Lecture 8: The Open Economy in the Short Run

Jacob Adenbaum

University of Edinburgh

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Readings: Gottfries, Chapter 13
Adapted partially from slides from Jakub Mistak

Recap and Roadmap

- Last week, we analyzed the behavior of an open economy in the long run
- With prices adjusting freely to keep output at its natural level, real exchange rates are pinned down, and changes to the real exchange rate ε drive everything
- This week, we will focus on the **short run**
  - Real interest rates can differ in the short run at home and abroad
  - There is a potential role for output stabilizing policy
  - Key differences between fixed exchange rate monetary regimes vs. floating exchange rates
- We will introduce the **Mundell-Fleming** model (IS-LM for open economies) and see how it differs from the closed-economy case

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Section 1

IS-LM in an Open Economy

Open Economy: Short Run

- In an open economy, output in the short run does not need to equal Y^n
- We still have that output will equal aggregate demand (**IS Curve**):

$$Y = C(Y - T, Y^e - T^e, r, A) + I(r, Y^e, K) + G + NX(\varepsilon, Y^\star, Y)$$

- Now, however, the supply of money (**LM curve**) is upward sloping
  - We will assume an identical LM curve as before
- Interest rates and exchange rates will still be pinned down by **interest parity condition**
- Four unknowns and three equations:
  - Y, i, e and M
  - Which ones move freely will depend on the **exchange rate regime**
  - Trilemma of International Finance: one of e or M must be pinned down, or you can't have capital mobility
- For simplicity, assume that $F = 0$ and $D = 0$

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Mundell-Fleming Model

Assume $F = 0$ and $D = 0$ (for simplicity):

IS: $$Y = C(Y - T, Y^e - T^e, i - \pi^e, A) + I(i - \pi^e, Y^e, K) + G + NX\left(\frac{eP}{P^\star}, Y^\star, Y\right)$$

LM: $$\frac{M}{P} = \frac{Y}{V(i)}$$

IP: $$1 + i^\star = (1 + i)\frac{e^e}{e}$$

- IS Curve: Same as in closed economy, but with net exports
- LM Curve: Identical to closed economy
- IP Curve: Interest Parity Condition

Key Changes from IS-LM:

- Exchange rate and net exports add new channel for feedback/multiplier effects
- IP constrains monetary policy, depending on fixed/floating exchange rates

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Section 2

Fixed Exchange Rates

How credible is your peg?

- Suppose the central bank announces $e = e^{\otimes}$
- In general, it's quite hard to fix exchange rates 100% of the time
  - Central bank sets a target value, called the **central parity**
  - Promises to keep exchange rate within $\pm 1\%$ of this value
- Moreover, sometimes the central bank can change its mind:
  - If it announces a new $e_1^{\otimes} > e_0^{\otimes}$ this is called a **revaluation**
  - If $e_1^{\otimes} < e_0^{\otimes}$ this is called a **devaluation**
- What happens if people begin to suspect that the central bank will devalue its currency in the future?
  - These types of currency runs (which we'll talk about next week) have a lot in common with classic bank runs
  - Ugly potential for bad self-fulfilling equilibria

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Fixed Exchange Rate Constrains Monetary Policy

- Even if the central bank is credible, a fixed exchange rate severely constrains their ability to run a sovereign monetary policy

  We discussed this extensively in Lecture 6. It is called the Trilemma of International Finance

- If $e^{\otimes}$ is credible, then $i = i^{\star}$
  - Otherwise, there is an arbitrage opportunity for investors
  - If central bank increases M to drive down i, then you can borrow in small open economy and lend abroad.
  - To do this, you sell the currency of our economy
  - Maintaining the peg forces the central bank to buy it back (which decreases the money supply by taking the domestic currency out of circulation), counteracting the initial monetary expansion
- This is evident from our IP condition:

$$1 + i^{\star} = (1 + i)\frac{e^{e}}{e}$$

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What variables do we care about?

- We have four variables potentially moving around:
  - Y, M, i, and e
  - With a fixed exchange rate, we know that $e = e^{\otimes}$ is set by the central bank
  - This pins down $i = i^{\star}$ exactly through IP
  - Only Y and M are endogenous now
- M is determined by the LM curve, but why do we care?

