The Determination of Exchange Rates

1. Interest Parity

Investment problem for US resident with $100.

Choice 1: By US bonds, earning nominal interest i_t, and receive $\$100(1+i_t)$ next year.

Choice 2: By German bonds. Convert $100 to DM at exchange rate E_t, to earn DM $\frac{100}{E_t}$. By the bonds and earn foreign interest i_t^*, giving DM $\frac{100(1+i_t^*)}{E_t}$ next year. Convert back to $ at next year's exchange rate, E_{t+1}, to get

$$\frac{\$\ 100\,(1+i_t^*)\,E_{t+1}}{E_t}$$

E_t = no. of domestic ($) currency units needed to buy one foreign (DM) unit.

An increase in E_t is a depreciation of the $.

To have demand for both US and German bonds, returns on them must be equal:

$$\cancel{100}\,(1+i_t) = \frac{\cancel{100}\,(1+i_t^*)\,E_{t+1}}{E_t}$$

- Difficulty:
  - Although investor know the values of i_t, i_t^*, and E_t, she cannot yet observe E_{t+1}.
  - So replace E_{t+1} with her forecast:

E_t^e – what we expect E to be next period.

time subscript refers to time expectations are made.

Under the simplifying assumption that only expected returns matter, equilibrium then requires

$$(1+i_t) = \frac{E_t^e}{E_t}(1+i_t^*)$$

"the interest-parity condition."

The interest parity condition ensures that investors are indifferent between holding U.S. and German bonds.

- Interest parity describes the relationship that must be satisfied if there is to be equilibrium in the market for assets.
  - equation does <u>not</u> determine each country's interest rates. These are determined by the intersection of each country's IS & LM curves.
  - it does not determine the expected exchange rate - we'll see later what determines this.

Thus, interest parity determines the <u>current exchange rate</u>, so we will write it as

$$E_t = E_t^e \frac{(1+i_t^*)}{(1+i_t)}$$

So today's exchange rate is <u>determined by</u>:

- the nominal interest rate in each country
- expectations about the future exchange rate.

Currency depreciation / appreciation

Define $D_t^e = \dfrac{E_t^e - E_t}{E_t}$

} = expected % depreciation of domestic currency.
(i.e. if $D_t^e < 0$, a currency appreciation is expected).

Note that

$$D_t^e = \frac{E_t^e}{E_t} - 1,$$ so interest parity can be written as

$$(1 + i_t) = (D_t^e + 1)(1 + i_t^*),$$

$$\Rightarrow \quad i_t = i_t^* + D_t^e + D_t^e i_t^*$$

$$\approx i_t^* + D_t^e$$

} this is a small number

In equilibrium, the domestic interest rate equals the sum of the foreign interest rate and the expected rate of depreciation of the domestic currency.

Two ways to write interest parity:

$$E_t = E_t^e \frac{(1+i_t^*)}{(1+i_t)} \quad ; \quad i_t = i_t^* + D_t^e \; .$$

From which

- If the dollar is expected to depreciate ($D_t^e > 0$), then equilibrium requires $i_t > i_t^*$. The interest rate differential is compensation for a declining currency value.
- If foreign IS/LM curve shifts raise i_t^*, then - given E_t^e and i_t - the effect will be to cause an increase in E_t.
- Conversely, a rise in i_t causes an appreciation of the domestic currency.
- News that causes expectations E_t^e to change, induce a change in E_t today, of the same direction.
  - i.e. bad news about tomorrow's value of the $ will cause a sell-off of the $ today, until its current price has dropped sufficiently.

The efficient market hypothesis

- We can use the interest parity condition 'backwards'
  - if we know the current exchange rate, and the two interest rates, then we can use the IPC to calculate E_t^e.
  - This is a version of the efficient market hypothesis. It does not mean we can predict next year's exchange rate accurately; just that there is no other information that can be used to consistently make better predictions.

Forward exchange rates

E_t: spot rate – exchange rate in force for exchanging currency today.

E_t^f: forward rate – exchange rate in force for committing to exchange a quantity of currency at a specified date in the future.

As it must be the case that

$$(1+i_t) = \frac{E_t^f}{E_t}(1+i_t^*), \text{ we have } E_t^f = E_t^e$$

Interest parity + efficient markets: the numbers

FT .com
FINANCIAL TIMES

Dollar spot and forward rates
Thursday 1 April, 2003

	Spot	One month	Three months	One year
UK	1.8574	1.8527	1.8424	1.7974
Euro	1.2366	1.2356	1.2336	1.2278

which give implied expected depreciations of the dollar of . . . .

	One month	Three months	One year
UK	–0.25%	–0.81%	–3.20%
Euro	–0.081%	–0.24%	–0.71%

International money market rates

US Treasury Bond (1 year):	1.266%
Eurocurrency bonds (1 year):	2.031%
UK Government bond (conv., 1year):	4.719%

Interest parity:

For dollar-euro: $D_t^e \approx i_t - i_t^* = -0.765\%$.

For dollar-pound: $D_t^e \approx i_t - i_t^* = -3.453\%$

Compare these with the depreciation rates implied by forward rates.

Note: we can also infer that the euro is expected to appreciate against the pound.

Have a successful career in exchange rate forecasting without any effort!

- Read the Wall Street Journal for the spot and forward exchange rates.
- If $E_t^f > E_t$ concoct some half-baked story about why you expat a depreciation. If $E_t^f < E_t$, do the opposite.
- Mail out the newsletter.
- Go fishing.

Graphical analysis

Rewrite the IPC (again!) as

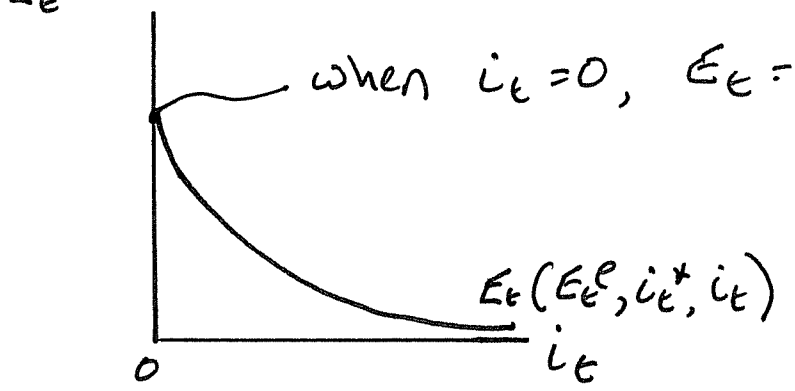
$$E_t = \frac{E_t^e}{1 + i_t - i_t^*},$$

recall, this is an approximation for i_t, i_t^* small, so $1 + i_t - i_t^* > 0$.

from which

$$\frac{dE_t}{dE_t^e} > 0, \quad \frac{dE_t}{di_t} < 0 \quad \frac{dE_t}{di_t^*} > 0.$$

We usually choose to plot E_t vs. i_t:



- An increase in E_t^e causes the IPC (interest parity curve) to shift up.
- An increase in i_t^* cause the IPC to shift up.
- An increase in i_t is a <u>movement along</u> the curve.

The determination of E_e^e

- To pin down the location of the IP curve, we need a theory of how E_e^e is formed.
- We assume investors form expectations that are consistent with a theory of long-run exchange rates known as purchasing power parity (PPP).

PPP

- Old theory, asserting that changes in the exchange rate between two countries are determined by changes in their general price levels.
- Intellectual basis for PPP is the law of one price

Law of one price:

- If a goods can be costlessly transported between two countries, and there are no trade barriers, then the good must have the same price in both countries:

$$P_i = E P_i^*$$

P_i: domestic price of good i.

P_i^*: price of good i in foreign

From law of one price to PPP

Assume further that each country spends the same proportion, w_i, of GDP on good i.

Then, the general price levels are

$$P = \Sigma w_i p_i \,, \quad P^* = \Sigma w_i p_i^* ;$$

But as

$$p_i = E p_i^* \quad \text{by the law of one price,}$$

we have

$$w_i p_i = w_i E p_i^*$$

$$\Rightarrow \Sigma w_i p_i = E \Sigma w_i p_i^*$$

$$\Rightarrow \underline{\underline{P = EP}} \quad \text{STRONG FORM OF PPP.}$$

Implications of PPP

- Rearrange last equation to write

$$\frac{EP^*}{P} = 1$$

$\frac{EP^*}{P}$ — real exchange rate, we will call it 'q'.

$= 1$ — strong form of PPP says real exchange rate is equal to 1

- Take logarithms:

$$\ln E + \ln P^* = \ln P,$$

and differentiate:

$$\frac{dE}{E} + \frac{dP^*}{P} = \frac{dP}{P}$$

$\frac{dE}{E}$: depreciation

$\frac{dP^*}{P}$: foreign inflation, π^*

$\frac{dP}{P}$: domestic inflation, π

So,

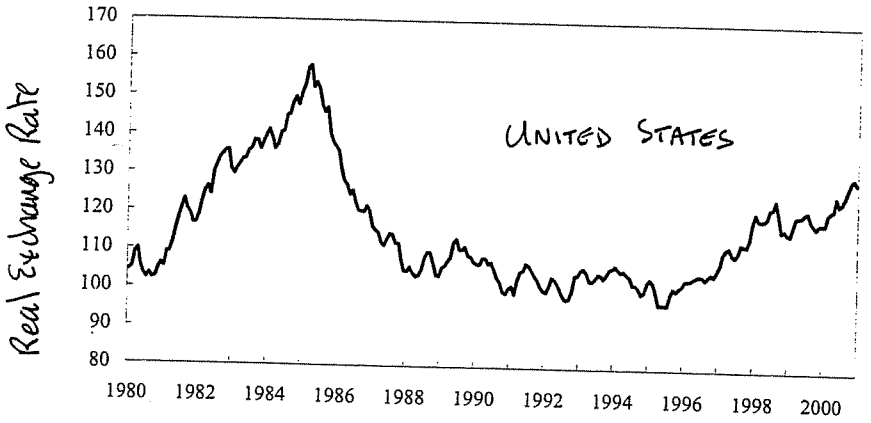
$$\frac{dE}{E} = \pi - \pi^*$$

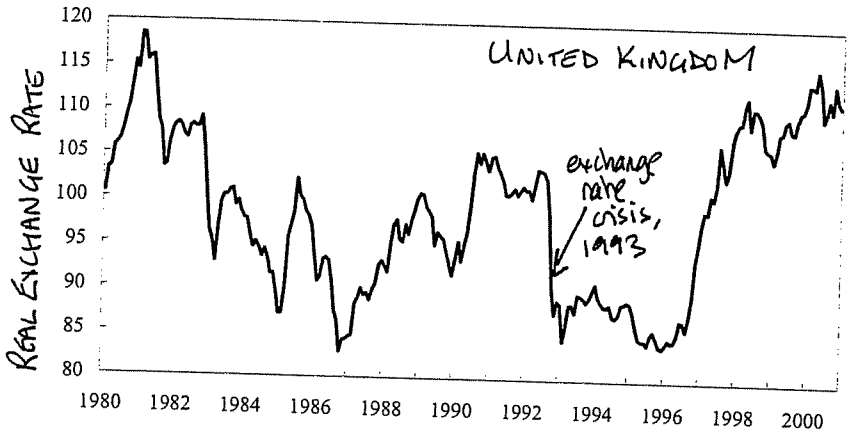
WEAK FORM OF PPP

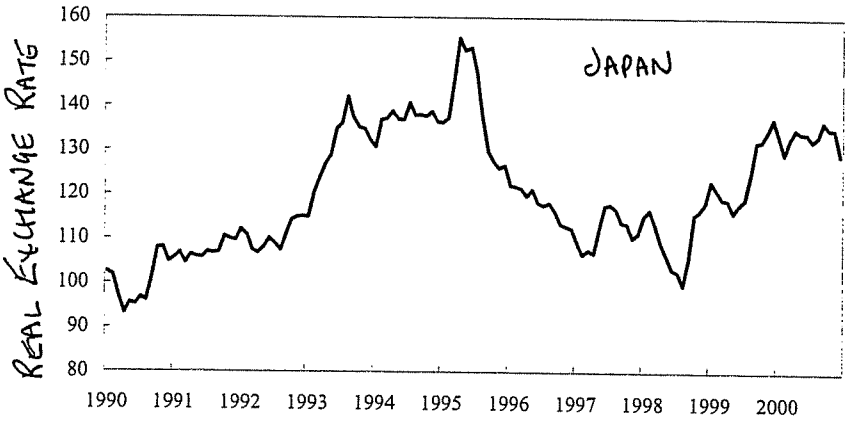
Depreciation of domestic currency equals excess of domestic inflation over foreign inflation.

- Expectations about the future nominal exchange rate depend on what is expected to happen to prices. But quantity theory of money relates prices to the money supply. Hence, E_t^e depends on expectations about the future conduct of monetary policy in each country.

