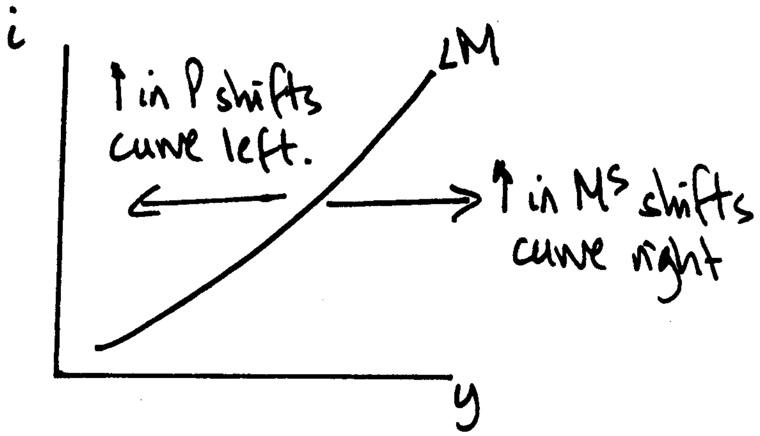
• Holding i constant, we get:

a) $\frac{dM^s}{P} = M_y \, dy \implies \frac{dy}{dM^s} = \frac{1}{PM_y} > 0$

so an increase in M^s increases y for any given i.

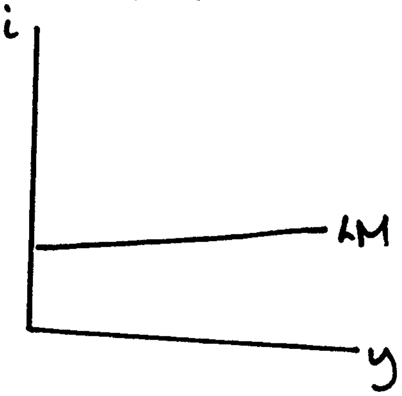
b) $-\frac{M^s}{P}\frac{dP}{\cancel{\partial}P} = M_y \, dy \implies \frac{dy}{dP} = -\frac{M^s}{P^2 M_y} < 0$

so an increase in P increases y for any given i.



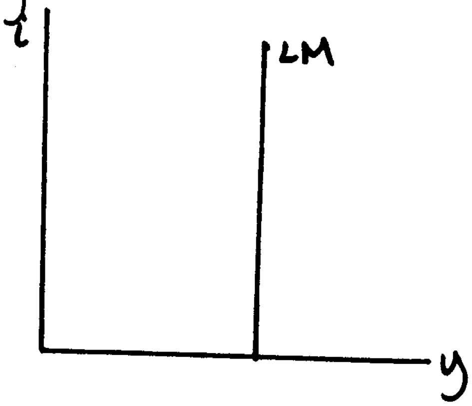
FACTORS SHIFTING LM CURVE.

As $M_i \to \infty$ (money demand highly sensitive to changes in the interest rate), $di/dy \to 0$.....



...so LM curve is flat.

As $M_i \to 0$ (money demand not at all sensitive to changes in the interest rate) $di/dy \to \infty$. . . .



...so LM curve is vertical.

Derivation of IS Curve.

Recall Keynes' equation:

$$y = \underbrace{C(y-t)}_{\substack{\text{Keynes thought}\\ \text{C did not depend}\\ \text{on r...}}} + I(r) + G \quad \text{...but I did.}$$

A similar version is used in the construction of the IS-LM model:

$$y = C(y-t, i-\pi^e) + I(i-\pi^e) + G,$$

which has two changes:

i) the dependency of consumption on the real rate of interest is restored

ii) we use the <u>expected</u> real rate of interest, $r^e = i - \pi^e$.

- Holding everything except y and i constant, and differentiating gets us the slope:

$$dy = C_y\, dy + C_{r^e} di + I_{r^e} di$$

$$\therefore (1 - C_y)\, dy = (C_{r^e} + I_{r^e})\, di$$

$$\therefore \quad \frac{di}{dy} = \frac{1 - C_y}{C_{r^e} + I_{r^e}} < 0.$$

$$\frac{di}{dy} = \frac{1-C_y}{C_{\pi^e}+I_{\pi^e}}$$

C_y = change in C given one unit change in y (or y-t). This is the marginal propensity to consume.
So numerator = 1 - MPC is the marginal propensity to save, and lies between 0 and 1.

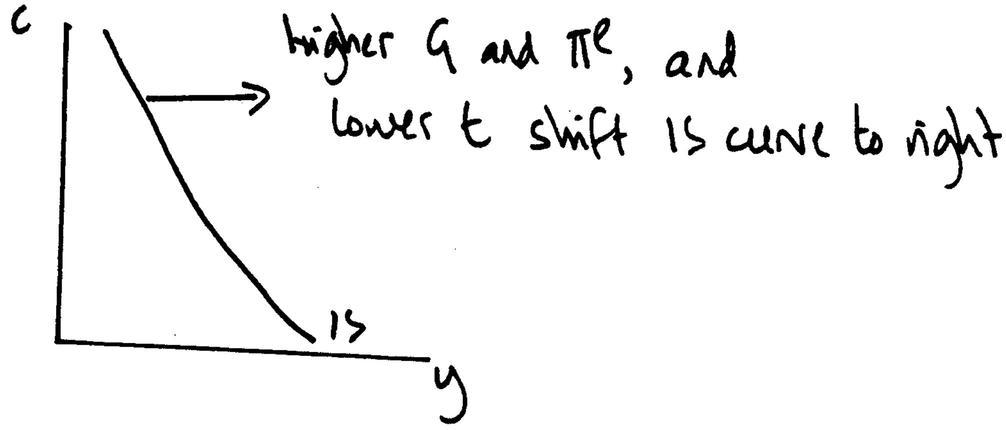
$C_{\pi^e}+I_{\pi^e}$ is the sensitivity of private sector demand (C+I) to changes in π^e.

- IS curve has negative slope.
- If C_{π^e} and I_{π^e} are small (not very sensitive to changes in π^e), then the IS curve is steep.

To get shifts in IS curve, hold i constant and differentiate:

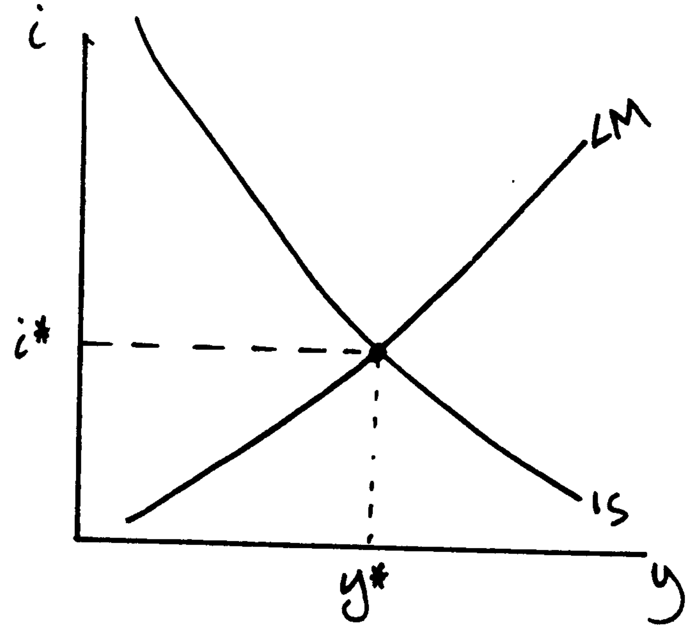
- $dy = C_y\,dy - C_y\,dt \Rightarrow \boxed{\dfrac{dy}{dt} = -\dfrac{C_y}{1-C_y}}$
- $dy = C_y\,dy + dG \Rightarrow \boxed{\dfrac{dy}{dG} = \dfrac{1}{1-C_y}}$
- $dy = C_y\,dy - C_{\pi^e}d\pi^e - I_{\pi^e}d\pi^e$

$$\Rightarrow \boxed{\frac{dy}{d\pi^e} = -\frac{(C_{\pi^e}+I_{\pi^e})}{1-C_y} > 0}$$



Equilibrium in the IS-LM Model.

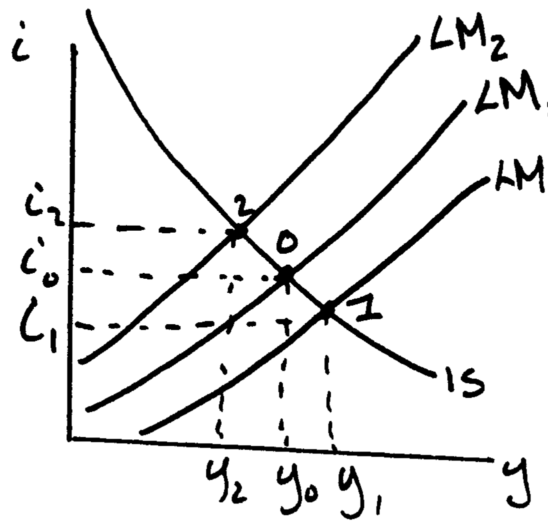
- LM curve: pairs of i and ~~Y~~ y, given P and M^s, consistent with equilibrium in the money market.
- IS curve: pairs of i and y, given t, G and π^e, consistent with equilibrium in goods market.
- Intersection: unique pair i^*, y^*, given P, M^s, t, G, + π^e, consistent with equilibrium in both markets.



Equilibrium in the IS-LM Model.

Policy shifts in the IS-LM model.

A) Changes in the money supply.

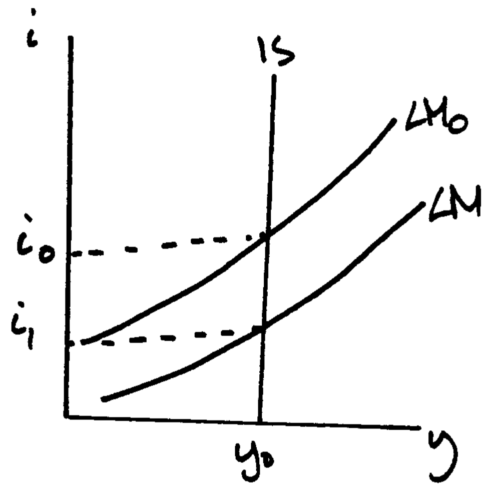


1. An increase in M^s, shifts LM curve right, to LM_1.... raising output, and lowering the interest rate.
2. A reduction in M^s, shifts LM curve left, to LM_2.... lowering output and raising the interest rate.

NOTE: a) The shift in the LM curve captures how changes in M^s affect the relationship between y + i necessary for money market equilibrium:

- to induce me to hold more money when my income is y, you must lower the cost of holding money – i.e. lower i.

b) The net effect on output also depends on the slope of the IS curve. Monetary expansion raises output by lowering i, which in turn raises C and I, as long as C and I are sensitive to changes in the interest rate.



C and I are not sensitive to changes in i. The IS curve is consequently (almost) vertical, and monetary expansion is <u>not</u> an effective stimulus to output.