  We only care about the money supply insofar as it moves real variables around, but the only mechanism for that is through the interest rate i, and that channel isn't present here

- In an open economy with a fixed exchange rate, **the only relevant endogenous variable is Y**, which is determined by the IS curve

$$Y = C(Y - T, Y^e - T^e, i^{\star} - \pi^e, A) + I(i^{\star} - \pi^e, Y^e, K) + G + NX\left(\frac{e^{\otimes}P}{P^{\star}}, Y^{\star}, Y\right)$$

Calculating Multipliers

- We want to be able to say something quantitative about this model, but that's hard when we're just dealing with arbitrary functions
- To make more progress, we will need to make some functional form assumptions:

$$
\begin{aligned}
C &= c_0 + c_1[(1-\tau)Y + Tr] && \text{where } 0 < c_1 < 1 \\
I &= b_0 - b_1 i && \text{where } b_1 > 0 \\
IM &= \varepsilon q Y && \text{where } 0 < q < 1 \\
X &= d\varepsilon^{-\sigma} Y^{\star} && \text{where } d > 0 \text{ and } \sigma > 0
\end{aligned}
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- Notice that:
  - Elasticity of imports with respect to ε is 1 (in line with empirical estimates)
  - $IM/\varepsilon = qY$ so q is the marginal propensity to import
  - $-\sigma$ is the elasticity of exports

$$\frac{\partial X}{\partial \varepsilon}\frac{\varepsilon}{X} = -d\sigma\varepsilon^{-\sigma-1}Y^{\star}\frac{\varepsilon}{X} = -\sigma\frac{d\varepsilon^{-\sigma}Y^{\star}}{X} = -\sigma\frac{X}{X} = -\sigma$$

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Y in reduced form

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- Plug into IS Curve:

$$Y = c_0 + c_1 Y - c_1 \tau Y + c_1 Tr + b_0 - b_1 i^\star + G + d\varepsilon^{-\sigma} Y^\star - qY \tag{1}$$

- Collect Y terms:

$$Y - (1-\tau)c_1 Y + qY = c_0 + c_1 Tr + b_0 - b_1 i^\star + G + d\varepsilon^{-\sigma} Y^\star \tag{2}$$

- Solve for Y:

$$Y = \frac{1}{1-(1-\tau)c_1 + q}\left[c_0 + c_1 Tr + b_0 - b_1 i^\star + G + d\varepsilon^{-\sigma} Y^\star\right] \tag{3}$$

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Comparative Statics: $G\uparrow$

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- What happens if $G\uparrow$? Need to take the derivative:

$$\frac{\partial Y}{\partial G} = \frac{1}{1-(1-\tau)c_1+q}$$

- Since $q > 0$, the multiplier is *lower* than in the closed economy
- Some of the increase in aggregate demand induced by higher government spending leaks out to the rest of the world, via increased demand for imports
- Put some numbers on it: it $c_1 = 0.5$, $\tau = 0.5$, and $q = 0.35$, then

Closed Economy	Open Economy
$\frac{\partial Y}{\partial G} = \frac{1}{1-0.25} = 1.33$	$\frac{\partial Y}{\partial G} = \frac{1}{1-0.25+0.35} = 0.91$

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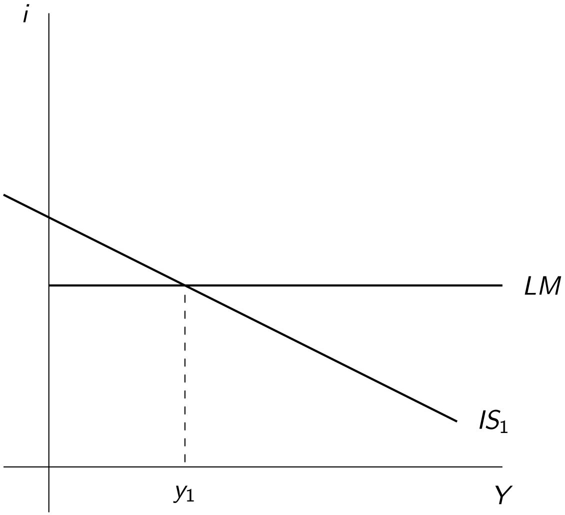
Drawing the graphs

- In the closed economy, the central bank would offset the increase in aggregate demand by raising interest rates
- You'd only get the full multiplier if they hold i constant
- With a fixed exchange rate, they have already committed to an interest rate policy:
$$i = i^{\star}$$
- This means the LM curve is horizontal, and we achieve the full multiplier effect