Clearly, PPP is a very rough theory:



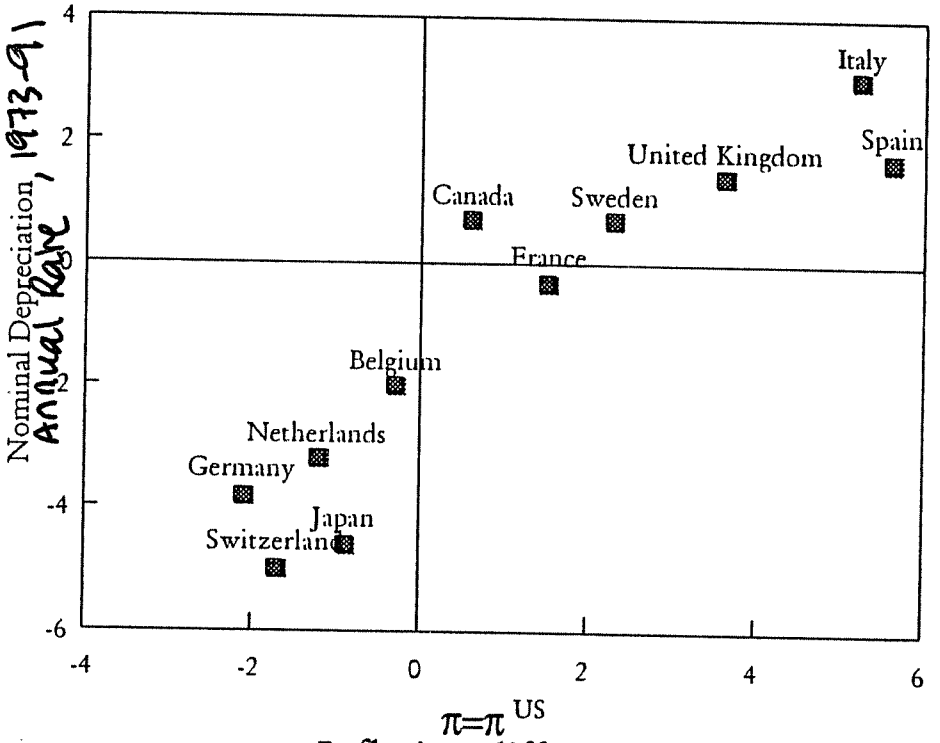




- This is partly because i_t and i_t^* are moving around, causing E_t to move around quickly. At the same time price equalization through trade is quite slow.
- But deviations away from PPP are reversed too slowly.

Nonetheless, this is about the best we have.

The weak form of PPP does rather better:



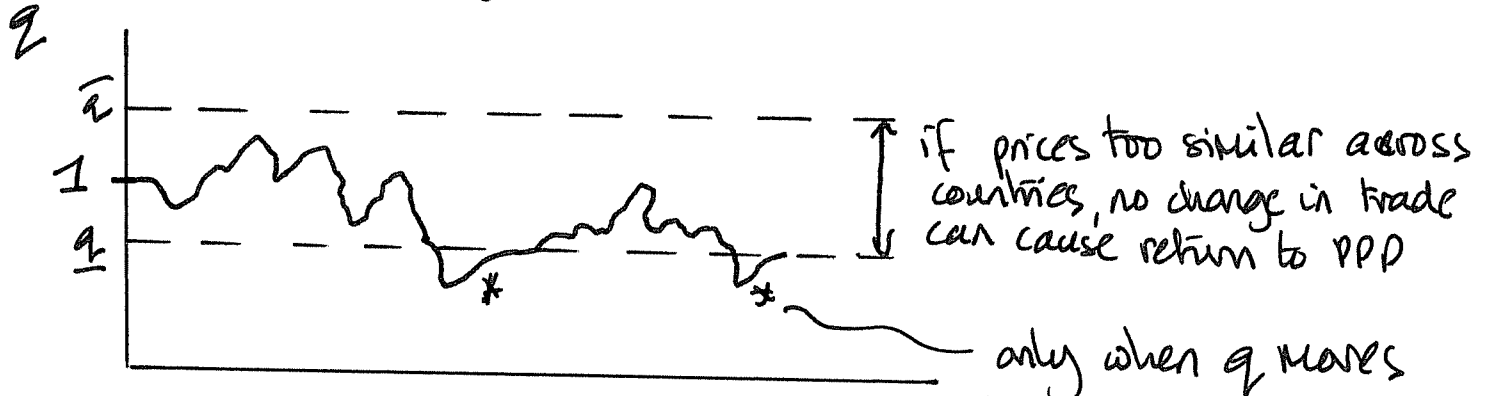
But it is still not perfect.

- Weak form of PPP predicts $\frac{\Delta E}{E} = \pi - \pi^*$
- Graph shows a relationship $\frac{\Delta E}{E} = -0.02 + (\pi - \pi^*)$

so where might this difference come from?

The answer is that PPP is based on arbitrage of traded goods, but the general price level includes both traded and non-traded goods.

Transportation costs will also prevent operation of PPP when real exchange rate is close to 1:



- So, between $\underline{q}$ and $\bar{q}$, q wanders around "aimlessly", while being buffeted about by changes in i_t and i_t^*.
- Outside this range, q has a tendency to move back towards the range.

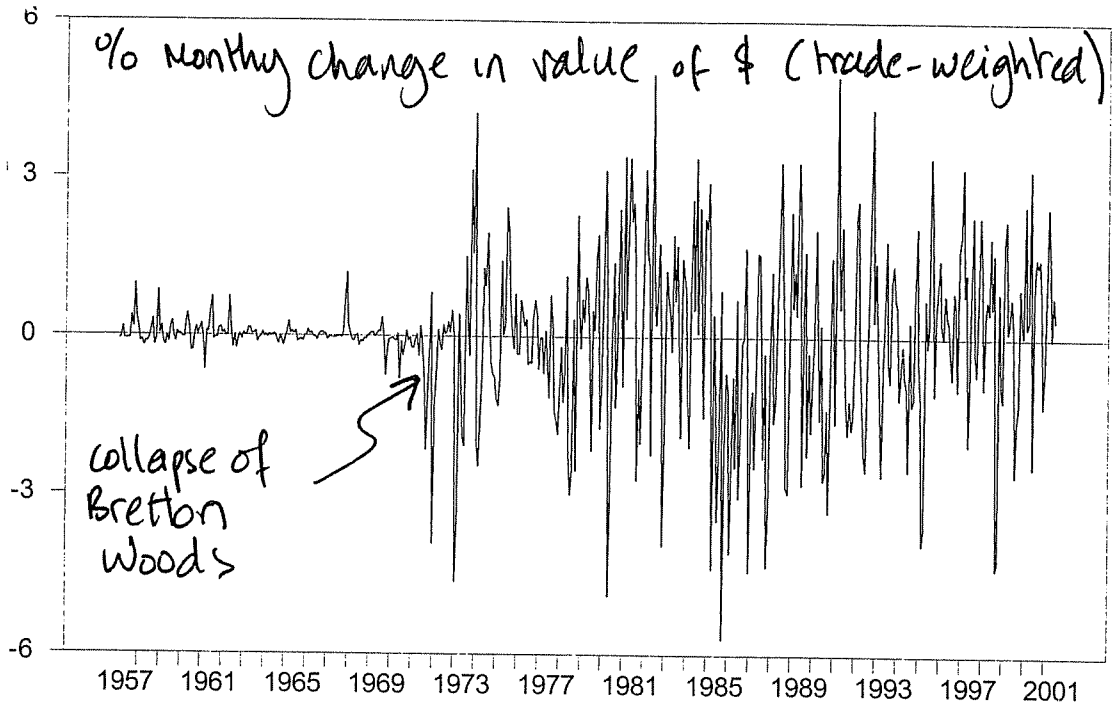
- Implication: PPP is likely to be violated for long periods of time.

  It only represents a rough forecast of future values for E_t.

Monetary Policy and Exchange Rate Volatility

- Until 1973, exchange rates were managed by the major economies as part of the Bretton Woods agreement of 1944
  - major economies used monetary policy to influence i_ϵ, and thus to influence E_ϵ
  - interventions were aimed at limiting movements in E_ϵ to create stability for international trade.
- Since the 1960s, many economists had advocated a movement to floating exchange rate regimes
  - let E_ϵ move freely to satisfy PPP
  - this would equalize prices across countries + reduce trade imbalances
- Led by the US, Bretton Woods was abandoned in 1973.

- The early experience of floating exchange rates came as a shock:
  - exchange rates fluctuated far more than was necessary to adjust for changes in domestic price levels
  - deviations from PPP were very persistent.



A slight increase in volatility!

- Many analysts concluded that the currency market was very inefficient, and thus that the world should return to a fixed exchange rate regime.

In 1976, Rudiger Dornbusch published a paper* explaining that it is because the currency market is so efficient that we see this volatility.

- Currency prices driven more by flows of capital ($150 trillion / year) than by trade (50 time smaller). Hence, interest parity is more important than PPP.
- Monetary policy was quite unstable in 1970s causing large swings in interest rates.
- Prices adjust slowly, much more so than exchange rates. This disparate speed of adjustment leads to a phenomenon Dornbusch termed "exchange rate overshooting"

To understand where overshooting comes from, we combine our interest parity curve with the model of money market equilibrium.

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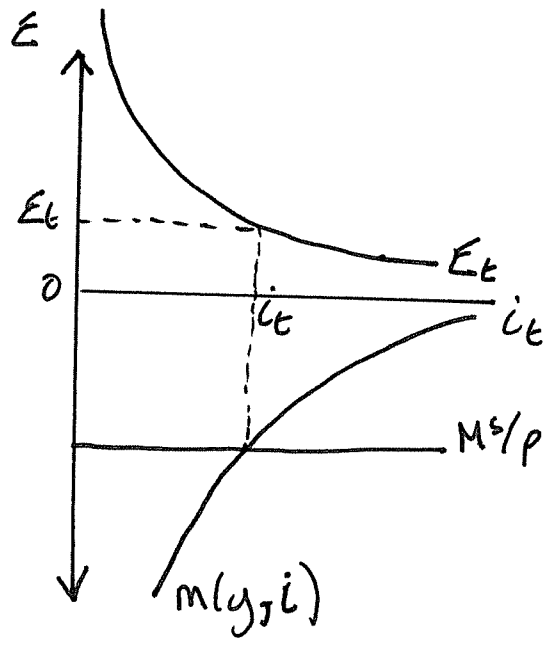
* "Expectations and exchange rate dynamics." Journal of Political Economy, 84.



→ money market determines the interest rate, which determines equilibrium E_t given values of i^*_t, + E^e_t.

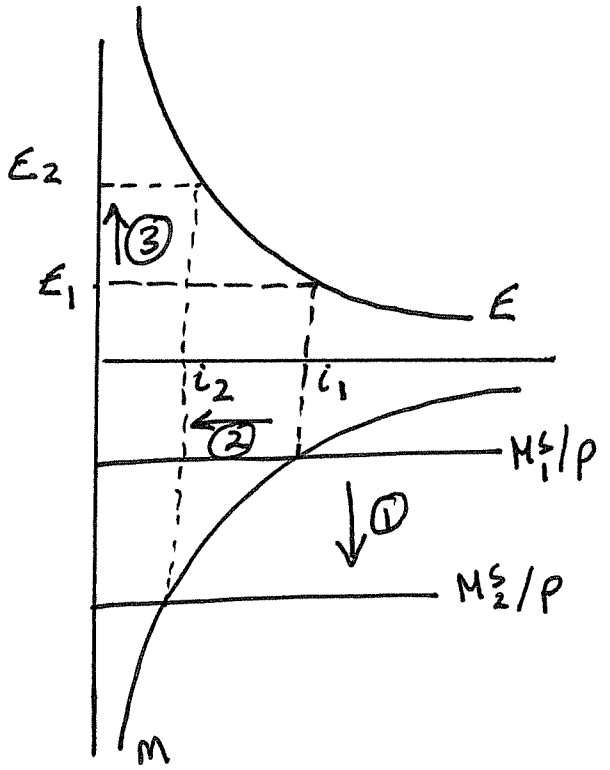
We shall use this diagram to study the effects of monetary policy on exchange rates.

Note: We know from IS-LM that a change in M^s changes y. This would cause $m(y,i)$ to shift. For the moment, we will simplify, and assume $m(y,i)$ does not shift as M^s shifts.

We will later allow $m(y,i)$ to shift — it will complicate the diagram, but the phenomenon of exchange rate overshooting will not go away.

Effect of a temporary increase in M^s

- A temporary increase is reversed before prices have a chance to change.



① Money supply is increased by central bank, shifting M^s/P line.

② Interest rate drops to keep money market in equilibrium by raising money demand.

③ E_1 falls to E_2 – there is an immediate depreciation of the currency.

④ When the monetary policy is reversed, i rises back to i_1, and E_2 returns to E_1.

Intuition:

Interest parity: $i_\epsilon = i_\epsilon^* + D_{\epsilon 2}^e$ ← expected depreciation

Increase in M^s lowers i_ϵ, so investors must be compensated with an expected appreciation. As <u>future</u> value of E is known to be E_1, exchange rate must jump <u>now</u> to E_2 to allow a later appreciation.

We can also use this diagram to analyze:

- A temporary increase in the foreign money supply
- A temporary increase in domestic income (e.g. from a windfall discovery of a depletable resource (this can hurt other exporters, a phenomenon known as the "Dutch disease.")).
- A temporary increase in foreign income.

In all these temporary changes, we assume that prices remain fixed. As expectations, E_t^e, depend on expectations about future price levels (via PPP), then E_t^e also is unchanged.

- Let's look at each of these on the blackboard.

Effect of a permanent increase in the money supply.

A permanent change in M^s is not reversed, so (by the quantity theory of money) prices will change.