Demand for money is very sensitive to changes in the interest rate. The LM curve is flat, so monetary expansion fails to lower interest rates, and so C and I fail to rise. Monetary expansion again <u>not</u> effective. This scenario is known as the "liquidity trap."

The effectiveness of monetary policy, an algebraic approach

Holding P, t, G and π^e constant, we have:

$$\frac{dM^s}{P} = M_y\,dy + M_i\,di \qquad (1)$$

$$dy = C_y\,dy + C_{re}\,di + I_{re}\,di \qquad (2)$$

Solve (2) for di:

$$di = \frac{(1-C_y)\,dy}{C_{re} + I_{re}}$$

and substitute into (1):

$$\frac{dM^s}{P} = M_y\, dy + \frac{M_i(1-C_y)}{C_{re}+I_{re}}\, dy$$

$$= \frac{(C_{re}+I_{re})M_y + M_i(1-C_y)}{C_{re}+I_{re}}\, dy$$

So we have:

$$\frac{dy}{dM^s} = \frac{C_{re}+I_{re}}{P(C_{re}+I_{re})M_y + P(1-C_y)M_i} \geq 0 \quad (3)$$

This last equation shows:

a) $C_{re} = I_{re} = 0 \Rightarrow \frac{dy}{dM^s} = 0$ (IS curve vertical)

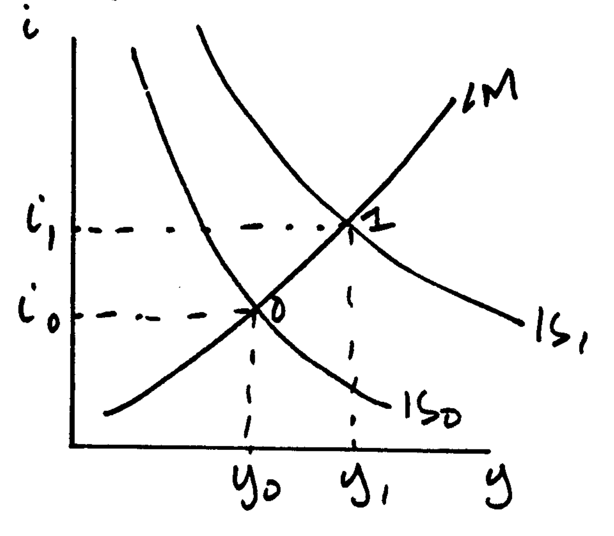
b) $M_r \to \infty \Rightarrow \frac{dy}{dM^s} = 0$ (LM curve flat)

which is what we showed graphically.

c) If $C_{re} + I_{re}$ become very large, then $\frac{dy}{dM^s} \to \frac{1}{PM_y}$, so the sensitivity of money demand to changes in income matter.

d) If $M_i = 0$, then $\frac{dy}{dM^s} = \frac{1}{PM_y}$, so M_y also matters in this case.

B) Changes in government expenditure

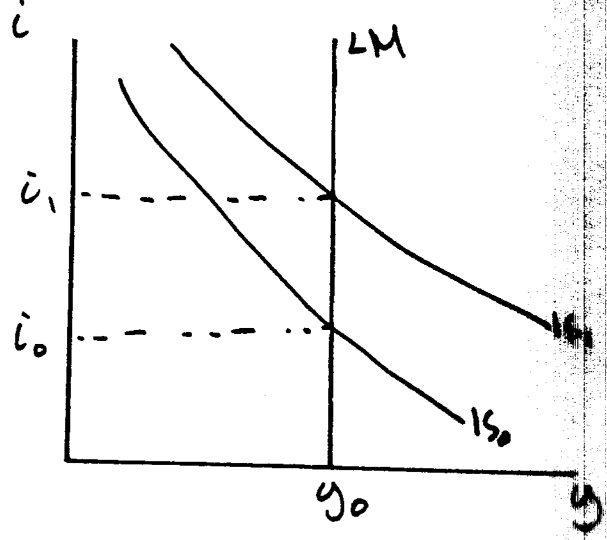


1. An increase in G shifts the IS curve right to IS_1, raising output and raising the interest rate.
2. A reduction in G (not shown) shifts IS left, lowering y and i.

A Note on crowding out.

- Recall – in classical model, with $\bar{y}$ fixed, all increases in G are offset by reductions in C and I. The question of crowding out was concerned with how much I goes down.
- In our first look at the Keynesian government multiplier, there was no crowding out because we (temporarily) assumed that I did not depend on the interest rate.
- In the IS-LM model, an increase in G raises i. Because I depends negatively on $i - \pi^e$, this must drive down – "crowd out" – investment.

The effectiveness of government expenditure, graphical



If the LM curve is vertical, an increase in G does <u>not</u> raise output. Instead, i rises so much as to reduce C and I by the same amount as the increase in G. The sum C+I+G is left unchanged.

Q. • What makes the LM curve vertical?

A: • Recall that the slope of the LM curve is

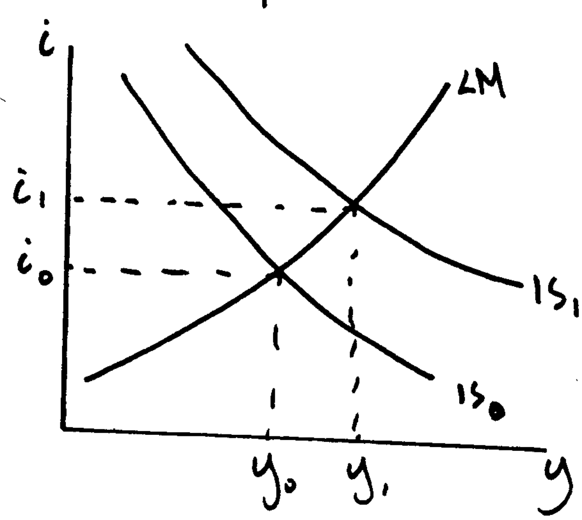
$$\left.\frac{di}{dy}\right|_{LM} = -\frac{M_y}{M_i}$$

So if $M_i \to 0$ (money demand is interest inelastic)
or $M_y \to \infty$ (money demand is extremely sensitive to changes in income,

then $\frac{di}{dy} \to -\infty$.

Now, $M_y \to \infty$ is just not plausible, so the effectiveness of government expenditure in raising output depends on the sensitivity of money demand to the nominal interest rate.

Tax policy.



1. A cut in taxes, shifts IS curve right, raising y and i.

A cut in taxes has qualitatively the same effect as an expansion of government expenditure.

A balanced budget fiscal expansion.

Let $dT = dG = dz$.

The effects are as follows

$$0 = M_y\,dy + M_i\,di$$

$$dy = -C_y\,dT + C_y\,dy + C_{re}\,di + I_{re}\,di + dG$$

$$\therefore (1-C_y)\,dy = C_{re}\,di + I_{re}\,di + (1-C_y)\,dz$$

$$= -(C_{re} + I_{re})\frac{M_y}{M_i}\,dy + (1-C_y)\,dz$$

$$\therefore \left[(1-C_y) + \left((C_{re}+I_{re})\frac{M_y}{M_i}\right)\right]dy = (1-C_y)\,dz$$

$$\therefore \boxed{\frac{dy}{dz} = \frac{(1-C_y)}{(1-C_y) + (C_{re}+I_{re})\frac{M_y}{M_i}} > 0}$$

but less than one.

The Debate on Policy Effectiveness.

- Different assumptions about the slopes of the IS and LM curves lead to different conclusions about the effectiveness of monetary and fiscal policy.

- In the classical model with p and w flexible, neither M^S, G or T can influence output (except for the incentive effects in the way T is collected).

- But, after Keynes, classical economists were willing to accept that p and w might not be flexible in the short-run.

  - In this case, they argued that money demand is not sensitive to i (recall quantity theory), so $M_i = 0$. Thus LM is vertical and fiscal policy is ineffective in raising output.

- Keynesians believed:

  a) $M_i >> 0$, so LM curve is quite flat.

  b) C and I are not highly sensitive to i, so IS curve is steep.

Hence: monetary policy is not very effective, but fiscal policy is.

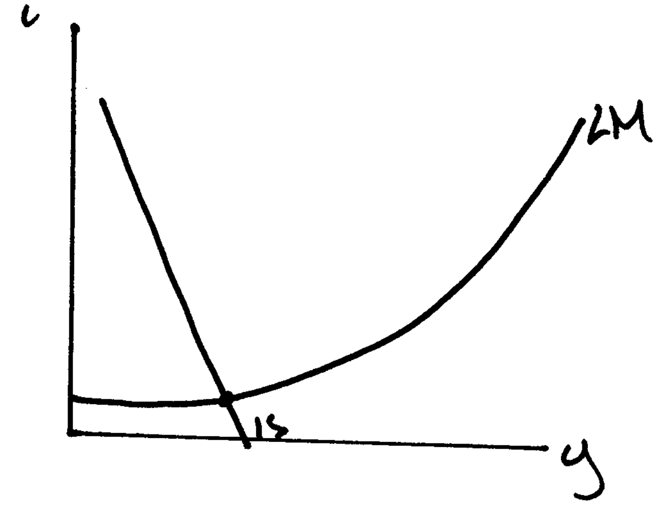
APPLICATION

THE LIQUIDITY TRAP IN JAPAN

Japanese data:

	1992	1993	1994	1995	1996	1997
GDP growth (%)	1.0	0.3	0.6	1.5	3.9	0.8
Inflation (%)	1.7	0.6	0.2	−0.6	−0.5	0.6
Fiscal surplus (% of GDP)	1.5	−1.6	−2.3	−3.6	−4.3	−3.3
nominal interest rate	4.5	3.0	2.2	1.2	0.6	0.6

- GDP growth very slow compared to previous decades
- Govt. engaged in expansionary fiscal policy, but it hasn't been successful
- Interest rates have become very low.



The low interest rates suggest the economy might be in a liquidity trap: simple monetary expansion shifting LM right won't help.

What more can they do?

① Fiscal expansion: but Japan's budget deficit is already large and it is politically difficult to raise it further.

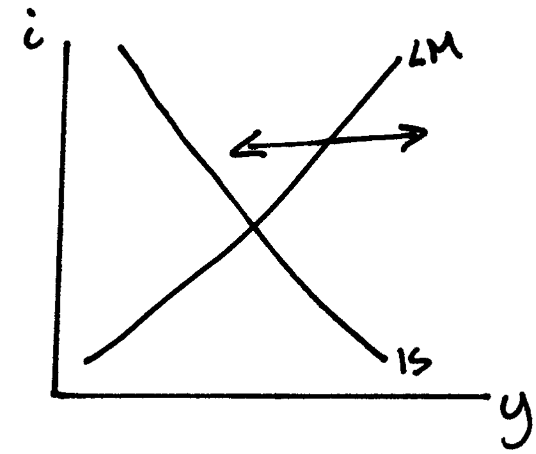
② Sustained money growth.

- But how does this work? Short-run money expansion has no effect.
- Sustained money growth will eventually generate inflation.
- This will lower expected real interest rates, and shift the IS curve out.