Drawing the graphs

- In the closed economy, the central bank would offset the increase in aggregate demand by raising interest rates
- You'd only get the full multiplier if they hold i constant
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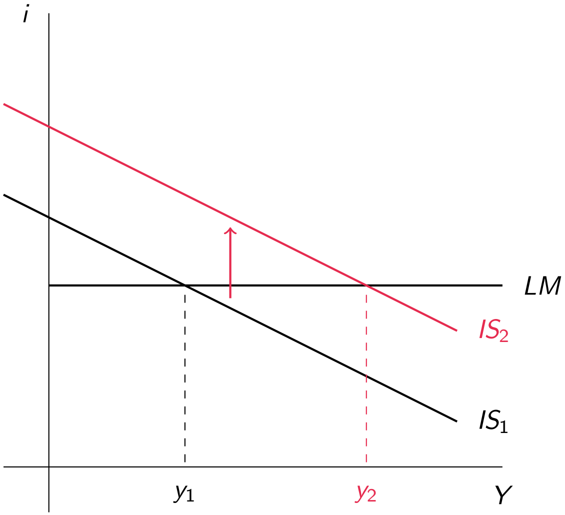

Comparative Statics: $G \uparrow$ effect on NX

- **Question:** What is the effect of an increase in G on NX?
- We know that with our functional form assumptions:

$$NX = d\varepsilon^{-\sigma} Y^{\star} - qY$$

- That means we can use $\frac{\partial Y}{\partial G}$ (which we already calculated) to find

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- Put some numbers on it: it $c_1 = 0.5$, $\tau = 0.5$, and $q = 0.35$

$$\frac{\partial NX}{\partial G} = -\frac{0.35}{1-0.25+0.35} = -0.32$$

- Every £1 billion increase in government spending results in a reduction in net exports of £320 million.
- Fiscal stimulus induces current account deficit (by increasing imports but not affecting exports)

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since $X = d\varepsilon^{-\sigma}Y^\star$

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$$\frac{\partial Y}{\partial \varepsilon}\frac{\varepsilon}{Y} = \frac{1}{1-0.25+.35}\cdot 2 \cdot 0.35 = -0.64$$

This means a 10% real appreciation reduces aggregate demand (and output) by 6.4%

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How credible is your peg?

- What does this mean for the credibility of our fixed exchange rate $e = e^{\otimes}$?
- We discussed earlier that central banks have an incentive to **change their mind** about the exchange rate in order to increase output. This is why
- In the short run, a devaluation can have large impacts on output
- But this relies on people believing that $e^e = e^{\otimes}$
- A central bank might be tempted to exploit that credibility to achieve higher output (in the face of a negative shock to demand), but that tends to destroy the credibility that they were relying on in the first place
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Fixed Exchange Rate Open Economy

Summary

- Interest rates are pinned down by Interest Parity condition (flat LM curve)
- Aggregate demand and output are determined by the IS curve (evaluated at $i = i^{\star}$)
- The money supply cannot be controlled by the central bank
- Fiscal policy doesn't have a crowding out effect in the short run, but has a lower multiplier than in the closed economy because some of the increased income gets spent on exports (leakage)
- A central bank has a strong incentive to devalue the currency to achieve short run increases in output, which can lead to self-fulfilling crises (which we will see next week)

Section 3

Floating Exchange Rate

Floating Exchange Rates

- Central bank does not care about the level of the exchange rate per se

  They obviously have to pay attention to it, because it impacts aggregate demand and inflation

- We can now write out our interest parity condition with the nominal exchange rate e on the left:

$$e = \frac{1+i}{1+i^{\star}} e^{e}$$

  - Higher i makes the economy more attractive for foreign lenders, so demand for the currency increases and $e \uparrow$
  - Higher $i^{\star}$ makes it less attractive for foreign lenders, so demand for the currency declines, and $e \downarrow$
  - Higher e^{e} means the asset will appreciate tomorrow, so people buy it today, driving up the price

- We take $i^{\star}$ as exogenous, and the central bank controls i.

- What about e^{e}?

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What determines e^e

- **Assumption:** e^e is exogenous
  - This is equivalent to assuming that any changes to e are temporary
  - Fairly strong assumption, but it will simplify analysis
- We will return later to the case where $e^e = e$ (changes to the exchange rate are permanent)
- Neither of these is really what you want...
- We really would like e^e to be *rational*
  - Search for an equilibrium where e^e is consistent with our model (people are not surprised on average)
  - In general, this can be done (although not necessarily in this class of models)
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Mundell-Fleming Revisited