For analytical simplicity, assume the following timing:

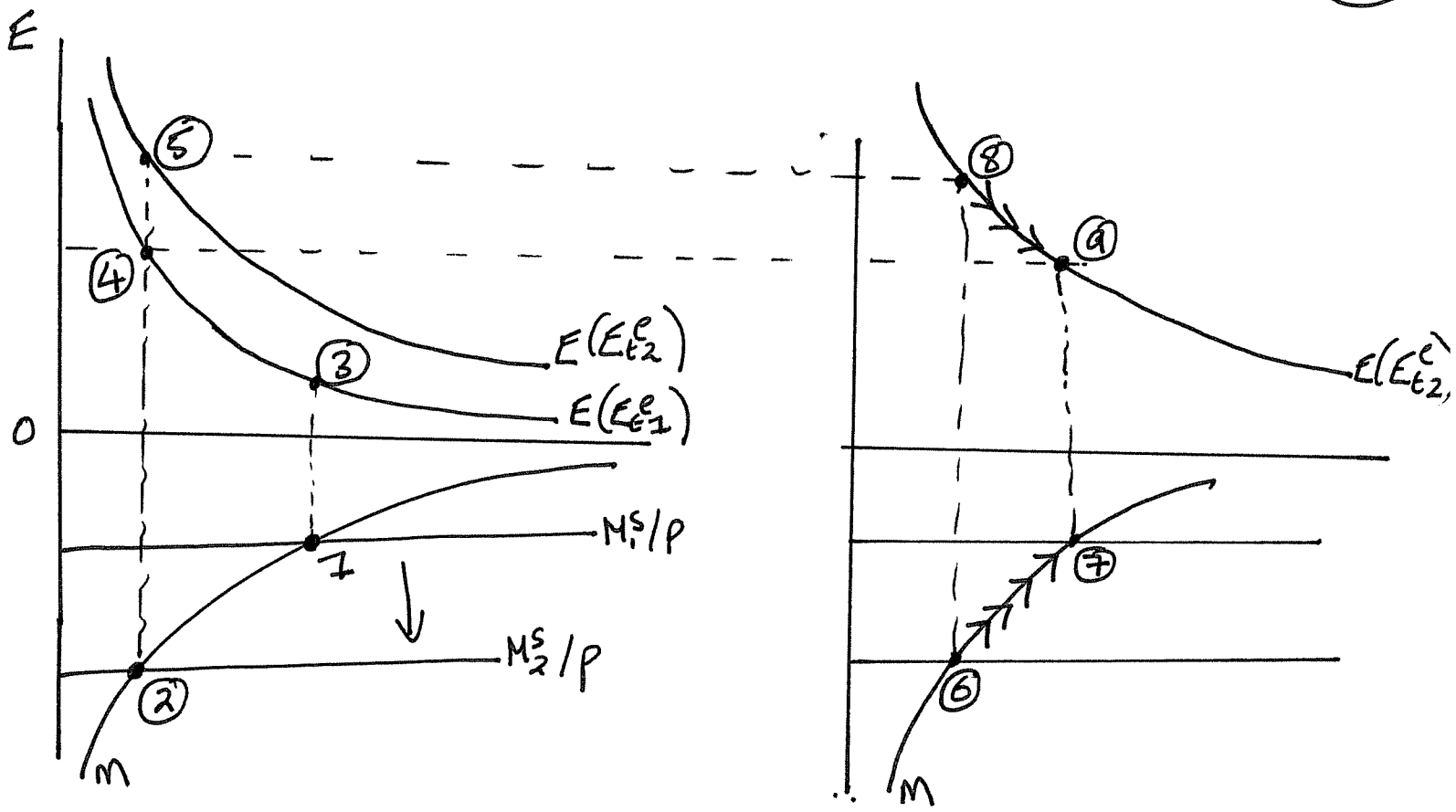
- Period t: M^s changes $\Rightarrow i_t, E_t$ changes
  But prices sticky, so P_t does not change
- Period $t+1$: Firms have had time to change prices, so P_{t+1} is higher

By quantity theory,

$$\frac{\Delta P_t}{P_t} = \frac{\Delta M^s_t}{M^s_t}.$$

It then follows that

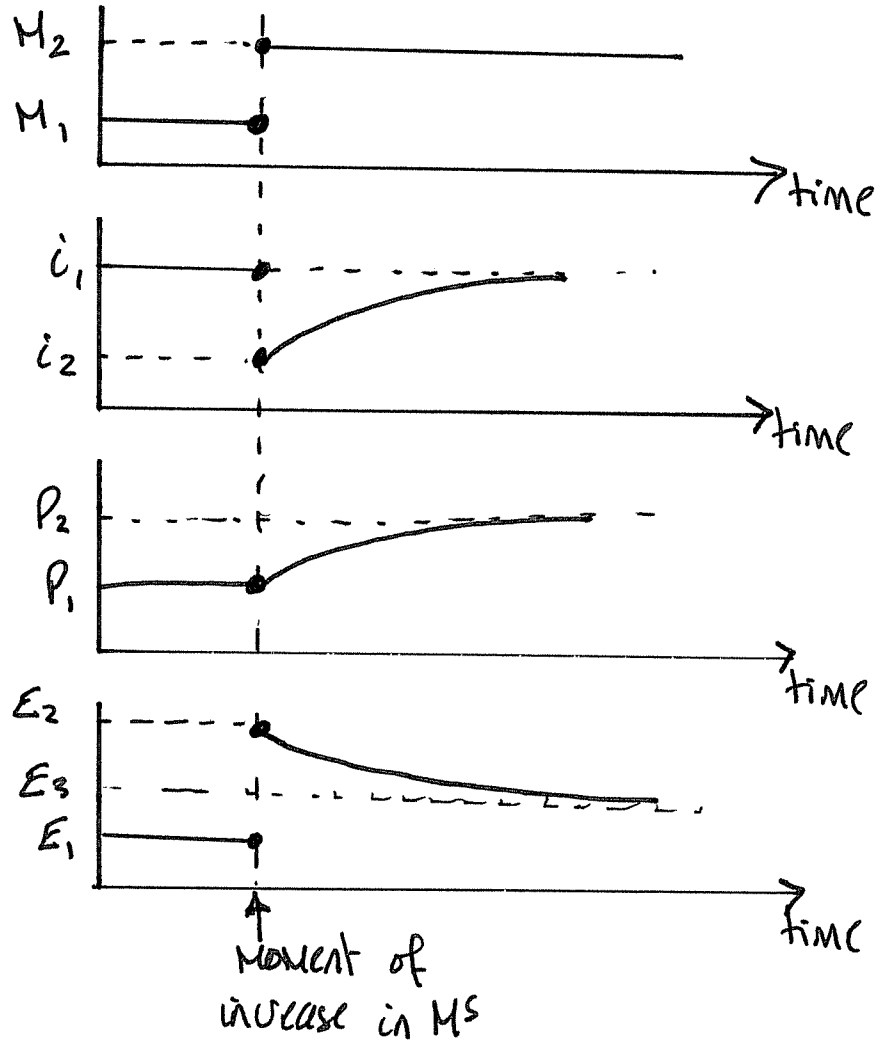
$$\underbrace{\frac{\Delta E_t^e}{E_t} = \frac{\Delta P}{P}}_{\text{PPP theory of expectations}} = \underbrace{\frac{\Delta M^s}{M^s}}_{\text{Quantity theory of Money.}}$$



Exchange Rate Overshooting

- M^s increases shifting money market equilibrium from (1) to (2).
- If E^e_t did not change, this would move E_t from (3) to (4)
- But as policy is know to be permanent, E^e_t rises, shifting IP curve up, from $E(E^e_{t1})$ to $E(E^e_{t2})$. Thus, E_t actually adjusts from (3) to (5).
- Now, prices begin to adjust due to quantity theory. M^s/P gradually falls, as we move from (6) to (7). Process ends when M^s/P is back where it started.
- At same time, i is gradually rising, and E falling in movement from (8) to (9).

So, long run equilibrium is at ④. This is a depreciation compared to ③, but an appreciation compared to ⑤.



M_1 increased permanently to M_2

i immediately drops, then gradually returns as prices rise

prices rise gradually to new equilibrium level

currency depreciates by a large amount, followed by a gradual appreciation.

→ exchange rate initially overshoots the long run equilibrium level E_3, by going first to E_2.

Exchange rate overshooting when y is allowed to change.

- We will do this on the blackboard.

Notes:
- increase in M^s raises y, which causes a shift in $m(y,i)$ curve
- if shift is large enough, we can create exchange rate undershooting
- but as long as shift is not too large (as long as i still goes down after increase in M^s), then we will still have overshooting.

Final intuition:

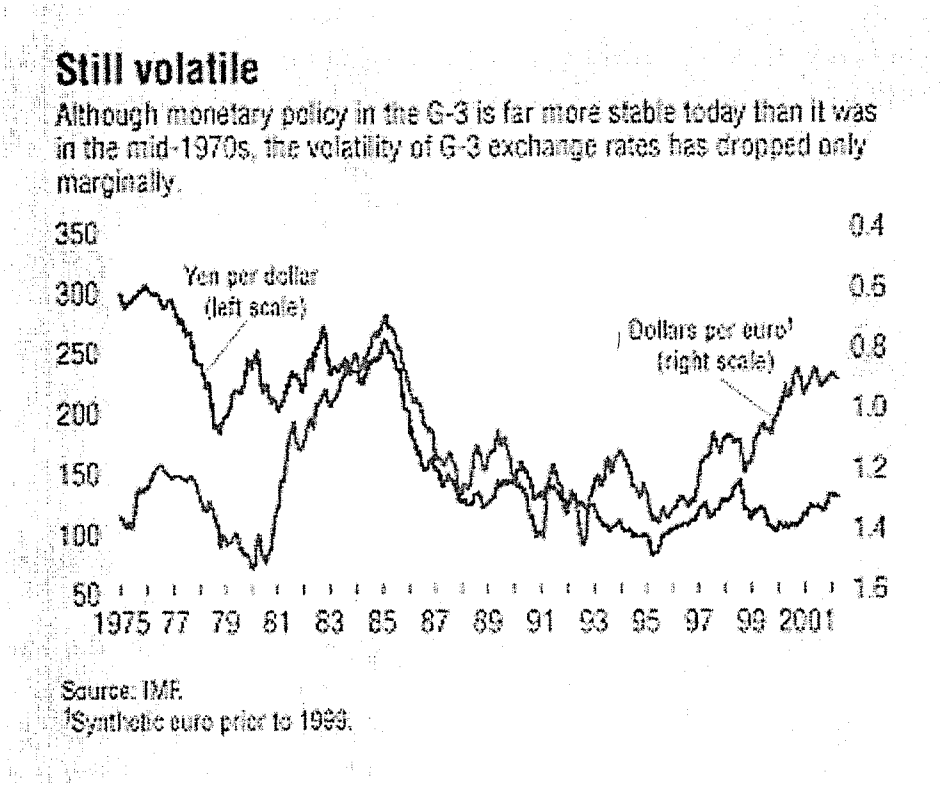
IPC has $i_t = i_t^* + D_t^e$.

- Increase in M^s lowers i_t. Thus D_t^e must be negative.
- But we know $E_{t+1} > E_t$ was just prior to monetary expansion (i.e. a depreciation)
- Only way out of apparent contradiction is if the initial devaluation exceeds the devaluation necessary for long-run equilibrium.

Volatility and monetary policy - a puzzle.

Online reading:

Ken Rogoff: "Why are G-3 exchange rates so fickle?" Finance & Development, June 2002.



As central banks learned about credibility, rules etc., monetary policy has become more stable. But then, E_t should also have become more stable. As graph shows, however, volatility remains high. This is an unresolved puzzle.

– we have more to learn about exchange rates.

Readings for this section

① The Economist "Why currencies overshoot."

- an extremely nice explanation of Dornbusch's theory.

② Rogoff, K. (2002): "Why are G-3 exchange rates so fickle?" Finance + Development, 39(2). (June)

- Just discussed. Rogoff writes

"The mystery of the volatility of the world's three key currencies continues, despite leading economist Rudiger Dornbusch's path breaking insights."

N.B. Dornbusch died in 2002, one month after this article was published.

③ Fairlamb, D. (200): "Take the currency markets? Think again." Business Week.

- Volatility in the euro had led to calls for fixed exchange rates; Fairlamb argues that it's a dumb idea.

A final note on Dornbusch, and his achievement:

Rudi Dornbusch Is Dead at 60

When I was in graduate school, Rudi Dornbusch was one of four macroeconomists who had bet their reputation on a theory-based prediction of what the future would hold, and had been right. Milton Friedman and Ned Phelps had bet that the low unemployment-low inflation prosperity of the 1960s was ephemeral, and they were right. Bob Shiller had bet that stock market indices would follow not a random walk but instead exhibit substantial mean reversion in the long run, and subsequent events have proved him right. Rudi Dornbusch had bet--back in the 1970s--that floating exchange rates would turn out to be extraordinarily volatile animals, and he turned out to be right.

Not only was he a brilliant thinker with a deep well of knowledge about the world and a tremendous concern for how to make the world a better place, but whenever we graduate student types saw Rudi, it was immediately apparent to us just how much fun he was having being an economist.

Brad DeLong, Berkeley
July 28, 2002

The IS-LM Model in an Open Economy

Recall our two equation closed-economy model:

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

IS: $y = c(y-t, i-\pi^e) + I(i-\pi^e) + G$. (goods Market)

Moving to the open economy changes nothing in the money Market; but now we have to add imports and exports to the IS curve:

$$y = c(y-t, i-\pi^e) + I(i-\pi^e) + G + \underbrace{X - M}_{B = X-M}.$$

"Trade balance."