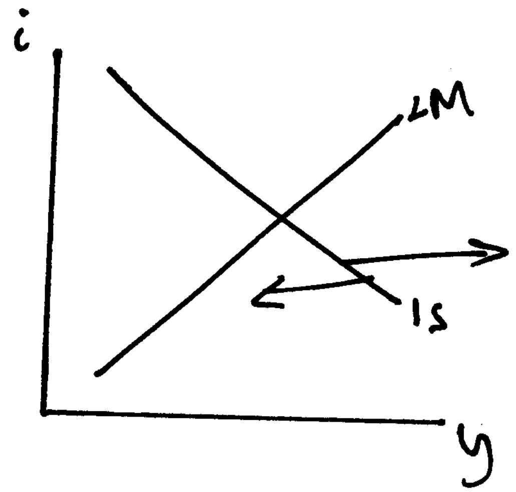
APPLICATION

THE POLICY MIX

So, we have seen:

- 

Monetary policy, changing M^s, shifts LM curve left and right...

- 

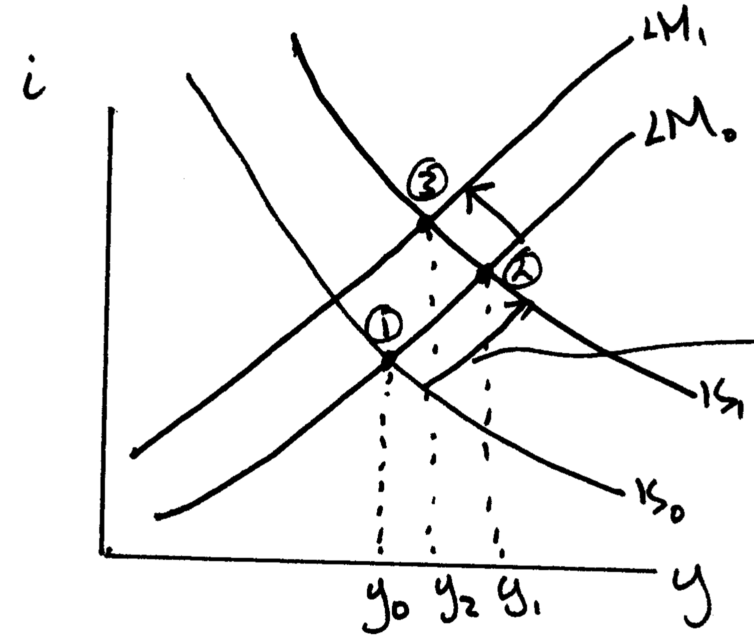
..while fiscal policy - changing taxes and government expenditure - shifts IS curve left and right.

- Imagine the government changes fiscal policy. The central bank can <u>cooperate</u> by adjusting monetary policy, or it can act to <u>offset</u> the fiscal policy change.

APPLICATION

GERMAN UNIFICATION

- In 1990, unification brought together two very different economies. In particular, firms in the East were not competitive, infrastructure was inadequate, etc..
- The government embarked on a massive program of investment. The fiscal position moved from a balanced budget to a deficit of about 3% of GDP.
- The Bundesbank, concerned that the fiscal expansion was too large – leading to too high an increase in Y, and possibly inducing inflation (mechanisms we study later) decided to choke off some of this activity. They contracted the money supply, raising the interest rate from 4.3% in 1988, to 9.2% in 1991.



① fiscal expansion induces too large an increase in y for the Bundesbank's comfort...

② ...So the money supply is contracted, raising i even further...

This has important consequences:

- High ~~[illegible]~~ interest rates reduce private sector investment, reducing the size of the future economy.
- Policy had consequences for the rest of Europe (through mechanism we will see later): it may have caused a recession.

APPLICATION

The Greenspan-Clinton Policy Mix.

- At the end of 1992, Clinton faced a tough problem:
  - Federal budget deficit was 4.5% of GDP, the second largest since WW2.
  - the economy was only just emerging from the recession of 1990-91.

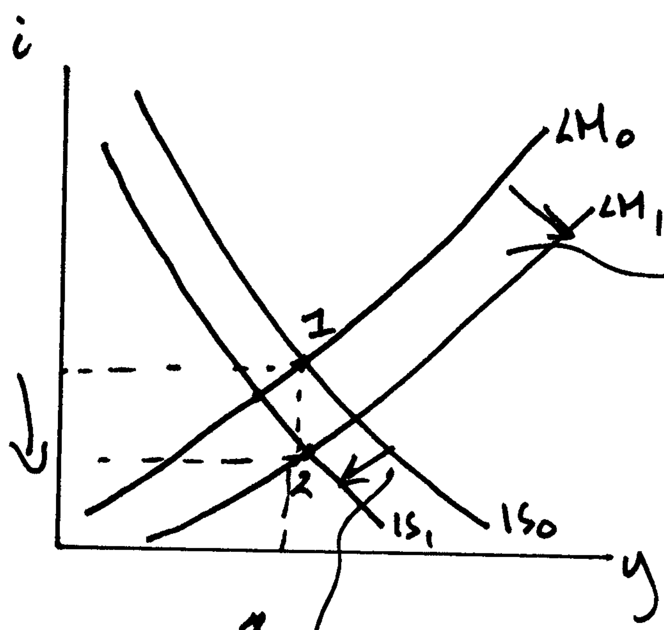
How does one cut the deficit, without reducing output and making the recession worse?

- The answer is to cut spending / raise taxes while using expansionary monetary policy to offset the contractionary effects of fiscal belt tightening.

- PROBLEM: The white house and congress control the fiscal side, but the Federal Reserve controls the monetary side.

- To overcome this, Greenspan and Clinton engaged in a game of indirect communication:
  - Greenspan gives speeches about how he is concerned about the size of the deficit and how he could use expansionary monetary policy if only the deficit were smaller.
  - Clinton gives speeches about how he is concerned about heading back into a recession, and would cut the deficit if only this could be avoided.
- Thus understood, the two engaged in their cooperative policy:

	1991	1992	1993	1994
Budget surplus (% of GDP)	-3.3%	-4.5%	-3.8%	-2.7% ...
Interest rate	7.3%	5.3%	3.7%	3.3%
GDP growth	-0.9%	2.7%	2.3%	3.4%



① Greenspan increases M^s, lowering i and stimulating output....

② ... enabling the white house to engage in deficit reduction..

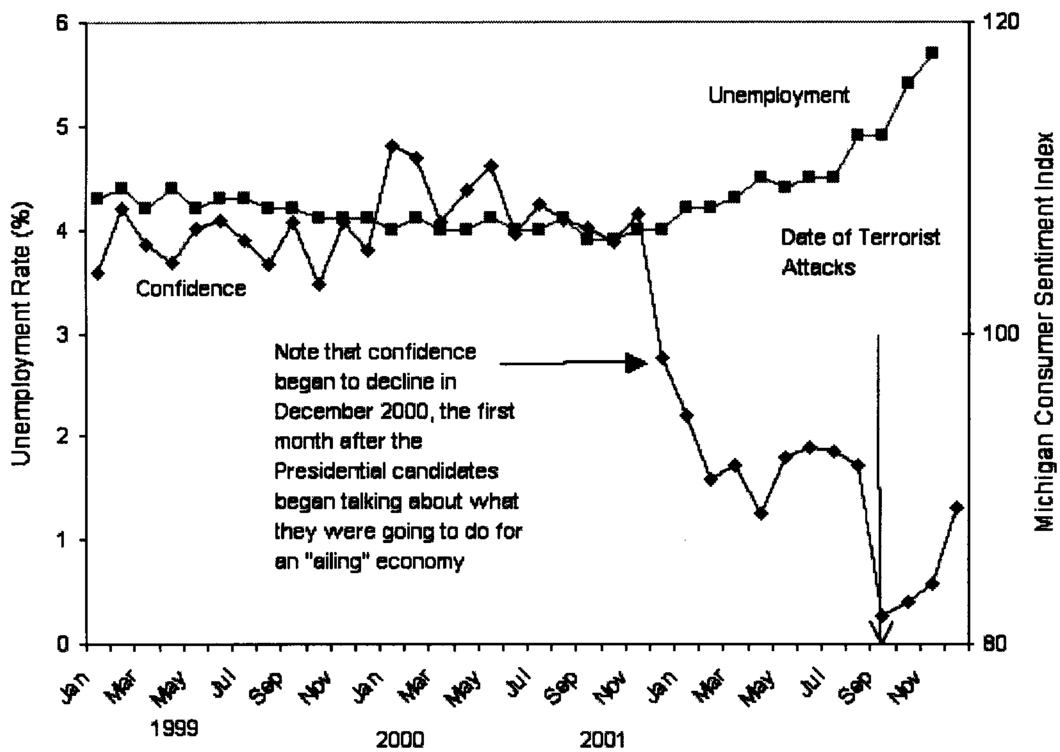
③ .. resulting in a large reduction in i...

④ ... but no decline in output.

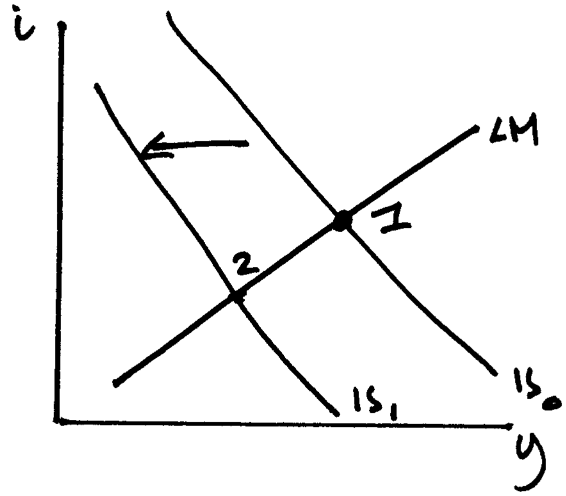
APPLICATION

SEPTEMBER 11, 2001

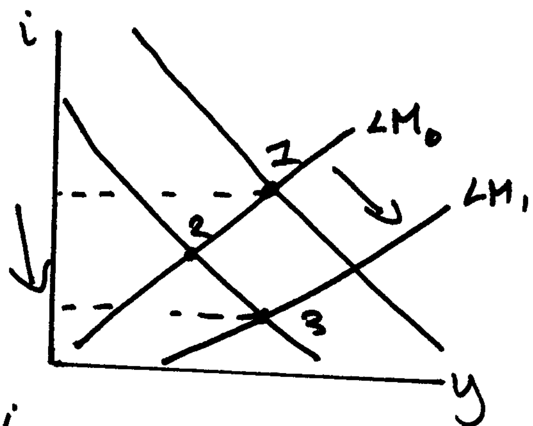
- A drop in consumer confidence?