- We now have three endogenous variables Y, i, and e

$$Y = C(Y - T, Y^e - T^e, i - \pi^e, A) + I(i - \pi^e, Y^e, K) + G + NX\left(\frac{eP}{P^\star}, Y^\star, Y\right) \quad \text{(IS)}$$

$$\frac{M}{P} = \frac{Y}{V(i)} \quad \text{(LM)}$$

$$e = \frac{1+i}{1+i^\star} e^e \quad \text{(IP)}$$

- To collapse this down to two dimensions, substitute the IP constraint into the IS curve:

Modified IS Curve: $IS^\star$

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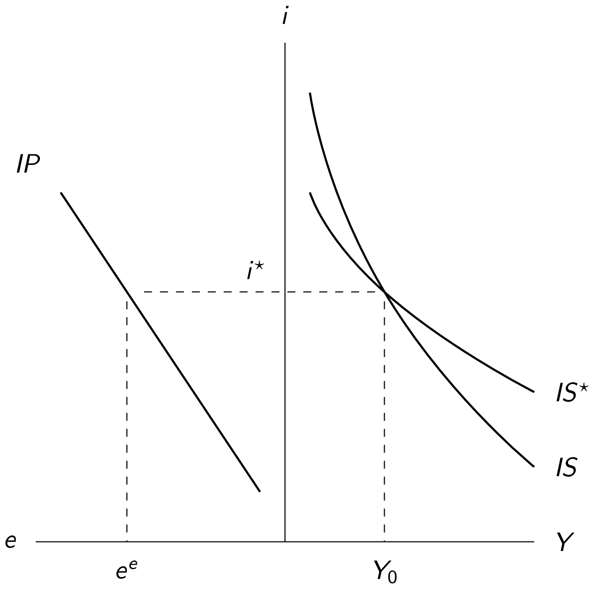
Modified IS Curve

- Two effects of i:
  1. **Direct effect** of i on C and I (like in closed economy)
  2. **Exchange rate Channel:** high i raises e, which reduces NX
- Notice:
  - IS and IS* intersect at $i = i^\star$, which implies $e = e^e$ according to IP
  - IS* is flatter than IS: increase in i has a bigger effect after accounting for exchange rate channel



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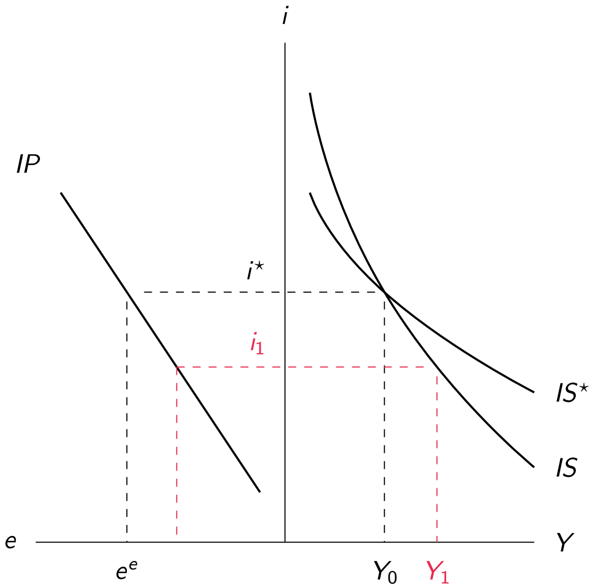

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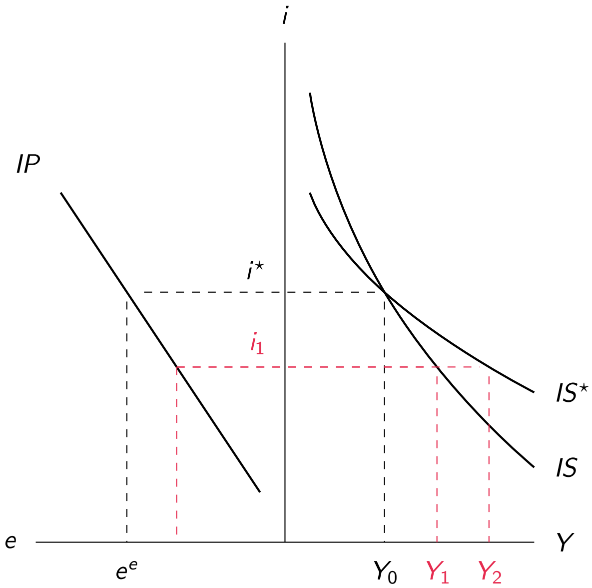