While the open-economy IS curve, as written, contains behavioral components for C and I, we have yet to write down the determinants of $B = X-M$.

Determinants of the Balance of Trade

We will assume that the following factors are the principal determinants of the balance of trade:

- B is negatively related to domestic disposable income, $y-t$. An increase in $y-t$ raises $C(y-t, i-\pi^e)$, causing imports to rise.
- B is positively related to foreign disposable income, y^*-t^*, because increases in y^*-t^* raises the foreigner demand for goods. Hence domestic exports rise.
- B is positively related to the real exchange rate, $q = \frac{Ep^*}{P}$. If q rises, foreign goods become more expensive relative to domestic goods. Thus domestic demand switches away from imports and toward domestic goods. Foreigner cut back on consumption of their own goods, and start buying more goods through trade. Thus, if q increases, $\mathcal{X}$ rises and M falls.

That is,

$$B = B\left(y-t,\ y^*-t^*,\ \frac{\mathcal{E}P^*}{P}\right),$$
$$(-)\quad (+)\quad (+)$$

and we can write the IS curve as

$$y = C(y-t, i-\pi^e) + I(i-\pi^e) + G + B\left(y-t,\ y^*-t^*,\ \frac{\mathcal{E}P^*}{P}\right).$$

It is useful to use the interest-parity condition to get rid of $\mathcal{E}$. Recall that

$$\mathcal{E} \approx \frac{\mathcal{E}^e}{1+i-i^*},$$

so

$$y = C(y-t,\ i-\pi^e) + I(i-\pi^e) + G + B\left(y-t,\ y^*-t^*,\ \frac{\mathcal{E}^e P^*}{(1+i-i^*)P}\right)$$

<u>The slope of the open-economy IS curve</u>

When we plot y against i, the closed-economy IS curve was found to have a negative slope. Is this also true of the open economy IS curve?

To find out, differentiate with respect to y and i, holding everything else constant:

$$dy = (C_{y-t} + B_{y-t})\,dy + (C_{i-\pi e} + I_{i-\pi e})\,di - \frac{B_q E^e p^*}{(1+i-i^*)^2 p}\,di$$

check that you understand this term!

Rearranging,

$$\frac{di}{dy} = \frac{1 - C_{y-t} - B_{y-t}}{C_{i-\pi e} + I_{i-\pi e} - \frac{B_q E^e p^*}{(1+i-i^*)^2 p}}$$

(−) over the numerator; (−) (−) (+) over the denominator.

Recall the closed economy version

$$\frac{di}{dy} = \frac{1 - C_{y-t}}{C_{i-\pi e} + I_{i-\pi e}} < 0.$$

(+) over the numerator; (−) over the denominator.

On the numerator, we are subtracting a negative term, B_{y-t}, so the numerator is still positive. To the denominator, we are subtracted a positive term, so it is still negative. Hence the open economy IS curve also has a negative slope.

Shifts in the open-economy IS curve.

As before, we hold i constant + see how y changes when each variable increases. If y goes up, this is a rightward shift, if y goes down we have a leftward shift.

- Increase in G.

$$dy = (c_{y-t} + b_{y-t})\,dy + dG$$

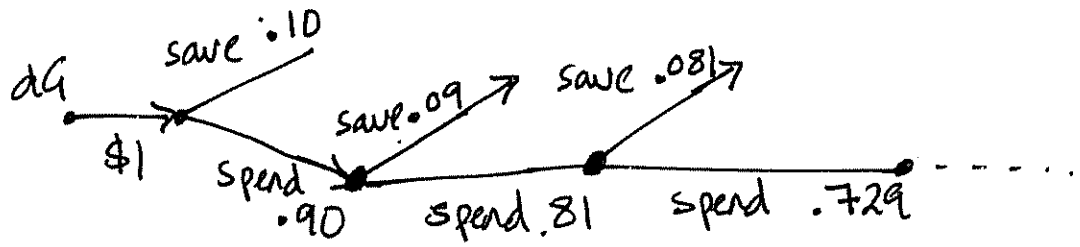
so $$\frac{dy}{dG} = \frac{1}{1 - c_{y-t} - b_{y-t}} > 0.$$

Because $b_{y-t} < 0$, the shift in the open-economy IS curve is smaller than the shift in the closed-economy IS curve. This is because part of the increase in private sector consumption induced by the increase in G "leaks out" as expenditure on imports.

To clarify:

assume $MPC_{,} = C_{y-t} = 0.9$, and marginal propensity to import out of disposable income $= B_{y-t} = 0.1$.

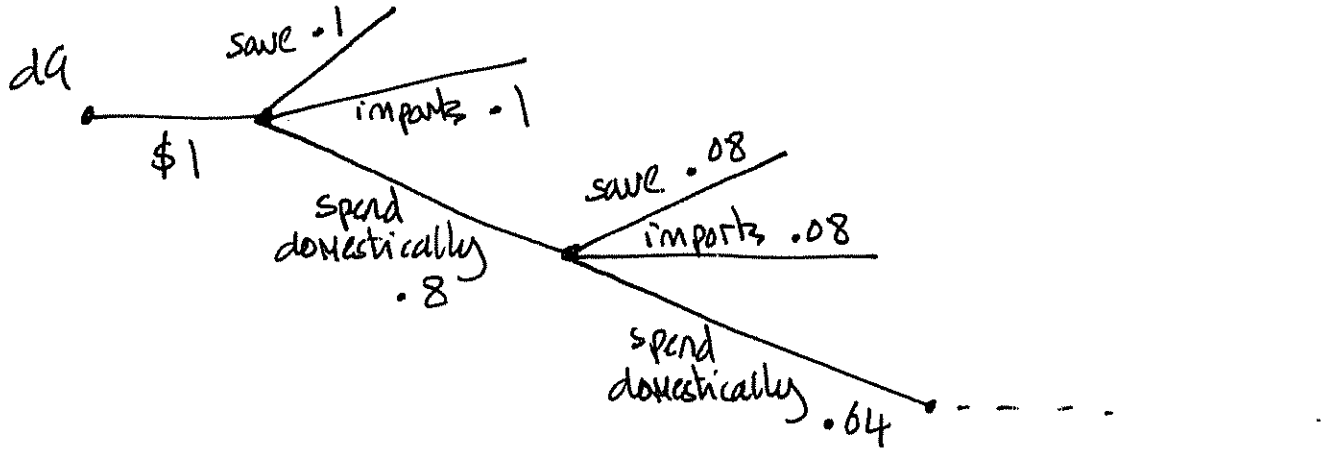
- In a closed economy, a \$1 increase in G induces



$dG = 1$

$$\Rightarrow dy = 1 + 0.90 + 0.81 + .729 + \cdots$$

- In an open economy:



$$dy = 1 + 0.80 + 0.64 + \cdots$$

So $\frac{dy}{dG}$ is smaller in the open economy.

- Increase in t

Shifts IS curve left

- Increase in π^e

Shifts IS curve right

But because of the term $B\left(y-t, y^*-t^*, \frac{E^e p^*}{(1+i-i^*)p}\right)$, there are now additional variables that induce changes in the IS curve's location:

- i^* – an increase in i^* causes a depreciation of the currency; q goes down, and B goes up. This raises y, shifting the IS curve to the right.

Mathematically:

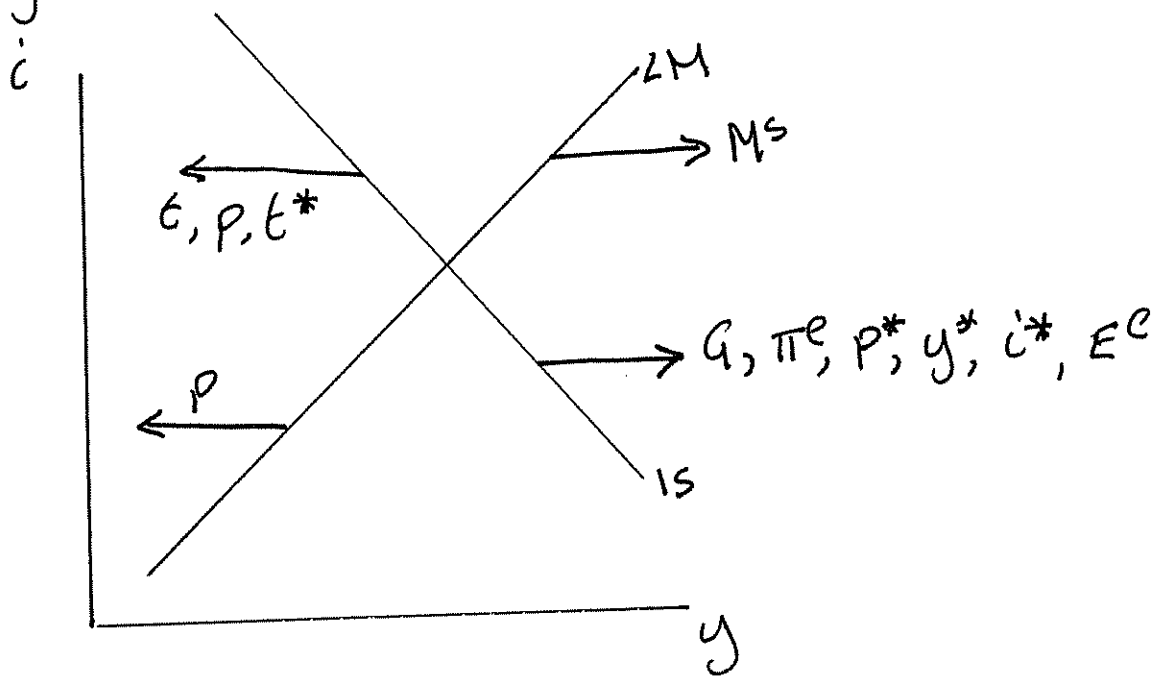
$$dy = (C_{y-t} + B_{y-t})\,dy + \frac{B_q E^e p^*}{(1+i-i^*)^2 p}\,di^*,$$

or $$\frac{dy}{di^*} = \frac{B_q E^e p^*}{(1+i-i^*)^2 p\,(1-C_{y-t}-B_{y-t})} > 0.$$

- Similarly:
  - An increase in y^* shifts IS right.
  - An increase in p^* shifts IS right.
  - An increase in p shifts IS left.
  - An increase in t^* shifts IS left.
  - An increase in E^e (an expected devaluation) shifts IS right.

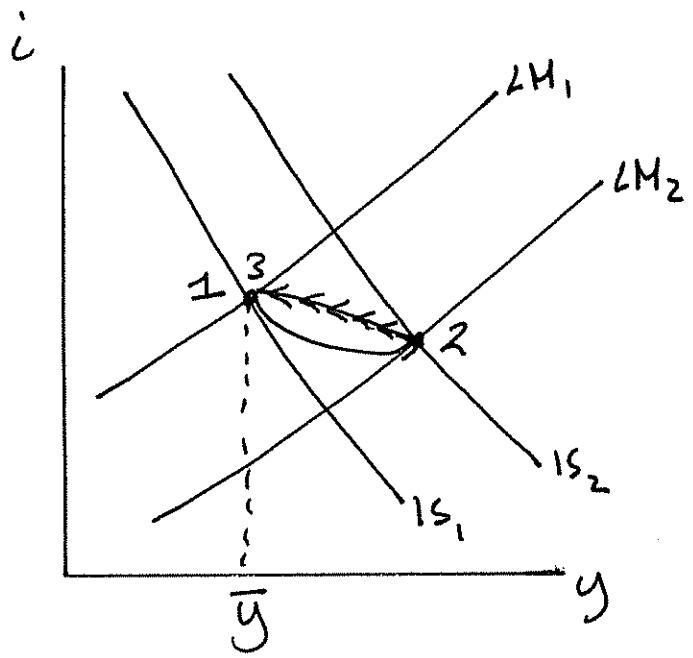
↳ you should be able to explain each of these in words.

- <u>Summary:</u>



- Qualitatively, the effects of changes in G, t, M^s are pretty much the same as in the closed economy case.

We look at one example: a permanent increase in M^s.



- Beginning at 1, increase in M^s shifts LM curve right.
- But combination of Quantity Theory of Money and PPP lead us to expect a devaluation; E^e rises
- If E^e rises, interest parity requires E to rise. This raises exports & reduces imports
- Increase in B shifts IS curve right.

Thus, IS curve shifts right along with shift in LM curve.

- Slowly, prices rise, inducing leftward shift of both curves. When prices have eventually risen by same amount as M^s, LM curve is back where it started, $q = 1$ again so B, and the IS curve are back where they started.

But the open economy IS-LM model highlights how the states of different economies are intertwined:

- An increase in foreign money supply – lowers i^*, and causes E to fall. This reduces y. The fall in y is partly offset by an increase in y^*.
- An increase in G^* – raises i^* and y^*. The rise in y^* induces an improvement in B, which causes y to rise. This is further enhanced by the fall in E.

So we would generally prefer our trading partners to stimulate their economies with fiscal expansions rather than monetary expansions.

The AA-DD Model

Sometimes, in thinking about open economies, we will be more interested in relationship between E and y than between i and y. We can play around with the IS-LM model to help us in this regard.

- To make life simpler, we will assume C, I do not depend on the interest rate (not necessary, but easier).

  In this case, we have

IS: $y = c(y-t) + I + G + B\left(y-t, y^*-t^*, \frac{EP}{P}\right)$

LM: $\frac{M^S}{P} = m(y, i)$

IP: $E_e = \frac{E^e}{1+i-i^*}$.