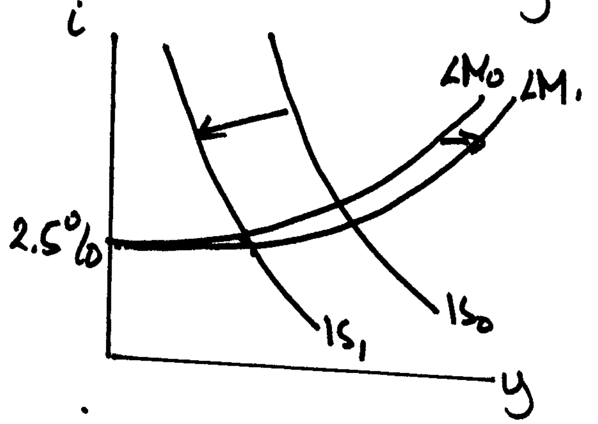
- Causes a reduction in consumption at any given interest rate
- which manifests itself as a leftward shift of the IS curve.



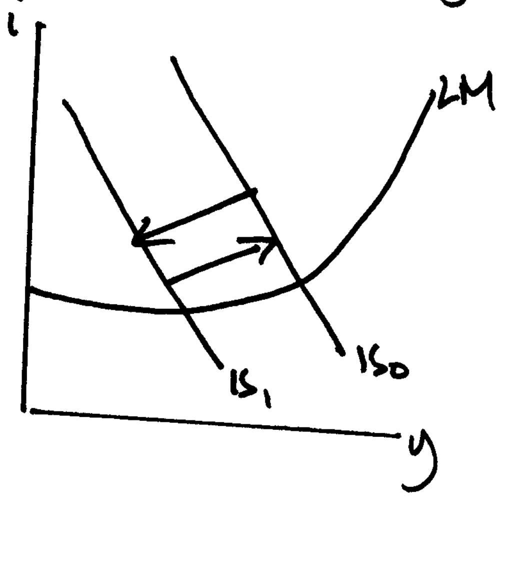
The drop in consumption...



... might be offset by increases in the money supply, reducing interest rates.. which the Fed has done.



But this might not be effective if interest rates are already low, as they are ...

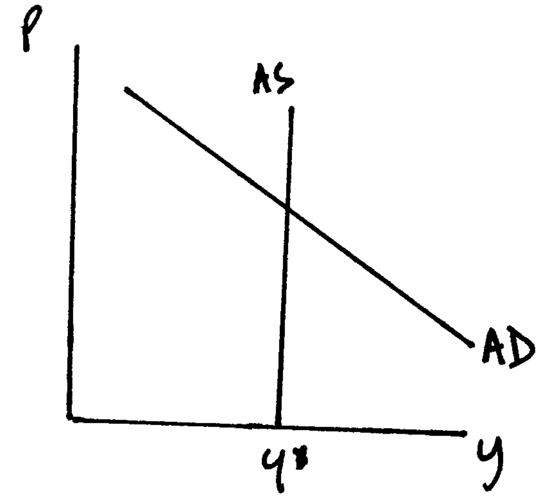


.. so we might need a tax cut to shift the IS curve back to the right.

Allowing Some Price Flexibility

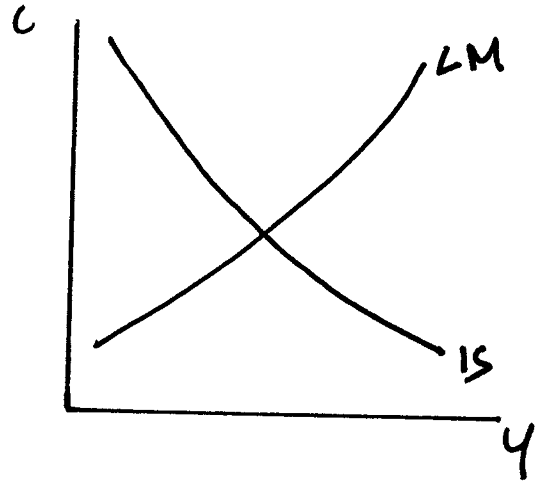
The AS-AD Model

- Recall from the classical model, we derived an AD and AS function:



Because P is assumed flexible shifts in AD affect price, but not Y.

- In the Keynesian model with complete price rigidity, we had:



An entirely different graph!

How can we compare these two models?

The best way is to create an AS-AD model out of the Keynesian model we have just looked at.

Algebraic Derivation of Keynesian AD curve.

- The LM curve was obtained directly from the money market condition:

$$\frac{M^s}{P} = m(y, i).$$

- The IS curve was obtained from the national income identity:

$$y = c(y-t, i-\pi^e) + I(i-\pi^e) + G$$

To get an AD curve, we want a relationship between P and y that does not depend on other endogenous variables. That is, we need to substitute i out of these equations.

Difficult, because the equations are nonlinear with undefined functions.

But we can get the slope, dP/dy of the AD curve:

Differentiate the two equations with respect to P, y and i:

$$-\frac{M^s}{P^2}dP = M_y\,dy + M_i\,di$$

$$dy = C_y\,dy + C_{i-\pi^e}\,di + I_{i-\pi^e}\,di$$

Rearrange to solve for di:

$$di = -\frac{M^s}{M_i P^2}dP - \frac{M_y}{M_i}dy$$

$$di = \frac{(1-C_y)}{C_{i-\pi^e}+I_{i-\pi^e}}dy$$

Combine to remove di:

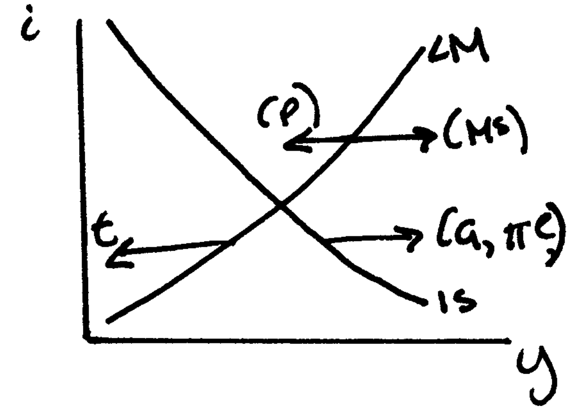
$$\frac{(1-C_y)}{C_{i-\pi^e}+I_{i-\pi^e}}dy = -\frac{M^s}{M_i P^2}dP - \frac{M_y}{M_i}dy$$

And rearrange:

$$\frac{dP}{dy} = -\frac{M_i P^2}{M^s}\left(\frac{1-C_y}{C_{i-\pi^e}+I_{i-\pi^e}} + \frac{M_y}{M_i}\right) < 0$$

So the Keynesian AD curve has a negative slope.

Graphical derivation of Keynesian AD curve.



Arrows indicate shift of curves when variable(s) in parentheses increase.

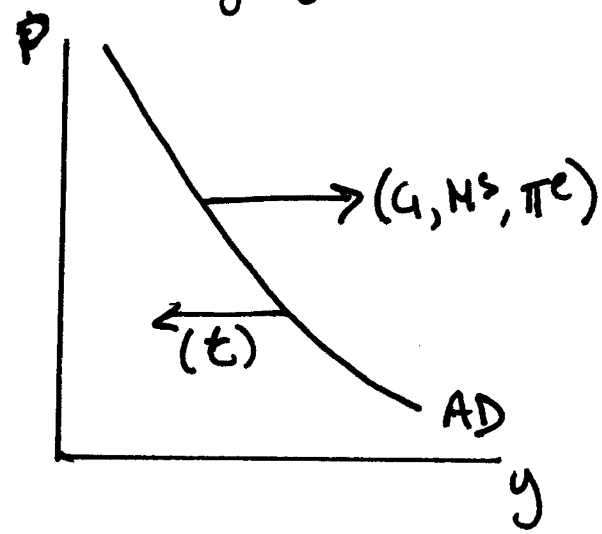
So, an increase in P shifts LM left, reducing y.

So P and y are negatively related – AD slopes down

NOTE: graphical derivation of AD is a lot easier, but contains less information!

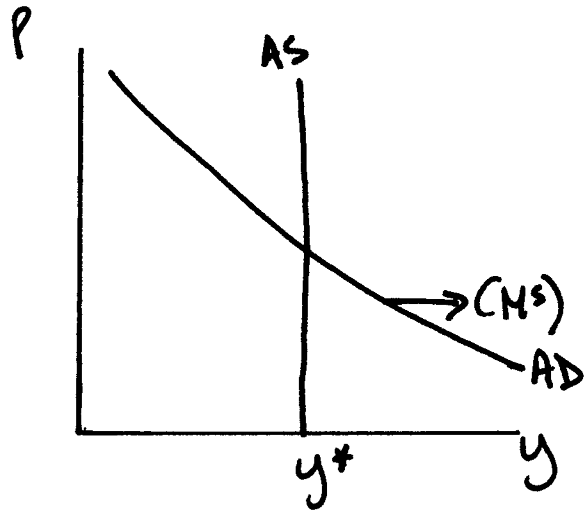
Now, hold p constant and note,

y goes up when G, M^s or π^e go up
y goes down when t goes down.

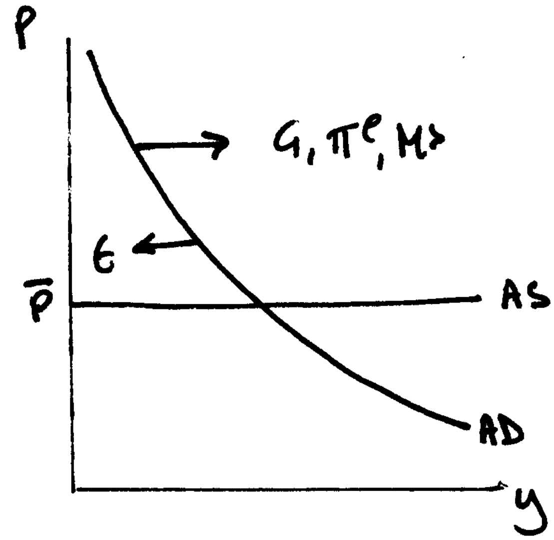


So now we know how the Keynesian AD curve shifts.

Comparing the Keynesian + Classical AS-AD Models.



Classical Model.



Keynesian Model

① More things shift AD than in classical model

② By not modeling the production side, we have implicitly assumed that firms will supply whatever is demanded at current price

So changes in G, t and M^s affect output in the Keynesian model...

...while in the classical model none of these variables influence output.

OK, both of these are extreme views:

- firms don't change prices and wages at every instant of time, so prices cannot be fully flexible in the very short-run.
- but firms *do* eventually raise prices and wages if, say, demand is high, so prices cannot be fully fixed in the long-run.

These observations suggest a natural synthesis:

1
- Interpret the classical model as a long-run model – it describes the equilibrium on which an economy will *eventually* converge.
- interpret the Keynesian model as a short-run model – it describes the 'immediate' response of the economy to a shock or a policy change.

2
- Devise a version of the aggregate supply curve that makes an adjustment over time from horizontal to vertical.

The synthesis suggested above is in fact what economists did in the 1960s. The combination of a Keynesian short-run with a classical long-run, dubbed "the neoclassical synthesis", was the dominant macroeconomic model of the 1960s.

Let's do task 2 first: derive an adjusting AS curve.

An Adjusting AS Curve

The Keynesian interpretation of aggregate supply relies on two key insights about the functioning of the labor market:

- Although workers and firms care about the real wage, the wage is actually set in nominal terms.
- Wage contracts specify nominal wages that are fixed for a period of time.