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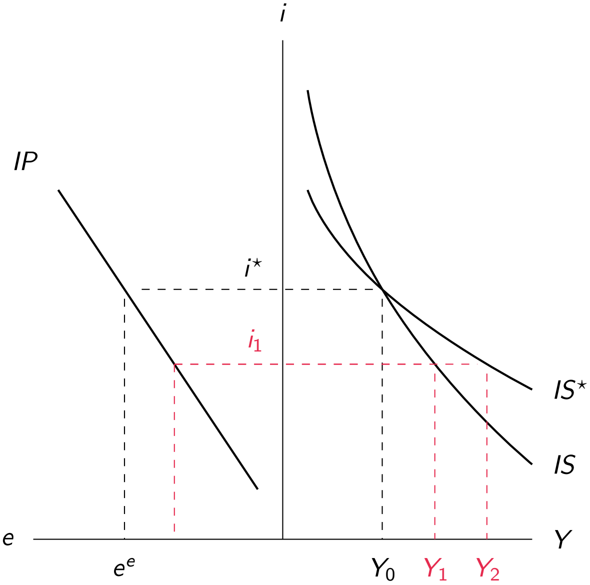
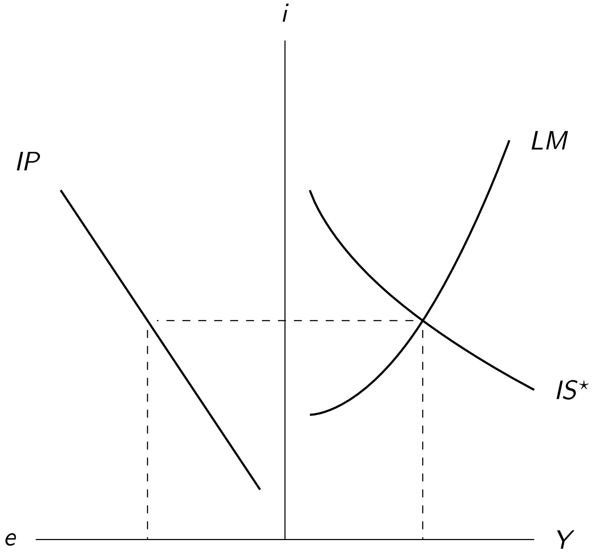


Mundell-Fleming Equilibrium

- Output is determined in the right quadrant (which is almost our usual IS-LM diagram)
- Exchange rate is determined in the left quadrant
- How to evaluate effect of policy or shocks:
  1. Which curve does the change shift?
  2. What happens to the equilibrium?
  3. Give explanation for what happens in each market (goods, money, currency)
  4. What happens to other variables?



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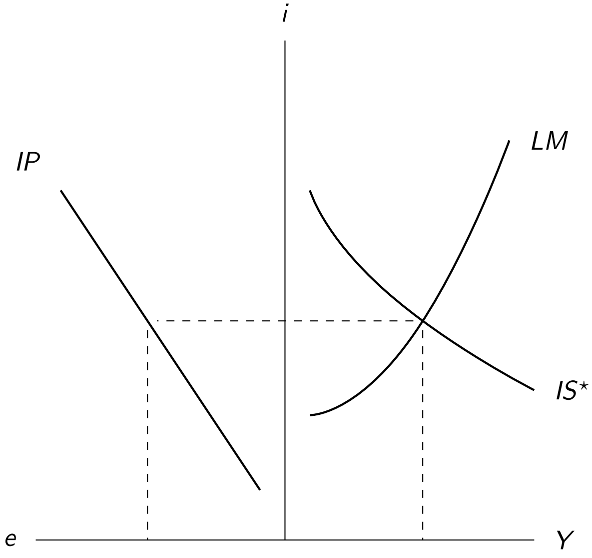
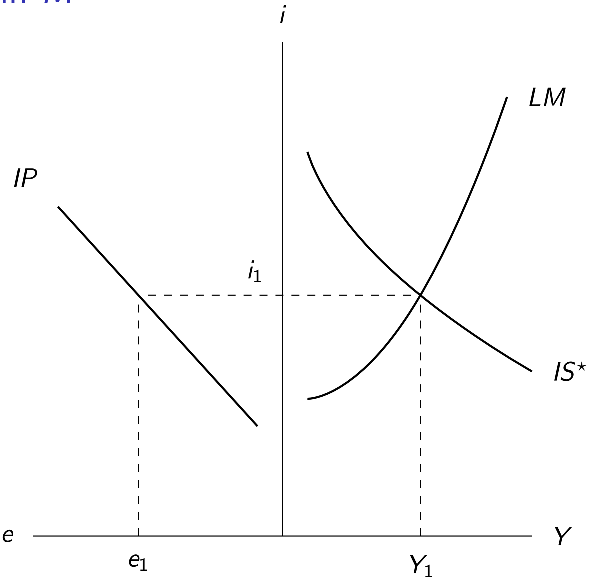