Rearrange the IP equation:

$$i = i^* + \frac{E^e}{E} - 1 \quad \left(\equiv i^* + D^e \right),$$

and substitute into the LM curve:

$$\frac{M^s}{P} = m\left(y, i^* + \frac{E^e}{E} - 1\right) \quad \text{we call this the AA curve.}$$

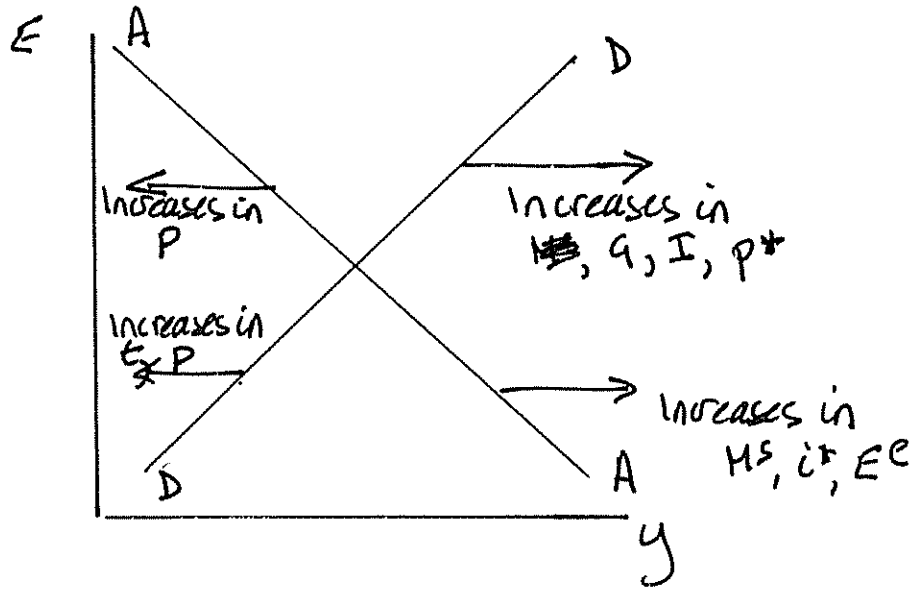
when we plot the relationship between y and E that keeps the goods market in equilibrium,

$$y = c(y-t) + I + G + B\left(y-t, y^*-t^*, \frac{EP}{P^*}\right),$$

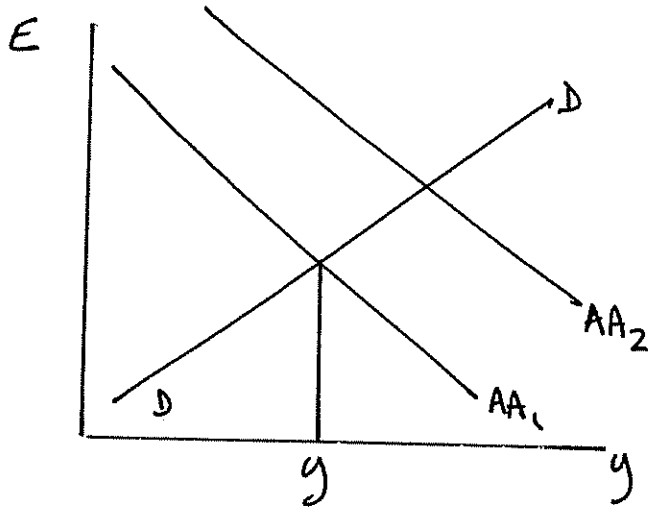
we call this the DD curve.

You can verify by calculus the following:

- AA has negative slope.
- DD has positive slope.

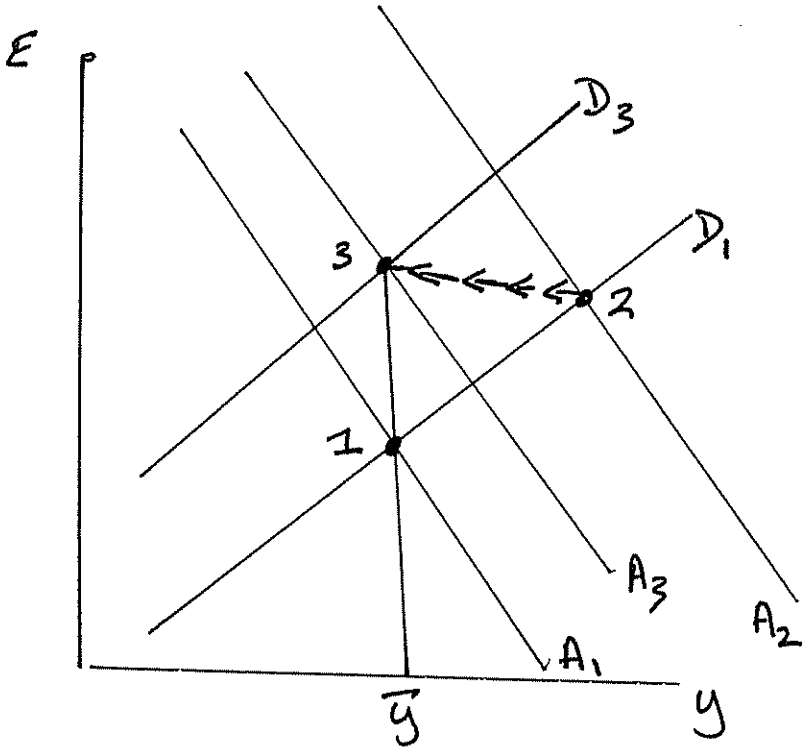


A temporary monetary expansion ...



- Shifts AA to right
- Induces increase in y
- Induces depreciation in currency.

A permanent monetary expansion.

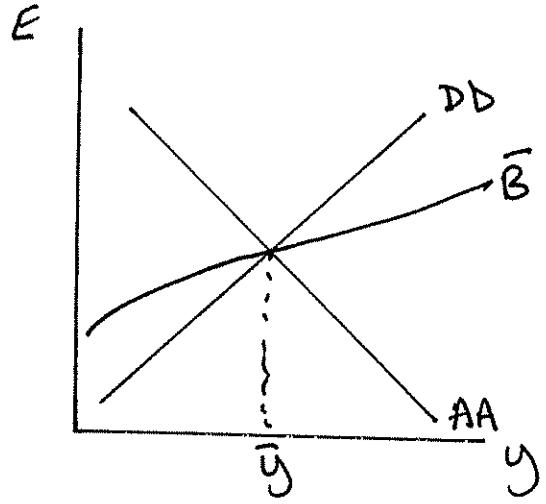


- Shifts AA right because
  (i) lowers interest rate causing E to rise for any given y
  (ii) raises E^e (PPP) causing E to rise even further
- So economy jumps to 2.
- $y > \bar{y}$, so w and p steadily rise (think AS-AD model).
- As p rises, both AA and DD shift left.
- Eventually we return to $\bar{y}$ (think AS-AD again) at 3.

- PPP and quantity theory predict % increase in E is same as % increase in MS.

The Trade Balance.

If y rises, B will decline. If E rises, B rises. Thus, there is a positive relationship that must hold ~~if~~ ~~the~~ ~~B~~ between E and y for the trade balance to be held constant at any level, say $\bar{B}$. We can plot this on our AA-DD model:



- Note: in fact there is a whole family of $\bar{B}$ curves, one for each possible level of B.
- A higher $\bar{B}$ curve corresponds to a ~~worse~~ better (~~smaller~~ larger) trade balance.

- We can prove that the curve $\bar{B}$ is <u>flatter</u> than DD. This is <u>important</u>, because our subsequent analysis depends on this property.

Proof that $\overline{B}$ is flatter than DD:

$\overline{B}$ curve is defined by relationship between y and E that satisfies

$$B\left(y-t,\ y^*-t^*,\ \frac{Ep^*}{P}\right) = \overline{B} \sim \text{constant}$$

Thus,

$$B_{y-t}\,dy + B_q \frac{p^*}{P}\,dE = 0,$$

$$\Rightarrow \quad \left.\frac{dE}{dy}\right|_{\text{along } \overline{B}} = -\frac{B_{y-t}}{B_q \frac{p^*}{P}} > 0$$

For DD:

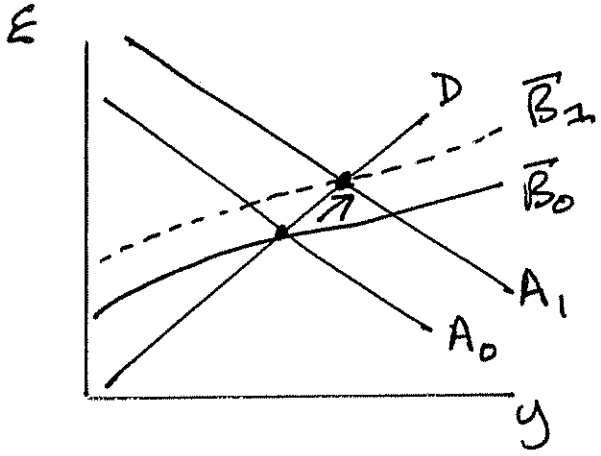
$$dy = C_{y-t}\,dy + B_{y-t}\,dy + B_q \frac{p^*}{P}\,dE.$$

Rearrange, to get

$$\left.\frac{dE}{dy}\right|_{DD} = \frac{1 - C_{y-t} - B_{y-t}}{B_q \frac{p^*}{P}}$$

$$= -\frac{B_{y-t}}{B_q \frac{p^*}{P}} + \frac{1-C_y}{B_q \frac{p^*}{P}}$$

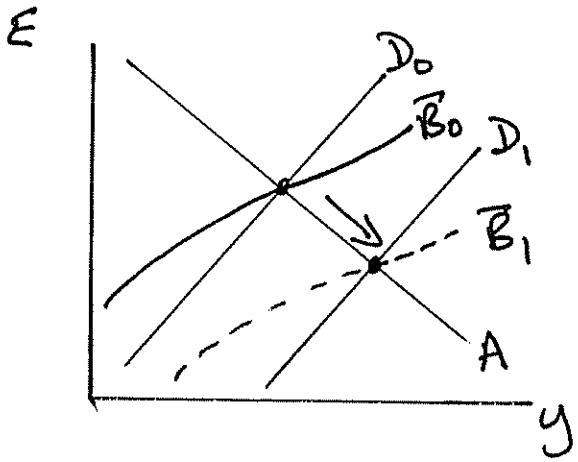
$$= \left.\frac{dE}{dy}\right|_{\text{along } \overline{B}} + \frac{1-C_y}{B_q \frac{p^*}{P}} > \left.\frac{dE}{dy}\right|_{\text{along } \overline{B}}. \quad \bullet$$



- Increase in M^S shifts AA curve right, moving to a higher $\bar{B}$ curve, where

$$\bar{B}_1 > \bar{B}_0 .$$

Thus, an increase in M^S improves the trade balance.



- An increase in G and/or a cut in t shifts DD right, moving to a lower $\bar{B}$ curve, where

$$\bar{B}_1 < \bar{B}_0 .$$

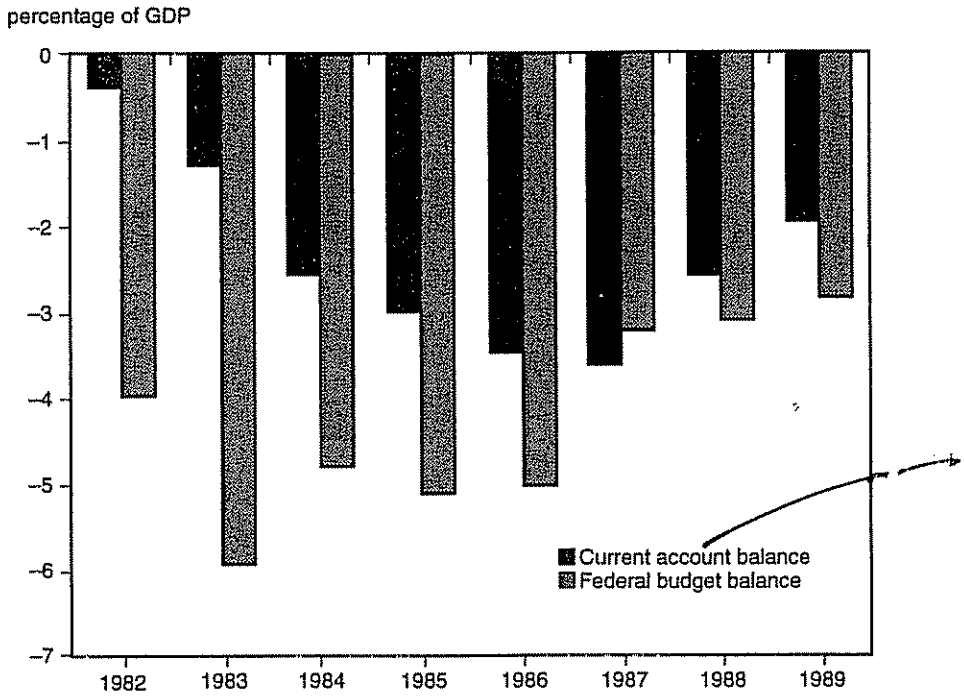
Thus, an increase in the government deficit causes a deterioration in the balance of trade.