This implies that firms and workers have to arrive at a negotiated wage on the basis of what they expect the price level to be in the future.

Assume $x = \left(\frac{w}{p}\right)^*$ is the desired real wage for the coming year. w is chosen directly, but p is not known.

So firms and workers set a nominal wage, $\bar{w}$, so that $\bar{w}/p^e = x$.

Now imagine the price level, p, turns out to be different from p^e. Then, the real wage will actually turn out to be

$$\frac{\bar{w}}{p} = x\,\frac{p^e}{p}$$

This implies:

- if $p^e > p$ (i.e. people overestimated the future price level), the real wage will be higher than expected, firms will employ fewer workers, and output will decline.

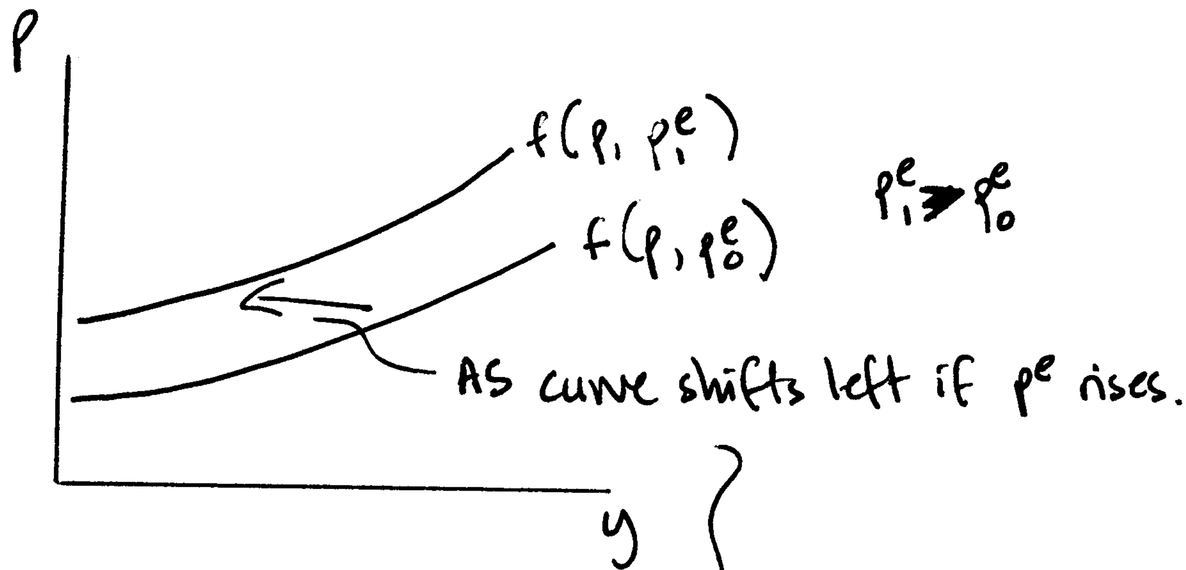
- if $p^e < p$ (people underestimated the future price level), the real wage will be low, employment will be be high, and output rises.

Note - this is one of the costs of unanticipated inflation talked about at the beginning of the course.

That is: for any given expected price level, p^e, output is an increasing function of price, p.

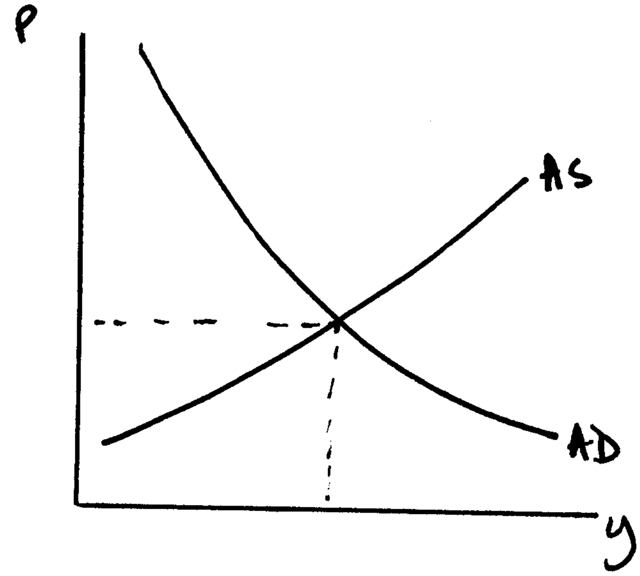
We can write this as:

$$y = f(\underbrace{p}_{\text{positively related to } y}, \underbrace{p^e}_{\text{negatively related to } y})$$



In words: if we expect prices to be high, then we will demand a high price for any given output level.

So, now we have:



But to show how the AS curve moves over time, we need to think about P^e.

It will help here if we begin with a specific functional form for the AS curve:

$$y = \bar{y} + \beta(P - P^e) + z$$

z: shift variable for cost shocks

$\bar{y}$: full employment level of output, OR "potential GDP".

If there is no surprise in the price level, output will equal the level implied by the classical model.

Modeling expectations in the 1960s.

- State of the art model of expectations in the 1960s is known as the model of <u>adaptive expectations</u>, developed by Cagan in 1956.

$$P_t^e = P_{t-1}^e + \alpha\left(P_{t-1} - P_{t-1}^e\right)$$

price level expected to prevail at time t	=	price level that had been expected for $t-1$	+	a fraction α of the error that had been made with the last forecast.

- What is attractive about the model is that P_t^e can be expressed as a function of the <u>price</u>:

$$P_t^e = \alpha P_{t-1} + (1-\alpha) P_{t-1}^e$$

$$= \alpha P_{t-1} + (1-\alpha)\left[P_{t-2}^e + \alpha\left(P_{t-2} - P_{t-2}^e\right)\right]$$

$$= \alpha P_{t-1} + \alpha(1-\alpha) P_{t-2} + \alpha(1-\alpha) P_{t-2}^e$$

$$\vdots$$

$$\underline{P_t^e = \alpha P_{t-1} + \alpha(1-\alpha) P_{t-2} + \alpha(1-\alpha)^2 P_{t-3} + \cdots}$$

Notes about this equation:

- If P has always been a constant, say $\bar{P}$, then $P_t^e = \bar{P}$:

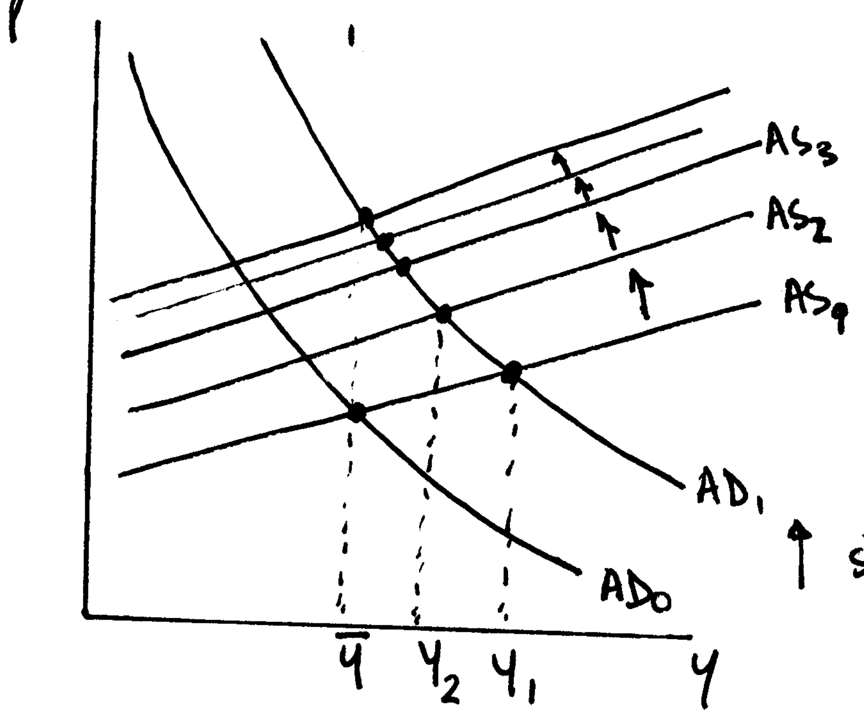
$$P_t^e = \alpha \bar{P} + \alpha(1-\alpha)\bar{P} + \alpha(1-\alpha)\bar{P}^2 + \dots$$

$$= \alpha \bar{P}^2 \sum_{j=0}^{\infty} (1-\alpha)^j$$

$$= \frac{\alpha \bar{P}}{1-(1-\alpha)}$$ — using formula for sum of geometric series

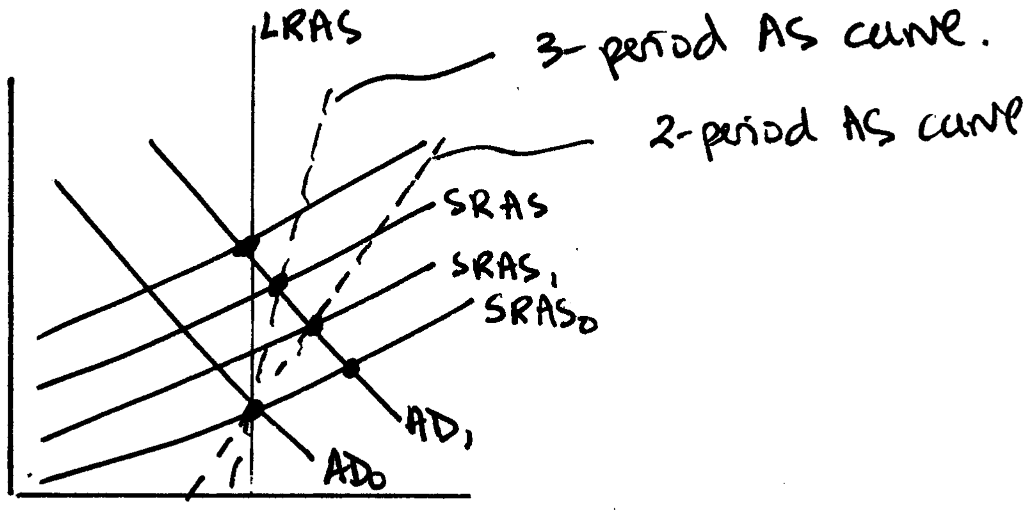
$$= \bar{P}$$

- If in period t, the price rises – say, because the AD curve shifts to the right – the AS curve will begin a <u>sequence of shifts to the left</u>. This is because P_t^e rises over time.



↑ shifts up due to policy change

We can accommodate these shifting AS curves by distinguishing between short-run and long-run AS curves.



- The simple point is that the AS curve between any two equilibria is steeper the further apart in time the equilibria are.

- In the long-run – after all the adjustments to expectations have been made, the AS curve is vertical.

- In the short-run, the AS curve is very flat.