Effect of Monetary Policy: Increase in M

1. LM Curve shifts down
2. Interest rates fall, output increases, and currency depreciates
3. Explanation
   - Central bank buys bonds to increase the money supply, so $i \downarrow$
   - Lower i stimulates C and G, so $Y \uparrow$.
   - Lower i makes it less attractive to hold currency, so $e \downarrow$
   - Lower e stimulates exports, so $Y \uparrow$ as well



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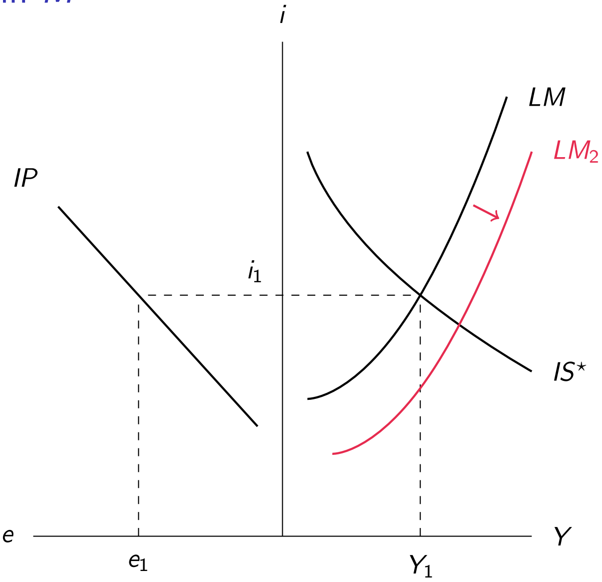

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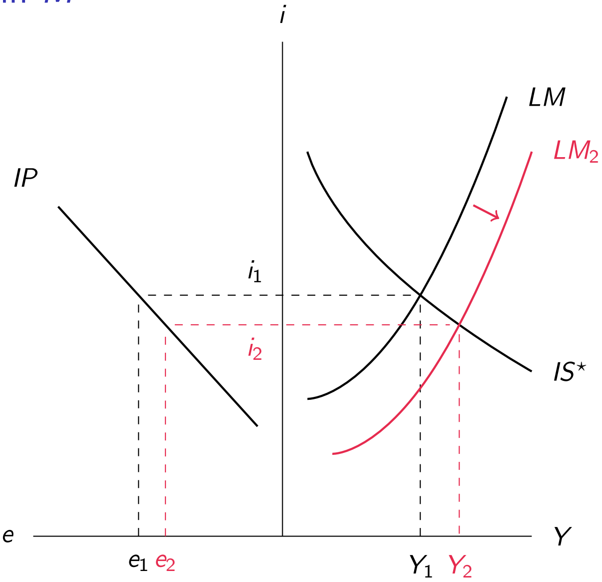

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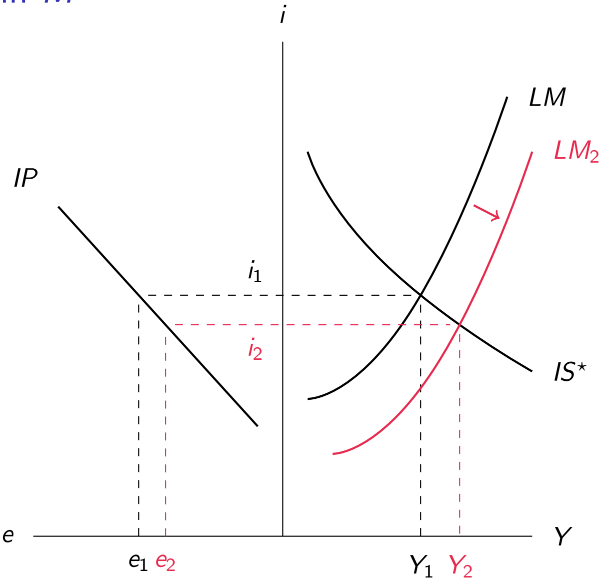