This phenomenon that links budget deficits and trade deficits has become known as the "<u>twin deficit story</u>"

The Twin Deficits

Required reading: Paul Krugman (1994): "The Twin Deficits" in The Age of Diminished Expectations

The phenomenon of the twin deficits became particularly apparent during the Reagan years:



Sources: US Department of Commerce, *International Transactions Tables*; Council of Economic Advisers, *Economic Report of the President*.

Source: Mann, C. "Is the US Trade Deficit Sustainable", IIE, Washington DC, 1999

1982: One of Reagan's economic advisors, Martin Feldstein, coined the term "the twin deficits". As Krugman writes,

> "At a time when most critics of that deficit worried that it would lead to inflation, or perhaps to high interest rates, Feldstein argued that it would lead to something quite different: unprecedented trade deficits. Initially, his audiences were bemused. Over time, however, as the budget and trade deficits mounted together, the idea of "twin deficits" became a cliché — as well as a target for bitter attack.
>
> "The Age of Diminished Expectations, p.47.

Our previous analysis seems straightforward:

- Increase G-T, and the DD curve shifts to the right. At the new equilibrium, we will be on a lower $\overline{B}$ curve, so the trade deficit deteriorates.

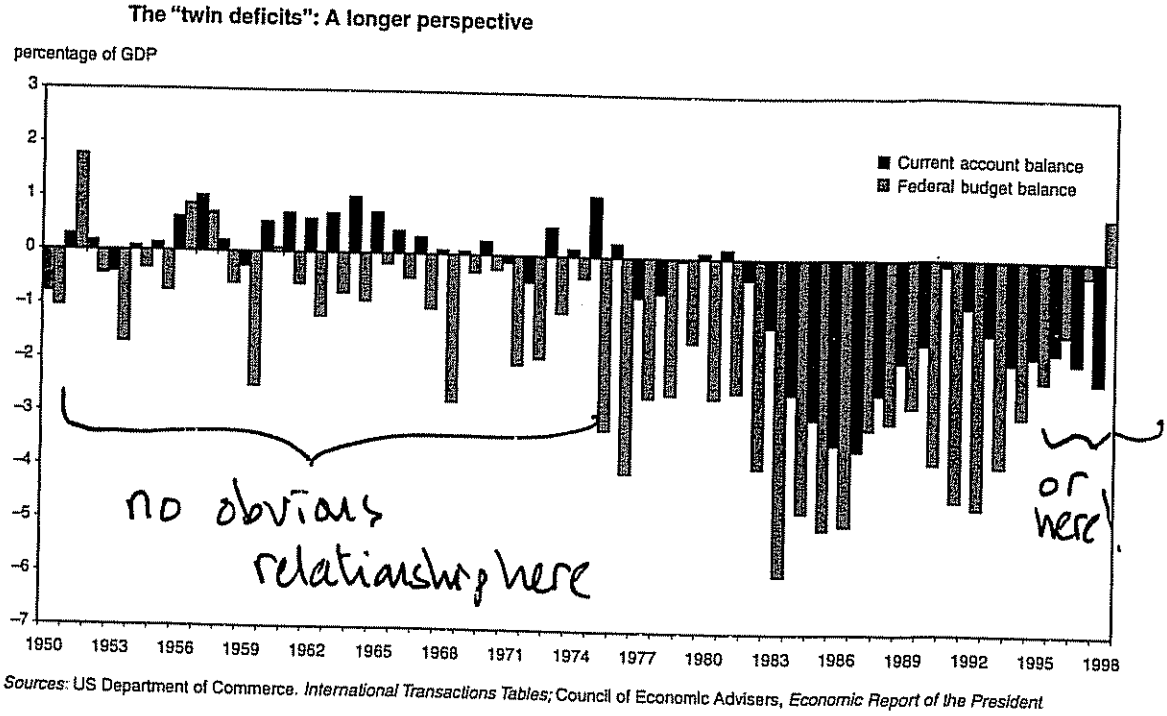
So why the "bitter attack"?

- A major link in the story is that the increase in G-T causes E to go down. In the 1980s, many conservatives were pushing for a return to fixed exchange rates (a gold standard), so they preferred not to believe that exchange rates were important for the trade balance.
- Other critics believed that the trade deficit was due to unfair trade practices in other countries (esp. Japan), and wanted to use trade policy, rather than exchange rate policy, to address the trade deficit.

Neither group wanted to accept that the high dollar was the cause of the trade deficit. But that wasn't the point —

> "the exchange rate is a crucial part of the mechanism that determines the trade balance, without being an independent cause of the trade balance."
>
> Krugman.

- Others have argued that the two deficits have not always gone in tandem:



Sources: US Department of Commerce. *International Transactions Tables;* Council of Economic Advisers, *Economic Report of the President*

Source C. Mann (1999).

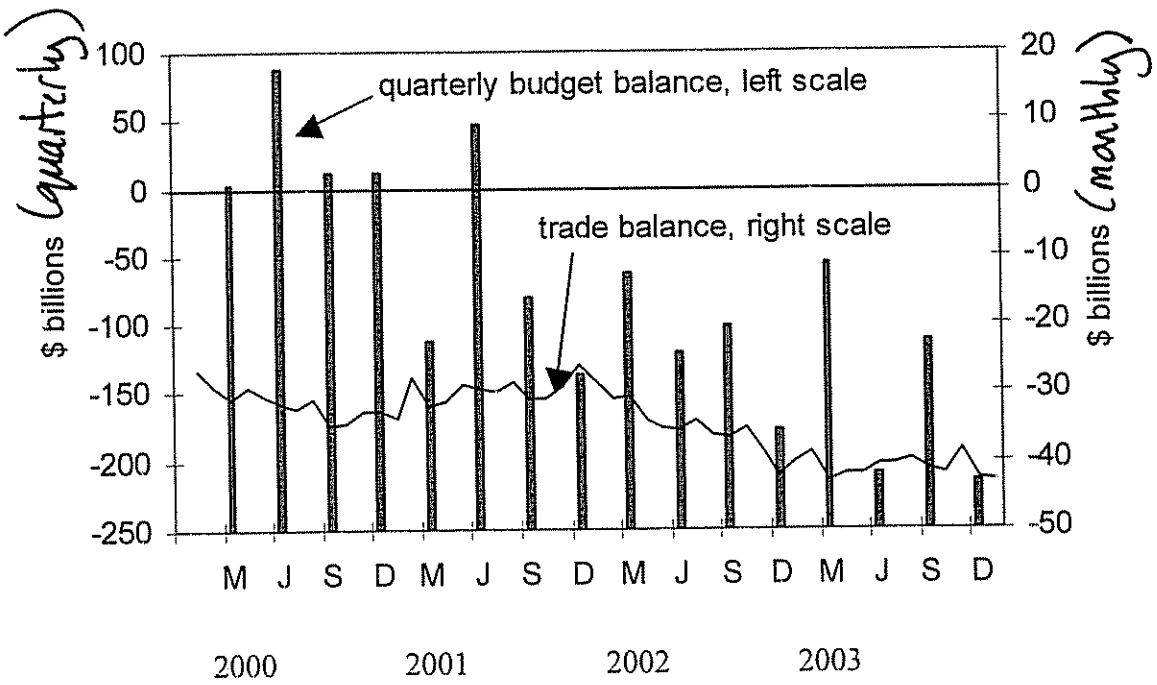
But the theory says, holding other things equal, an increase in G-T makes B lower.

- it identifies a correlation, not a one-for-one relationship.
- If G-T goes up, the correlation only fails if the change in G-T systematically induces an offsetting movement in DD (Ricardian equivalence?), or AA.

The Deficits under the Bush administration.

The first administration under George W. have been associated with rising deficits, reaching near-record highs as a % of GDP, and a soaring trade deficit, reaching an all-time record of >$43bn. by January 2004 (monthly).

Here are the numbers:



Note: the short-term relationship is weak (because: (i) deficits affect $, and $ affects trade slowly; (ii) other things are also changing). But the trend is quite clear.

Currency Crises

We now have enough tools to make serious sense of currency crises.

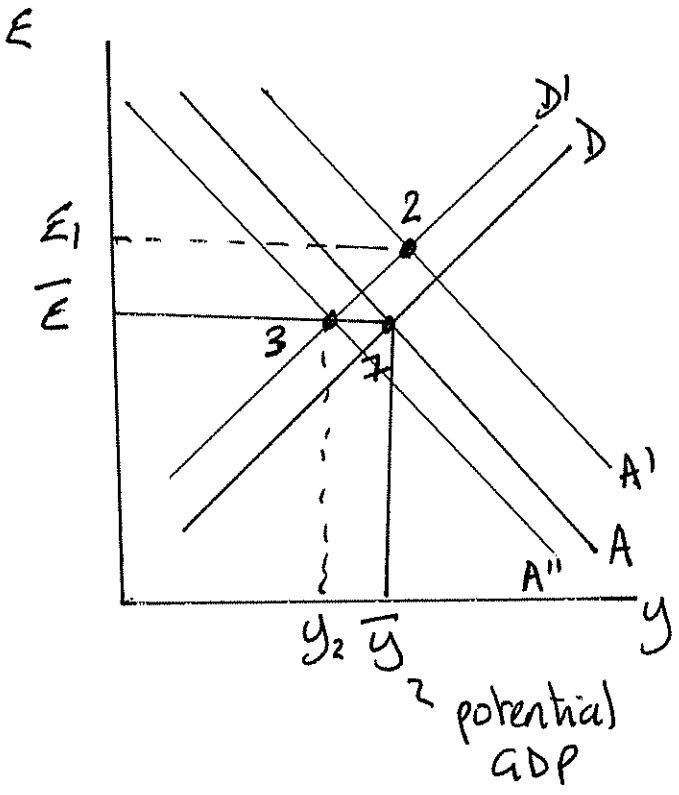
This section will make use of:

- AA-DD model
- Open economy IS-LM model
- Dornbusch overshooting + interest parity
- Concept of Taylor rules.

We will use these together to understand

- European currency crisis of 1992
- The Mexican peso crisis of 1994
- The East Asian crisis of 1997-98.

Fixed Exchange Rates in AA-DD.



- Consider a country that decides to maintain a fixed exchange rate at $\bar{E}$
  - Now assume a foreign trading partner raises its interest rate, ~~This~~ caused by a contraction in M^{S*}.
  - This causes a right ward shift in A (because i^* went up) and a leftward shift in D, (because y^* went down).

- The effect is to cause a depreciation of the currency, moving from $\bar{E}$ to E_1. (The net effect on y is ambiguous, but likely to be small + positive)

- The central bank must now reduce M^S to get E_1 back to $\bar{E}$. This shifts A from A' to A''. The new equilibrium is at $\bar{E}$ - but output has gone down, to y_2.

Main Messages

- If a country wants a fixed exchange rate against another country, it must give up choosing monetary policy to smooth out fluctuations in its own economy. Instead it must emulate the foreign country's monetary policy.

$$E_t = \frac{E_t^e}{1 + i_t - i_t^*} \approx$$

if you want to keep $E_t + E_t^e$ constant (and equal to each other), you must set i_t equal to i_t^*.

- Under fixed exchange rates, events in other countries may induce a recession at home, even though those same events would not have caused a recession if you didn't care about the exchange rate.

So why choose fixed exchange rates?

- It is a trade-off of benefits + costs.

A, Benefits of a fixed exchange rate.

- Fluctuations in exchange rates create uncertainty for exporters, who must pay most of their production costs in local currencies
- Import-competing firms have a better idea of their competitors' prices.
  - These were the main reasons for European Monetary union in 1999
- Fixed exchange rates avoid political turmoil that can arise from large swings in currency value.
- When it is easier to politically commit to a fixed exchange rate policy (because of its visibility relative to, say, a money growth target), a government can "exploit" the credibility of a foreign central bank.

B. Costs of a fixed exchange rate.

- Giving up an independent monetary policy.
- Country is more susceptible to shocks from abroad.

- If the benefits of two countries maintaining a fixed exchange rate with each other exceed the costs, they are said to constitute an "optimal currency area."
  - e.g. the 50 states of the US are believed to be an optimal currency area.
  - we do not know if the EU is one.

- In many other cases, a smaller economy for which trade is important unilaterally fixes its exchange rate against a large trading partner.