Demand Shocks

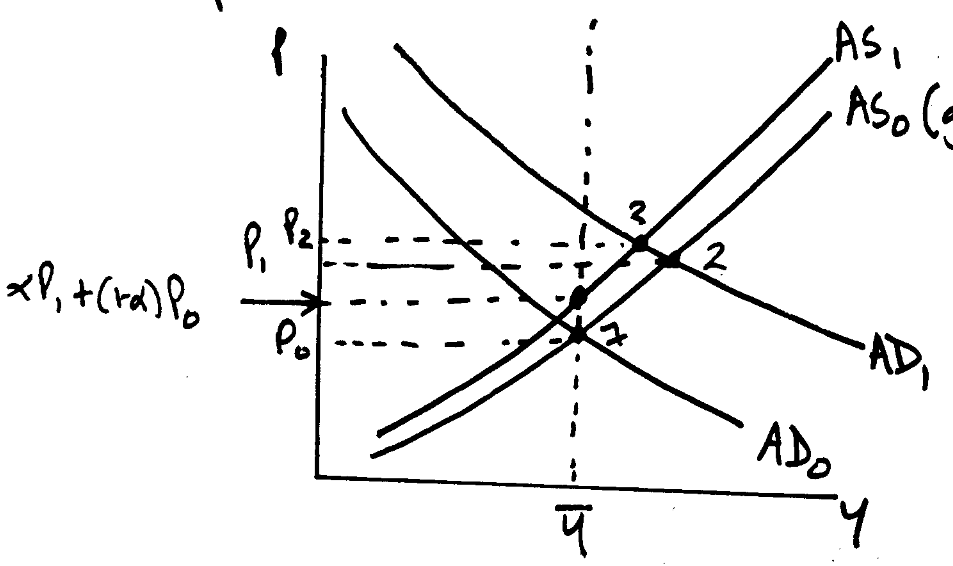
We can be more precise about the nature of the shifts in the AS curves.

Define $\bar{y}$ (L.R.A.S – long run aggregate supply) as the level of output such that $y = \bar{y}$. From the AS curve:

$$y = \bar{y} + \alpha(p - p^e)$$

this requires that $p = p^e$.

So, now imagine that the AD curve shifts upwards.

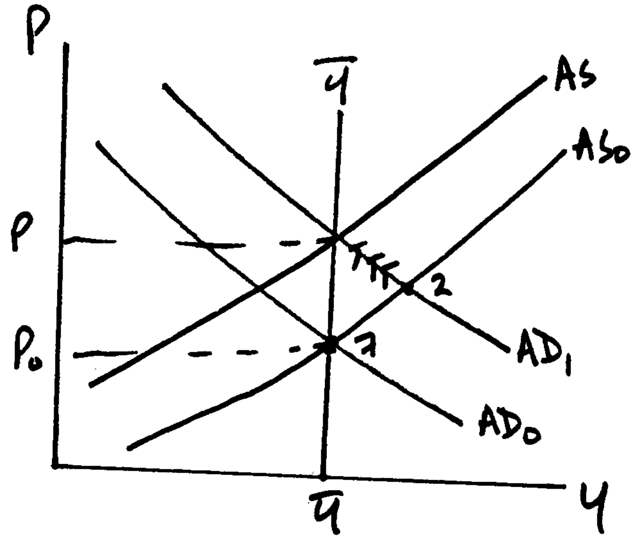


In the second period, P^e rises to some level greater than P^e_0 but less than P_1

if equals
$P^e_1 = \alpha P_1 + (1-\alpha)P^e_0$
why?

.. and this means that the new AS curve must pass through the point $(\alpha P_1 + (1-\alpha)P_0, \bar{y})$. Why?

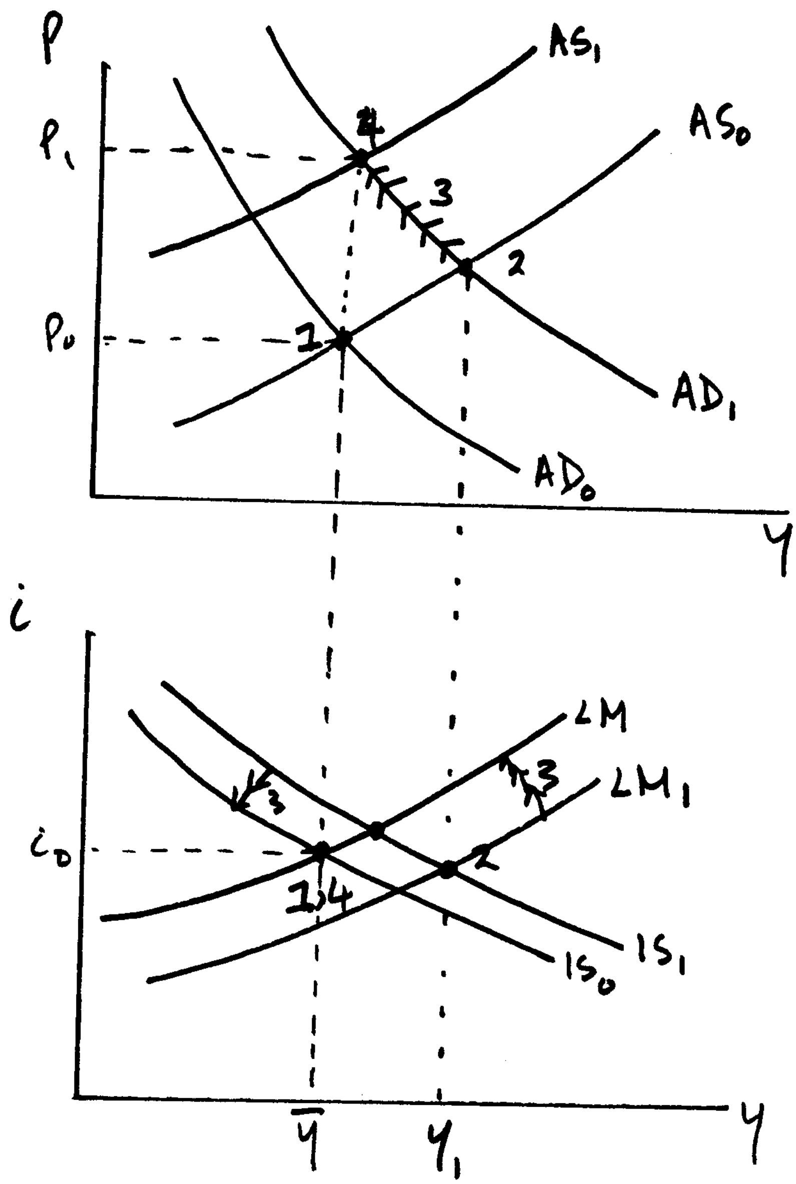
... And this process must continue until the final AS curve intersects the AD curve at $\bar{y}$.



We can conclude from this that

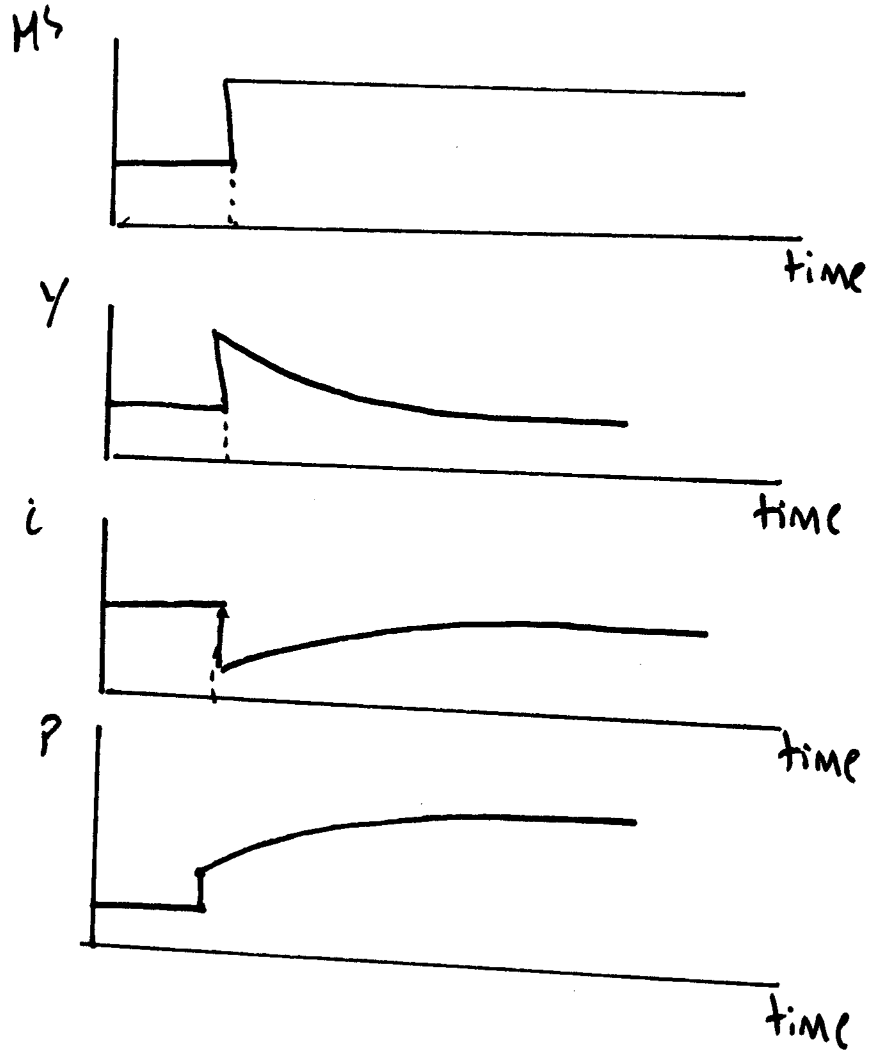
- a permanent increase in M^s and G, and a permanent decrease in T:
  - raise output and prices in the short run
  - induce further increases in prices, but offsetting declines in output as expectations change
  - in the long-run lead to a permanently increased price level, with output at its original level.

The Effect of a Monetary Expansion



1. Start out at $\bar{Y}$, with P_0 and i_0.
2. Increase in M^S shifts AD_0 to AD_1, raising Y and P_0. LM curve shifts to the right, as does the IS curve (IS curve shifts because <u>inflation</u> is expected). Effect on i not obvious but it turn out it must be negative
3. As expectations change, AS shifts up. Output contracts and P rises further, but at a decreasing rate. IS curve shifts down as inflation declines, and LM curve shifts left as P rises.

Time path of variables:



Permanent increase in MS

temporarily stimulates output..

reduces i temporarily.
...

.. and generates a permanently higher price level.