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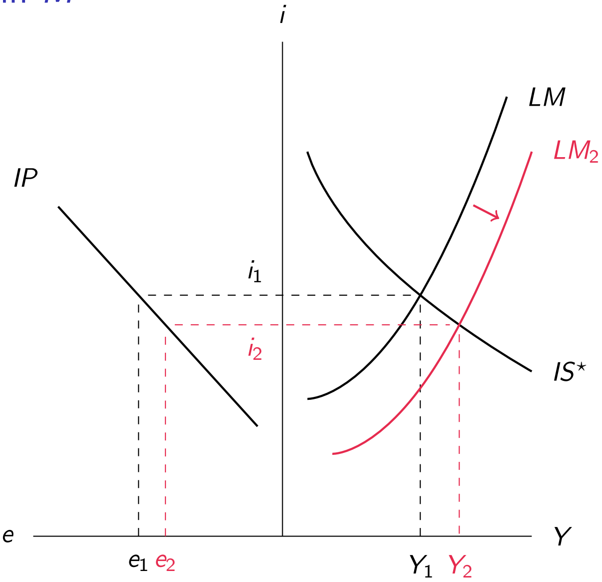

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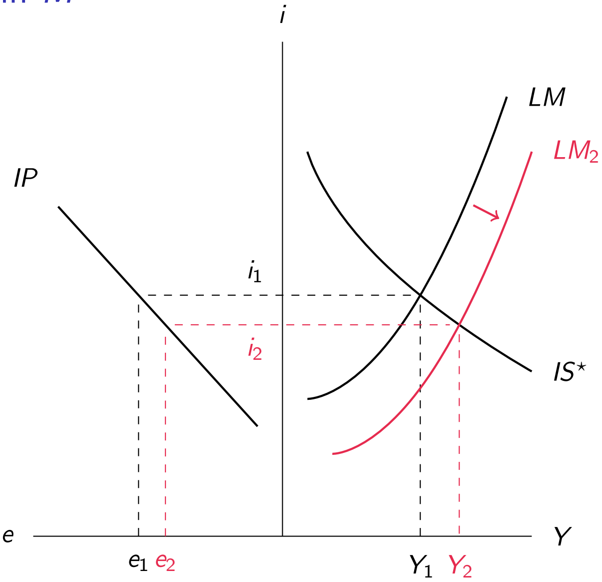

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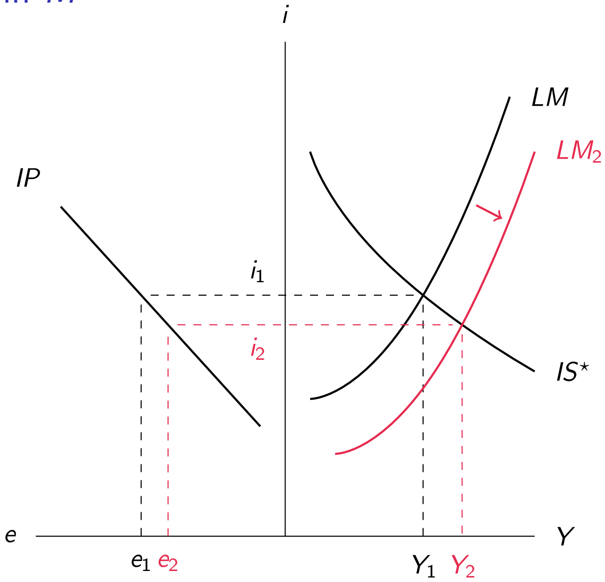
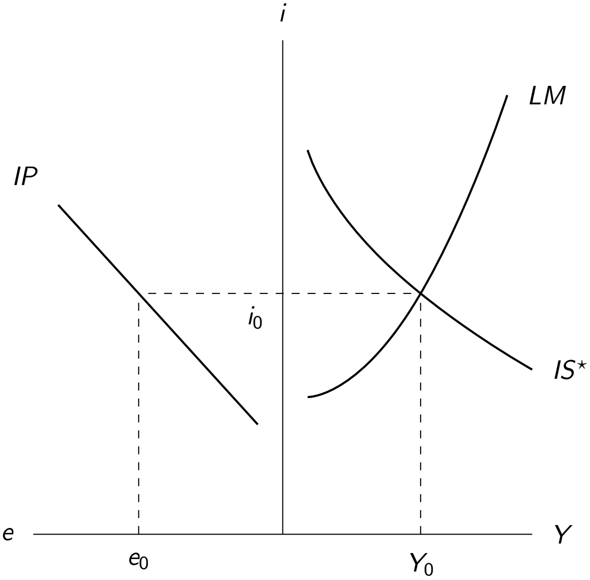