Anatomy of a currency crisis

The basic outline of any currency crisis is as follows:

- A central bank is choosing its interest rate policy to maintain a fixed exchange rate $\bar{E}$. If expected to continue, then $E_t^e = \bar{E}$ also, and

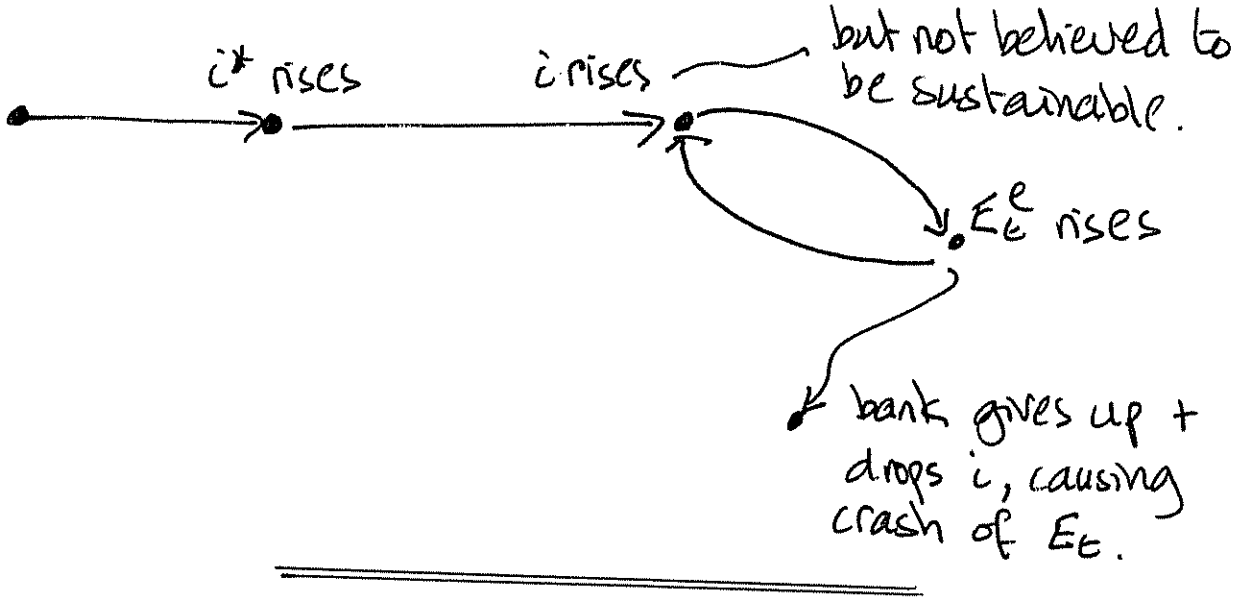
$$\bar{E} = \frac{\bar{E}}{1 + i - i^*},$$

or $$\underline{\underline{i = i^*}}$$

So the central bank simply sets domestic interest rate equal to the foreign interest rate.

- The foreign interest rate, i^*, rises, so i must rise too.
- This rise in i leads to expectations that i will subsequently be lowered
  - because central bank will run out of assets to sell
  - because of political pressure to lower i.

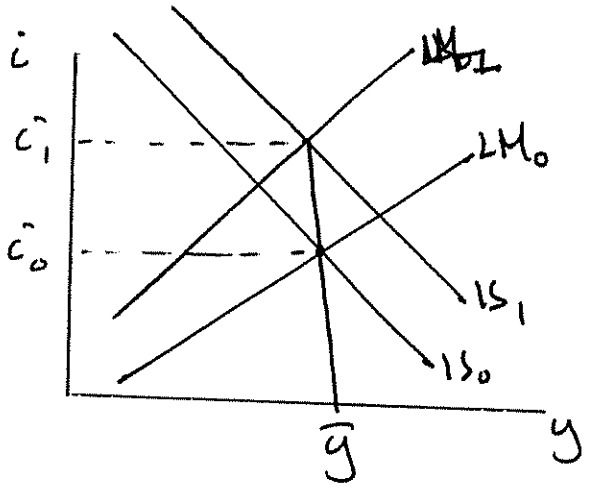
- This anticipation that i must fall below i^* soon causes E_t^e to rise.
  - this induces bank to raise i further, to maintain E
  - which causes E_t^e to rise again
  - which induces bank to ....



- So, signs of an impending currency collapse are that i is rising - often in the face of political complaints - just when the state of the economy suggests that i would not be increased if there were no fixed exchange rate policy.

The European Crisis, 1992.

- Governments were attempting to maintain fixed exchange rates as part of their preparation for monetary union.
- Because the German Bundesbank was constitutionally bound to fight domestic inflation, this meant that other countries were effectively unilaterally fixing their currency against DM.
- 1989-92 – German Unification:



- Government increases G to finance new infrastructure in East – shifting IS right
- Bundesbank intervenes to keep $y = \bar{y}$ (and so prevent future inflation). ← AS-AD Model!
- LM curve shifted to left, raising i from i_0 to i_1.
- Other countries are forced to raise their interest rates too. But some of these countries were already in recession (esp. Italy and UK), so the high i was not politically sustainable.

- If fixed exchange rates were not a policy, these countries would have set a lower i, say i_{float}, to stimulate their economy.

The difference, $i_{fixed} - i_{float}$ measures "financial stress." } can be approximated by a Taylor rule.

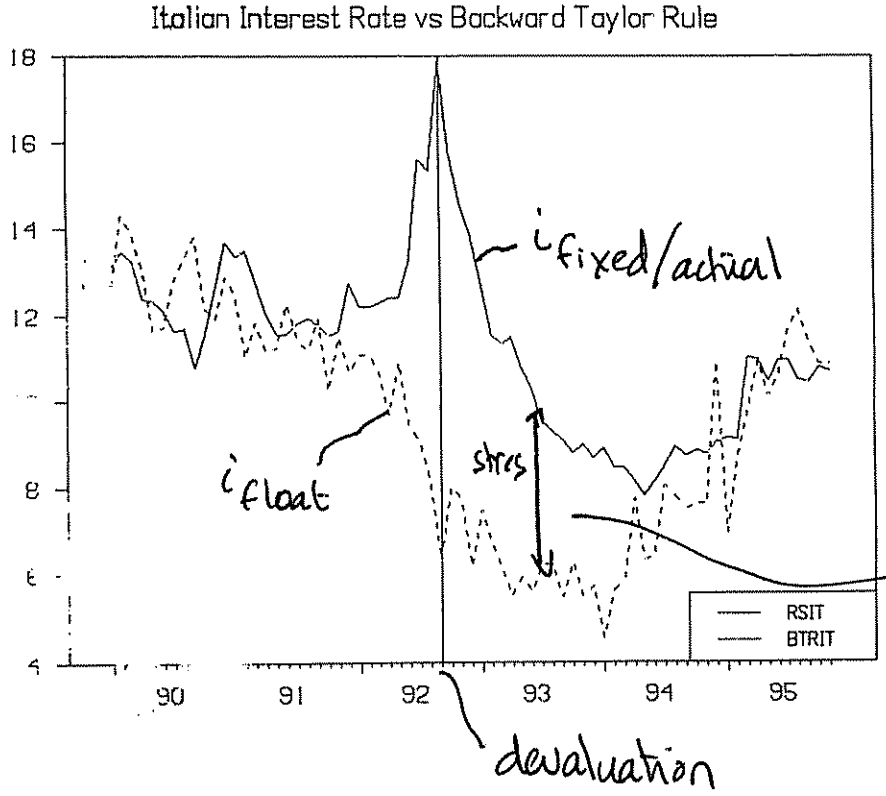
- As ~~i_{float}~~ $i_{fixed} - i_{float}$ gets bigger, more people expect government to give up, and reduce i. This raises E_t^e, which forces i_{fixed} even higher.

- Eventually, government gives up – i drops to i_{float}
  E_t drops.
  – and there is considerable political turmoil.

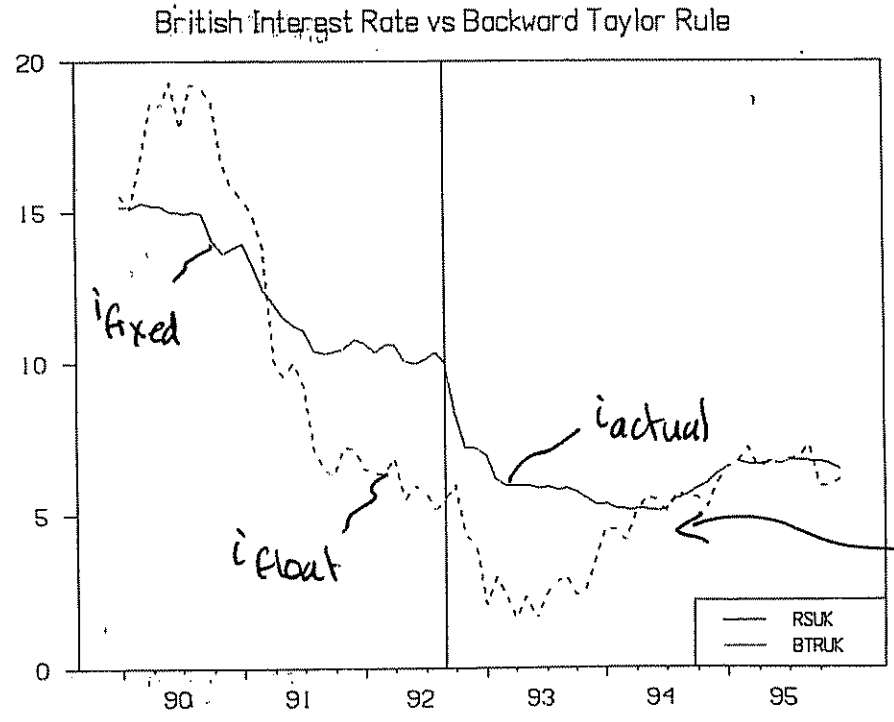
Financial Stress in Italy + Britain

i_{float} estimated by $i_{float} = \pi + 0.5(\pi - \pi^{*}) + 0.5(y - \bar{y})$

(π^{*}: target)



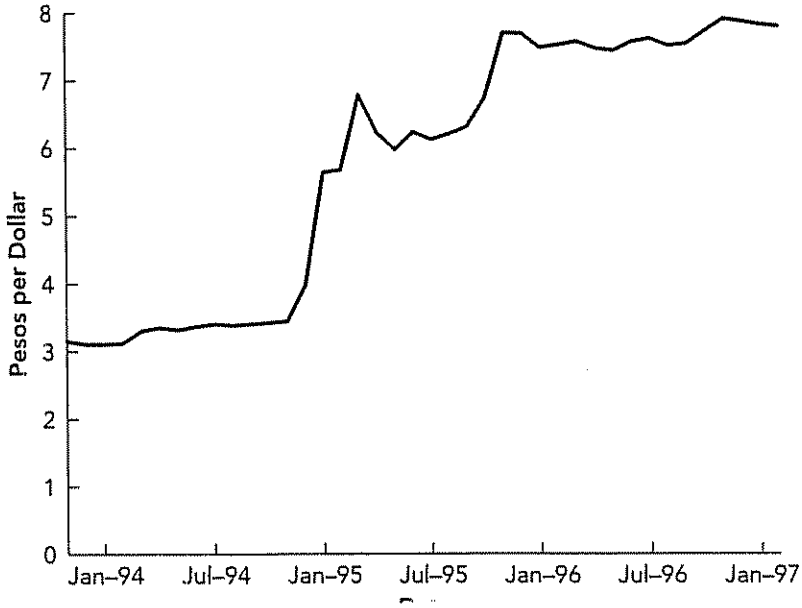
Italy reduces stress, but never fully abandons fixed policy - eventually it rejoins European system and, ultimately monetary union



Britain remains at a freely floating policy, and never rejoins system

Currency devaluations preceded by signs of increasing stress.

The Mexican Crisis, 1994-95



- Uprising in Chiapas in early 1994 cast doubts on political stability
- Increase in M^s around election time caused concerns that Bank of Mexico was politicized.
- So E_t^e jumped up.
- Bank raises i_t, to as high as 40%.

- Eventually, Bank gave up + allowed depreciation.

why? – <u>not</u> "financial stress" + political pressure.

– to raise i_t and contract M^s, a Bank must sell assets and buy back its own currency. Bank of Mexico was selling its reserves of foreign currency.

At the end of 1994, the Bank simply ran out of assets to sell, and so let the peso devalue.

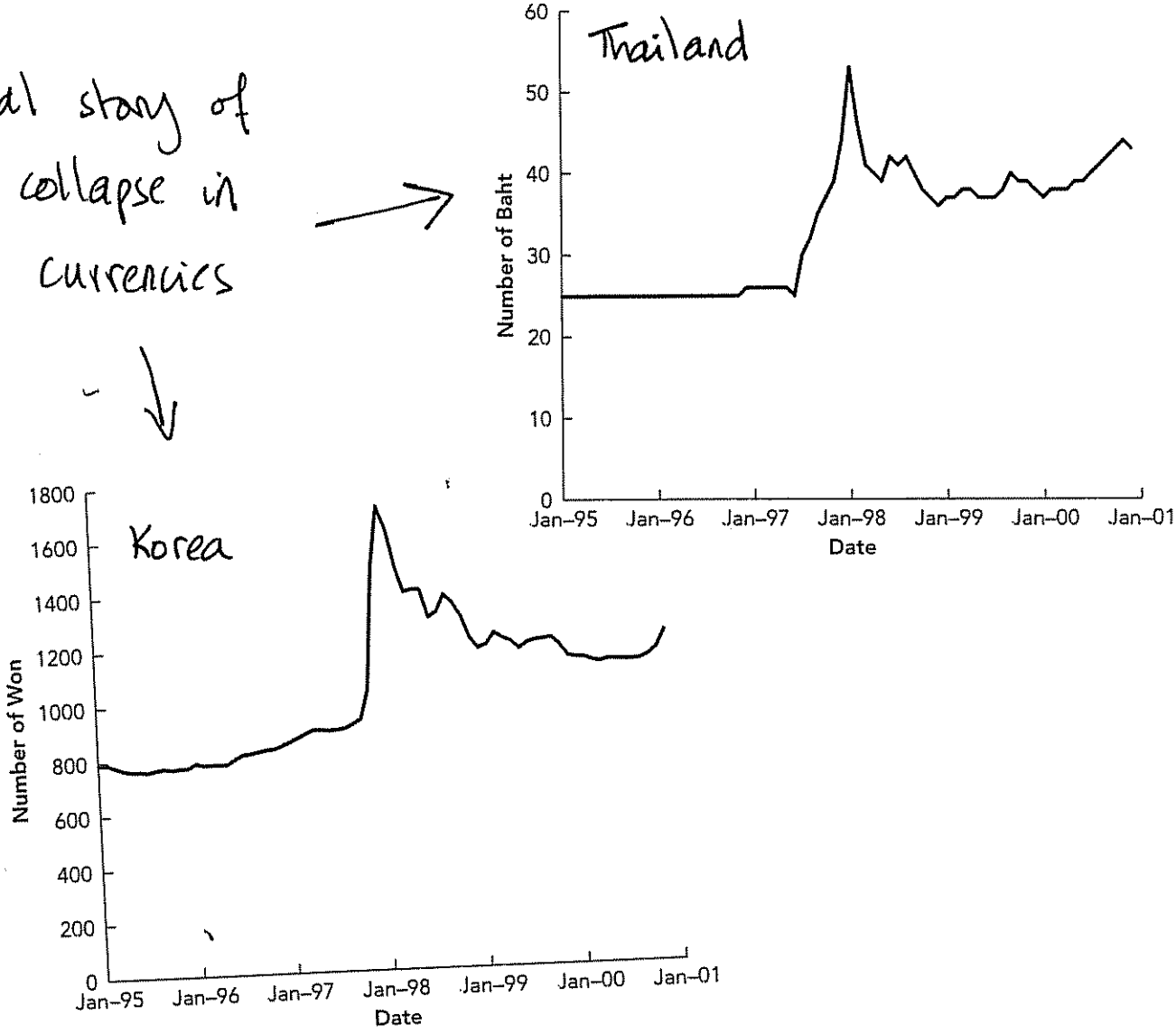
A loan for Mexico.