<u>MONEY NEUTRALITY</u>

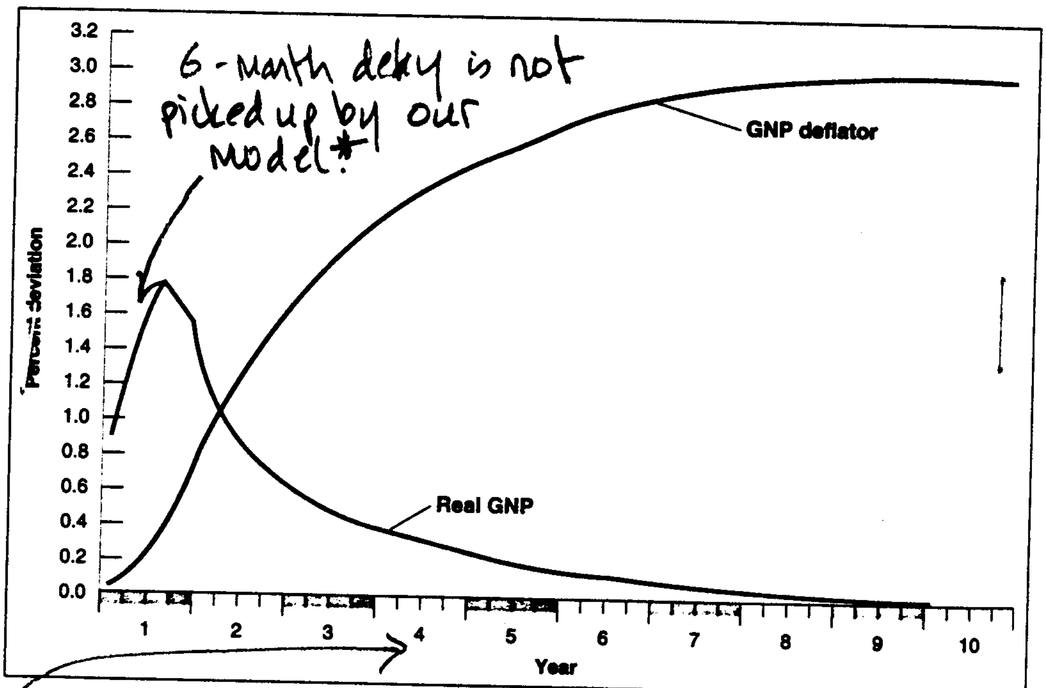
• Monetary policy can have temporary stimulating effects on the economy, but cannot be used to permanently change output and employment.

<u>Changes in G and T</u>

You should work these out on your own – in particular note permanent effects on the interest rate.

The magnitude + duration of the effects of money.

- One way to measure them is to construct a macroeconometric model. The figure below is obtained from such a model developed by John Taylor of Stanford.



Effects of a 3% increase in M^s.

The peak effect is a 1.8% increase compared to $\bar{Y}$.

the output effects are still significant after 4 years.

eventually the price level rises by 3% as the quantity theory predicts.

* More sophisticated versions of IS-LM can pick up this delay, but we will not attempt to do so.

Cost and Aggregate Supply

We have written down a simple AS curve:

$$y = \bar{y} + \alpha(p - p^e)$$

It is not obvious what role production costs play in this equation. We can imagine that at any given price, y will go down if input costs increase.

But, we need to be more precise.

Key to understanding how changes in input costs affect the aggregate supply curve is to look at the production side of the economy.

$$Y = \underbrace{\bar{K}^{\alpha}}_{\text{assumed fixed.}} N^{\beta} G^{1-\alpha-\beta}$$

G — other inputs such as oil

Then profits are

$$\pi = pY - rK - wN - P_a G$$

$$= p\bar{K}^{\alpha}N^{\beta}G^{1-\alpha-\beta} - r\bar{K} - wN - P_a G$$

Maximize profits by differentiating with respect to the choice variables, G and N:

$$\frac{d\pi}{dN} = \beta p \bar{K}^{\alpha} N^{\beta-1} G^{1-\alpha-\beta} - w = 0$$

$$\frac{d\pi}{dG} = (1-\alpha-\beta) p \bar{K}^{\alpha} N^{\beta} G^{-(\alpha+\beta)} - P_G = 0.$$

Rearrange, to get:

$$G = \left(\frac{P_G}{P}\right)^{-1/\alpha+\beta} \left((1-\alpha-\beta)\bar{K}^{\alpha} N^{\beta}\right)^{1/\alpha+\beta}$$

so for any given N, an increase in the relative price of inputs reduces G.

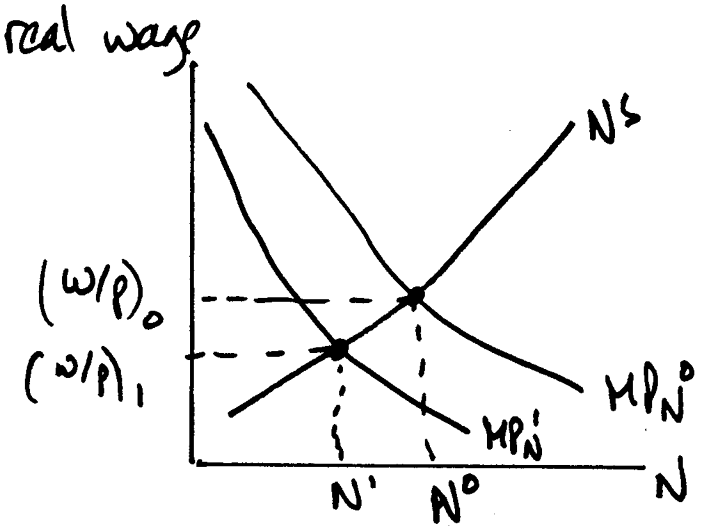
Now we can show that MP_N declines if G is lower:

$$MP_N = \beta \bar{K}^{\alpha} N^{\beta-1} G^{1-\alpha-\beta}$$

and

$$\frac{d(MP_N)}{dG} = (1-\alpha-\beta)\beta \bar{K}^{\alpha} N^{\beta-1} G^{-(\alpha+\beta)} > 0$$

so if G falls, then MP_N falls. The MP curve – the demand curve for labor – shifts down....



~ Increase in P_a/P reduces employment, which in turn reduces $\bar{y}$.

- So, we find that a rise in the cost of inputs reduces the long-run value of output, $\bar{y}$.

- We can then write AS as

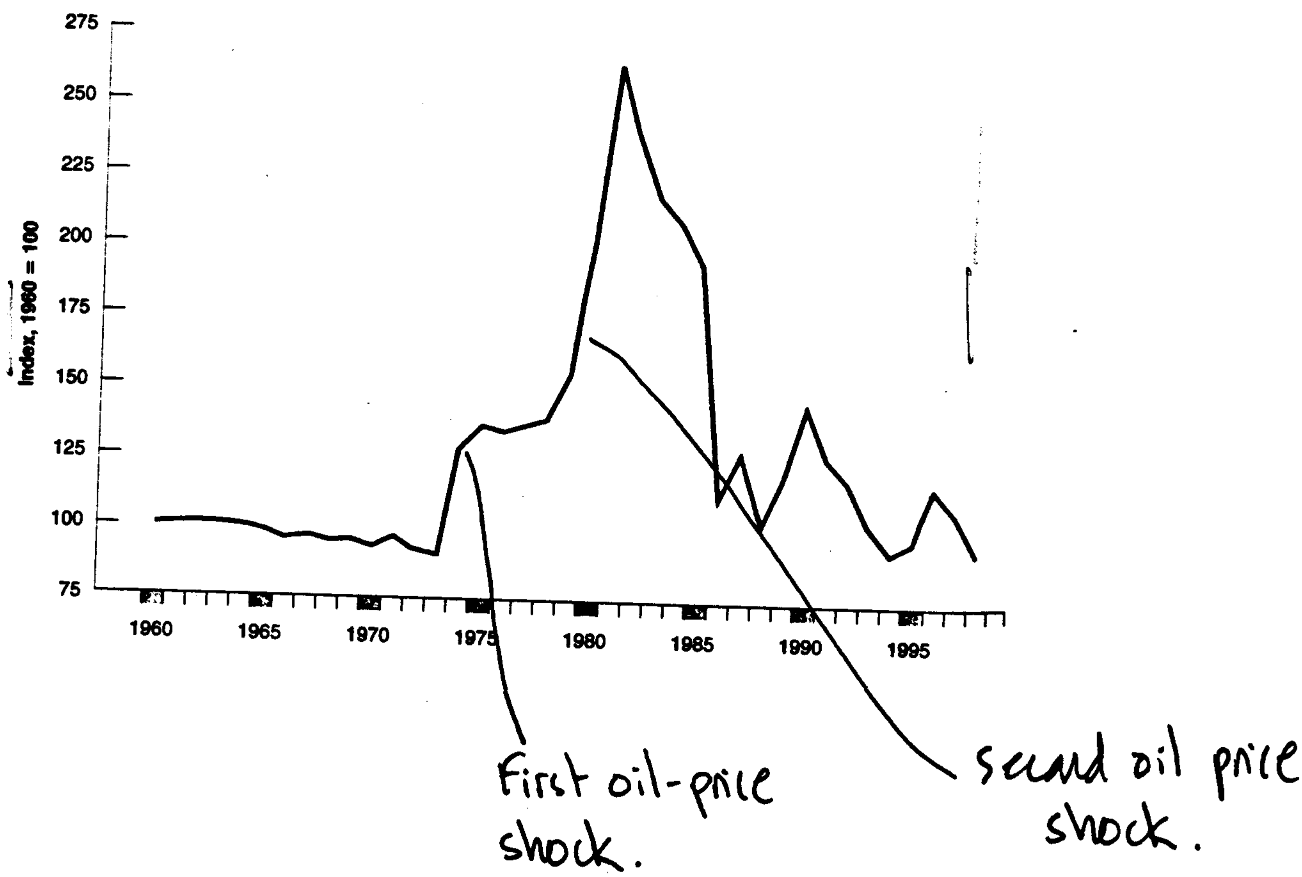
$$y = \bar{y}(p_a) + \alpha(p - p^e)$$

where $\bar{y}$ depends negatively on p_a.

- We can now use this to think about the consequences of a significant shock to production costs.

APPLICATION

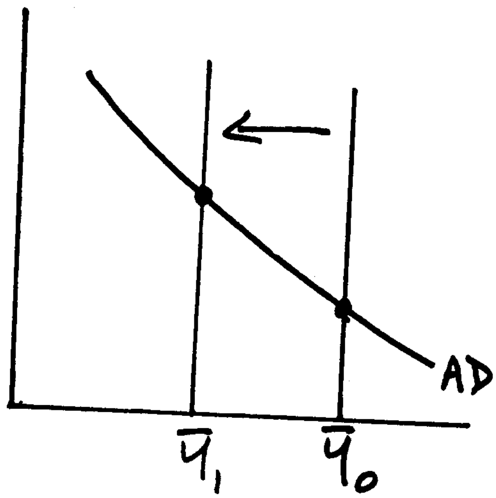
THE OIL-PRICE SHOCKS



OPEC supply reduction in 1973/4 and again 1979-81 led to sharp increases in the relative price of oil. The restricted supply began to fall apart as an increasing number of countries violated their quotas in the mid-1980s.

What does our model predict will happen?

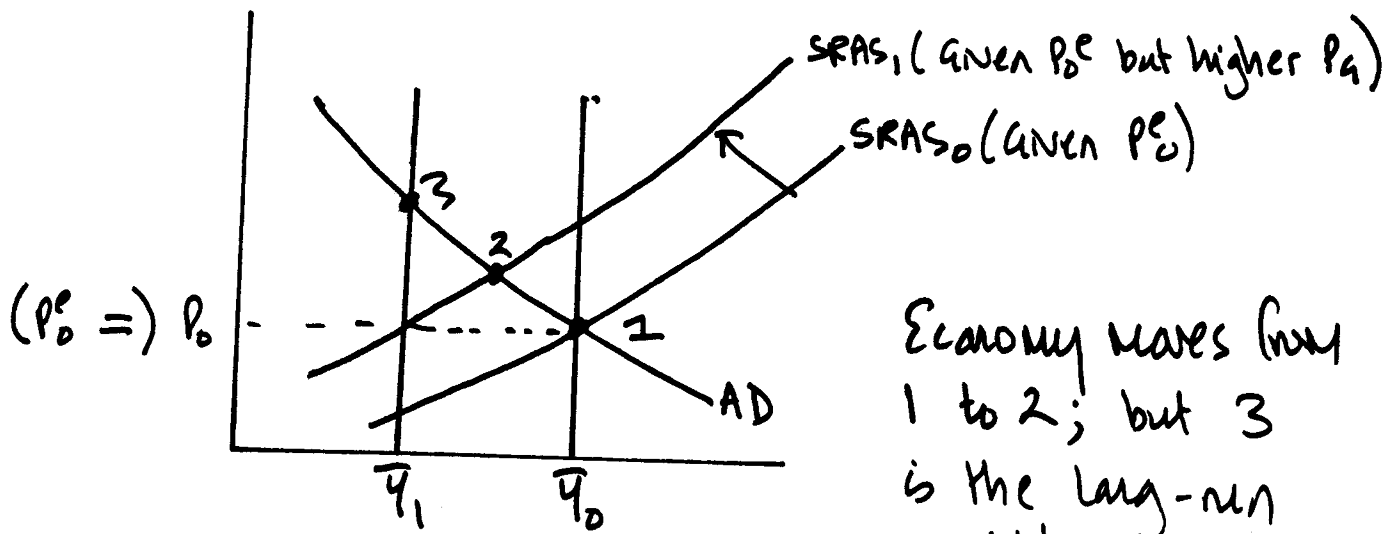
- The long-run equilibrium rate of output declines:



- This implies, from the AS curve:

$$y = \bar{y}(P_a) + \alpha(p - p^e)$$

that, for any given value of p^e, y falls. That is, the SRAS curve shifts left.



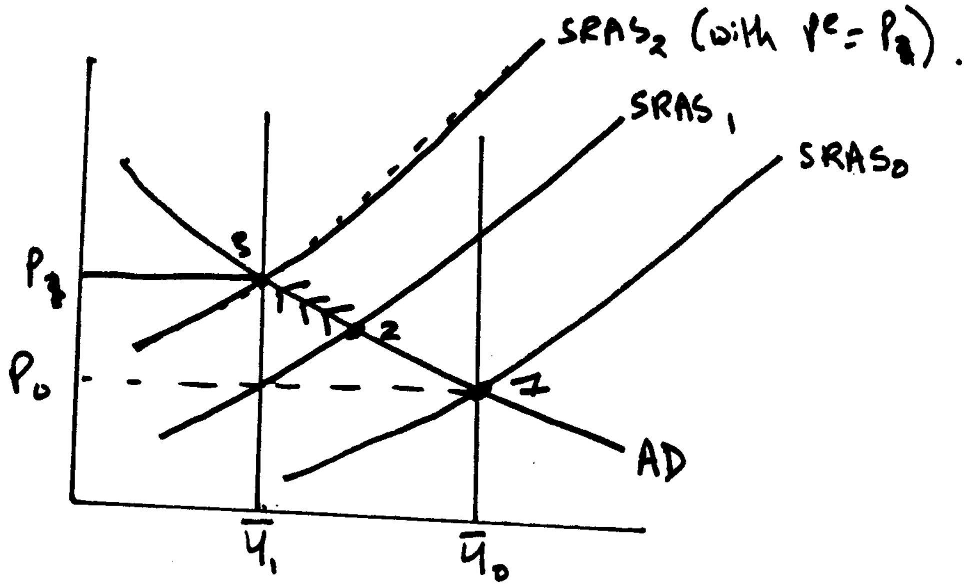
Economy moves from 1 to 2; but 3 is the long-run equilibrium.

- The final movement to 3 occurs gradually, as P^e is revised upwards according to the theory of adaptive expectations: each revision raises P^e, shifting the AS curve left.

- Eventually, P^e catches up to P, and we get

$$y = \bar{y}(P_4),$$

the new long-run equilibrium.



So, a shock to the supply curve has distinct effects from a shock to the demand curve.

- A negative shock to AD lowers output and lowers prices. But the effects (on output) are temporary.
- A negative shock to AS lowers output and raises prices, and the effects (on output) are permanent.

The 1973-75 Oil Price Shock.

	1973	1974	1975
change in price of oil (%)	10.4	51.8	15.1
change in price level	5.6	9.0	9.4
change in GDP (%)	5.8	-0.6	-0.4
unemployment rate (%)	4.9	5.6	8.5

- Effect of change in price of oil consistent with model.
  - price level rose and output fell "stagflation."
  - prices continued to rise and output continued to fall in the year <u>after</u> the main increase in the price of oil (the adjustment from point 2 to 3).

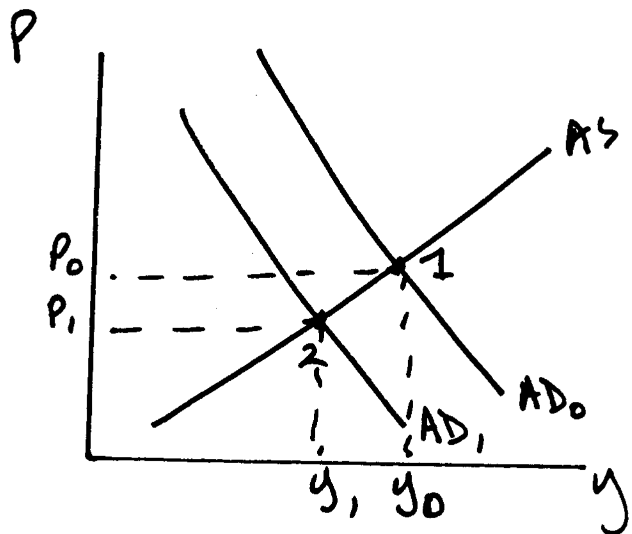
Unresolved puzzles:

Are the effects of changes in oil prices symmetric? We ask this because the favorable effects of of the large declines in oil prices after 1982 appear to have been weaker than the negative effects of the 1970's price increases.

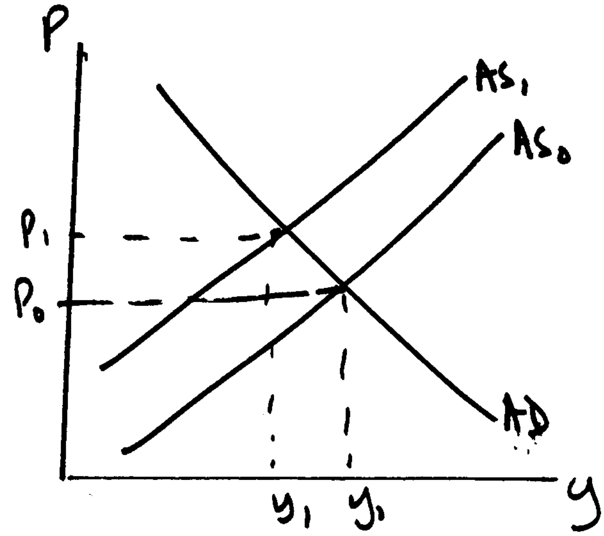
Forensic Analysis of Recessions.

- Combining the insights from the IS-LM and AS-AD Models, we can make some progress in assessing likely causes of shocks to output and employment.

- The AS-AD Model:



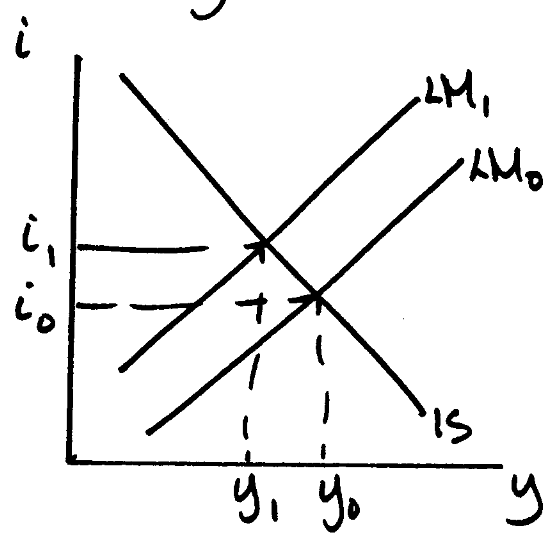
An unfavorable shock to aggregate demand lowers y and lowers p. More generally, inflation declines in a recession.



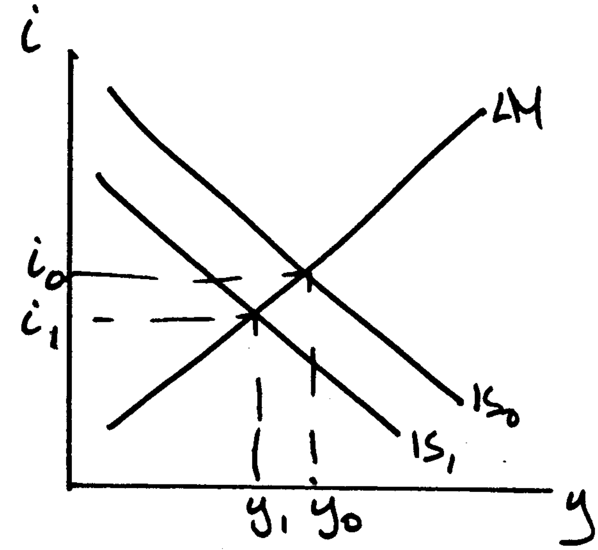
An unfavorable shock to aggregate supply lowers y and raises p. More generally inflation rises in a recession.

- So, to determine if a downturn is being caused by a decline in AD or AS, we should begin by looking at changes in the inflation rate.

- If we conclude that we are experiencing a negative shock to AD, then the IS-LM model provides further insight.



An unfavorable shock to the money market reduces y and raises i.



An unfavorable shock to the goods market reduces y and lowers i

These insights help pin down possible causes of an economic downturn.

A: inflation rising → Aggregate Supply Shock
- distortionary taxes in labor market?
- minimum wage increases
- regulations reducing labor productivity
- economic failures raising business costs - e.g. financial sector failures
- increases in relative price of inputs.

B: inflation falling
nominal interest rates up } → money market shock.

- monetary policy; reduction in money supply
- changes in money market shifting the money demand function up.
  - e.g. volatility/uncertainty in asset markets causing people to hold more of their assets in the form of money.

C: inflation falling
nominal interest rates down } → goods market shock

- reduction in government expenditures
- increase in taxes
- decline in consumer or investor confidence, lowering C and/or I.

Once one has pinned down the area of the economy that seems to be the prime culprit, one can then investigate that narrower field more closely to understand exactly what has changed.

- The next homework provides you with some practice at this.