- Devaluation made it harder for government to repay foreign debt. Risk of default meant risk of collapse in trade (because foreign creditors would seize goods). This would isolate Mexico.
- Alternative was for Bank to sell its domestic assets and send interest rates through roof (or raise the required reserve ratio!). This would put Mexico in a Great Depression.

- Clinton administration tried to get Congress to approve loans to Mexico, to beef up Banks foreign currency reserves.
  - opposed by Newt Gingrich & Robert Dole
  - eventually administration by-passed Congress + made loans from Treasury funds, which enabled fairly quick recovery.

The East-Asian Crisis 1997-98

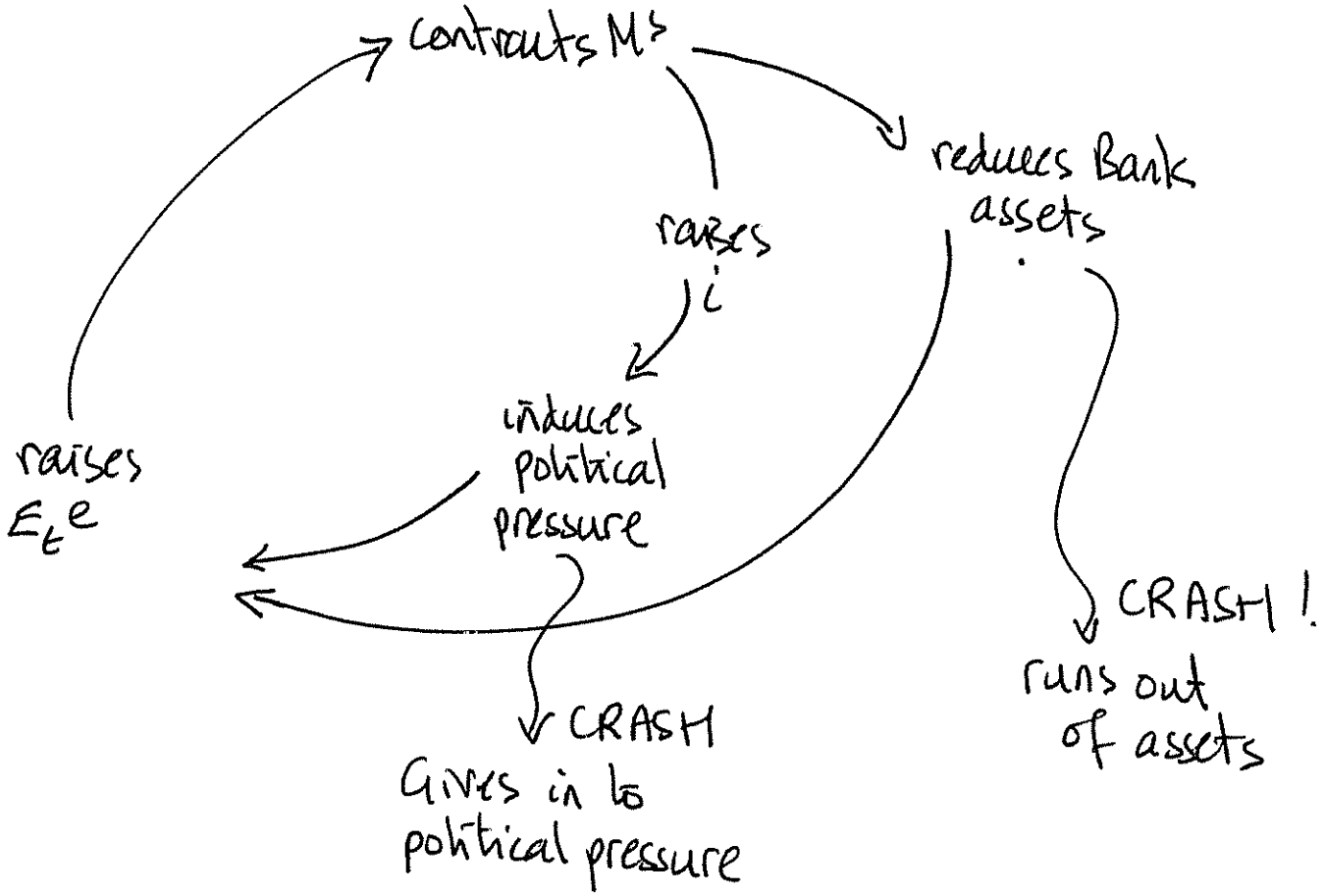
- Usual story of a collapse in currencies



- Again, initiated by a rise in E_t^e.
  - rising interest rates in face of recession
  - rising concern about default on non-performing loans, reduction in output, and decline in i due to leftward shift expected in IS curve.

Currency crises - summary.

- Arise when a sudden change in perceptions - usually foreign investors - raises E_t^e.
- This induces a vicious circle.



- But rise in "financial stress" + decline in Banks assets gives forewarning of crisis - just hard to guess magnitude and timing right.

Given these possible cases, why not go for full monetary union instead of fixed exchange rates?

The Credibility Argument.

For Fixed Rates.

- By fixing exchange rates to a country with a "quality" central bank, one can exploit that quality.
- But this only works if fixing exchange rates can be done with more credibility than committing to good monetary policy.
  - so why not go all the way + join currencies? surely it can't do worse than just fixing exchange rates?

We'll write down a simple model suggesting that one could indeed do worse.

A simple model

1. Each country choose π, given a π^e already built into wage contracts.
2. Output given by a Phillips curve:

$$y - \bar{y} = \pi - \pi^e$$

3. Government has a target output level an amount α over $\bar{y}$.
4. Cost of inflation is quadratic: $C_I = \beta \pi^2$
5. Cost of not meeting output target is also quadratic: $C_L = (y - \bar{y} - \alpha)^2$

Total costs are therefore

$$C = C_I + C_L$$

$$= \beta \pi^2 + (\pi - \pi^e - \alpha)^2$$

which the central bank wants to minimize.

$$\frac{dC}{d\pi} = 2\beta\pi + 2(\pi - \pi^e - \alpha) = 0$$

$$\text{or} \quad \pi = \frac{\alpha}{1+\beta} + \frac{\pi^e}{1+\beta}.$$

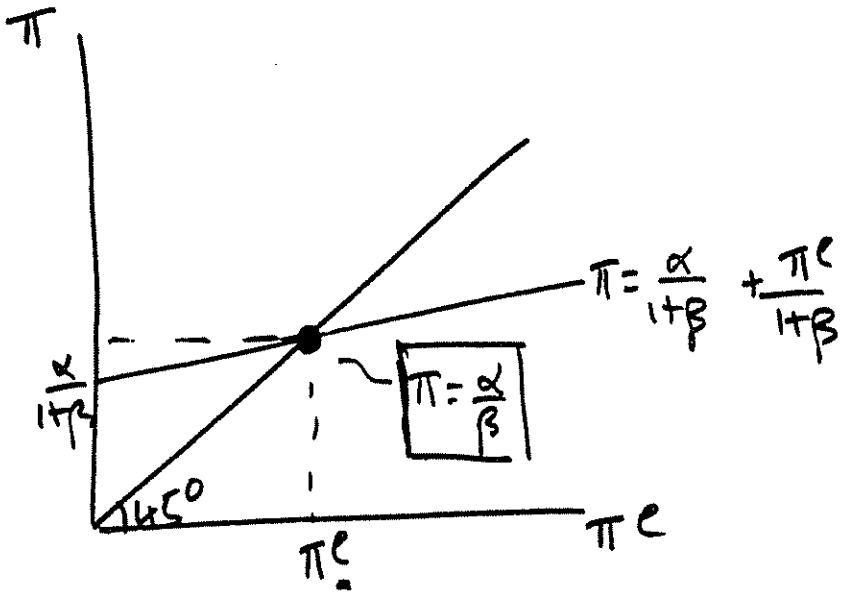
- inflation higher for countries with
  - high target output (high α)
  - low perceived cost of π (low β)
  - high expected inflation

IMPOSING RE: $\longrightarrow \pi^e = \pi$

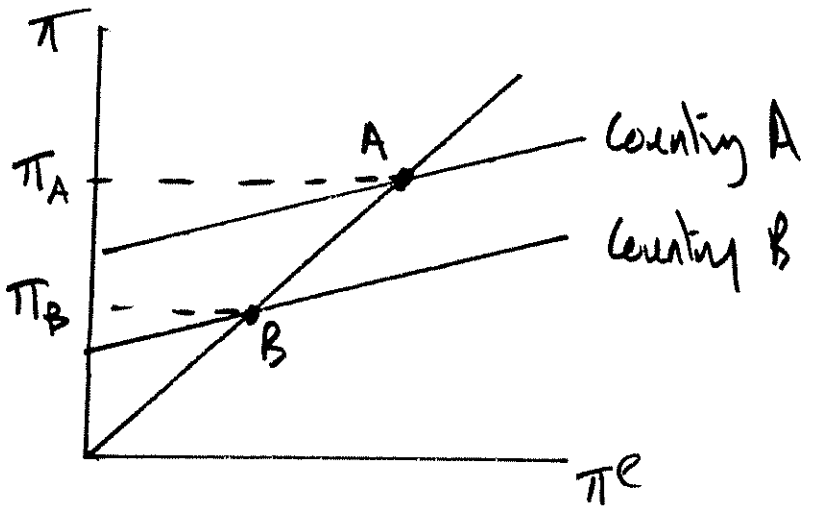
$$\Rightarrow \left(1 - \frac{1}{1+\beta}\right)\pi = \frac{\alpha}{1+\beta}$$

$$\Rightarrow \underline{\underline{\pi = \alpha/\beta}}$$

GRAPHICAL



Now consider two countries:



If country A fixes exchange rate against country B, it must chose π_B instead of π_A.

Now
$$C = \beta\pi^2 + (\pi - \pi^e - \alpha)^2$$
$$= \alpha^2 + \beta\pi^2$$

↳ so any way country A can lower π will make it better off, whatever the values of α and β.

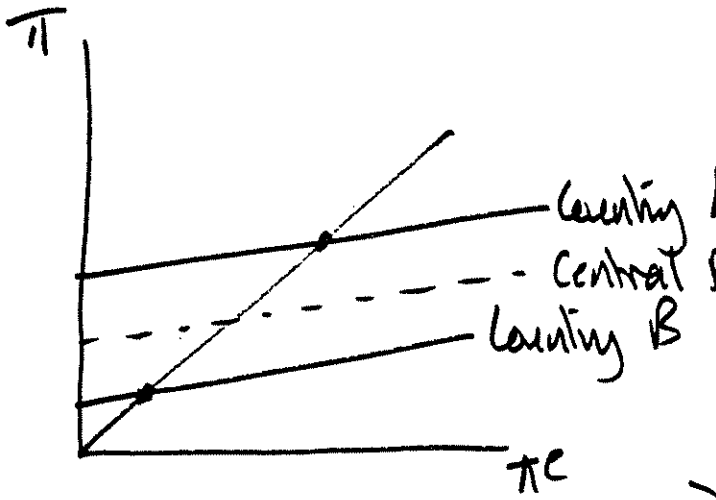
Now assume monetary union. A central bank is formed with cost function

$$C^E = C^A + C^B$$
$$= \beta^A\pi^2 + (\pi - \pi^e - \alpha^A)^2 + \beta^B\pi^2 + (\pi - \pi^e - \alpha^B)^2$$

Minimizing this gives

$$\pi = \frac{\alpha^A + \alpha^B}{2 + \beta^A + \beta^B} + \frac{2\pi^e}{2 + \beta^A + \beta^B}$$

setting $\pi^e = \pi$ $\Longrightarrow$ $\pi = \frac{\alpha^A + \alpha^B}{\beta^A + \beta^B}$



- Notes country A may be better off by fixing exchange rates.
- Country B loses. So why would it join?
  - political (?)
  - trade benefits.

Before EMU, Bundesbank tried to exclude Italy from joining in its first stage.