Effect of Monetary Policy

- In a world with floating exchange rates, monetary policy is **more effective** than in the closed economy
- The exchange rate channel reinforces the effect of monetary policy
- Increase in income is multiplied: consumption has a multiplier in this economy
- Some of the additional income will leak out through imports

Effect of Fiscal Policy: Increase G

- IS Curve shifts up
- If central bank keeps M constant, then LM curve stays the same
  - Output rises to Y_1, interest rate rises to i_1, exchange rate rises to e_1
- However, if central bank keeps i constant, then LM curve adjusts
  - Output rises even more (to Y_2)
- In practice, central bank is likely to at least partially offset increase in G, so interest rates will rise somewhat (there will be crowding out)



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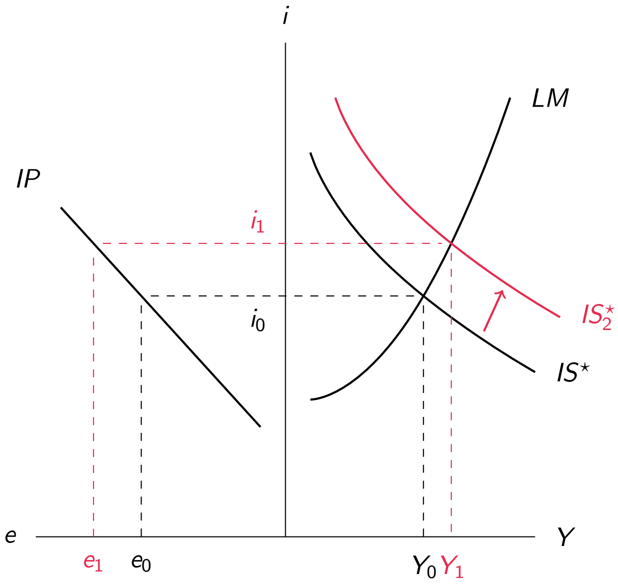

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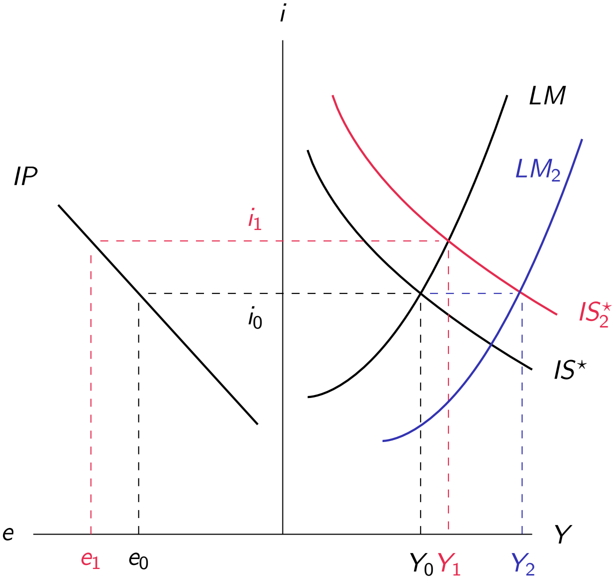
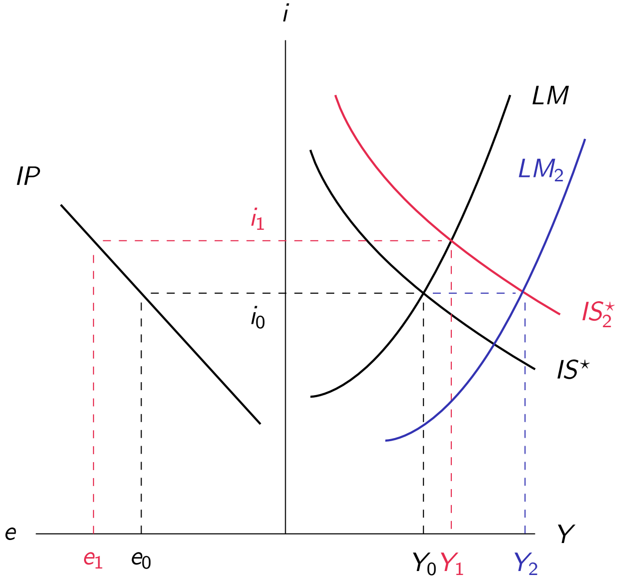


Effect of Fiscal Policy: Increase G

- IS Curve shifts up
- If central bank keeps M constant, then LM curve stays the same
  - Output rises to Y_1, interest rate rises to i_1, exchange rate rises to e_1
- However, if central bank keeps i constant, then LM curve adjusts
  - Output rises even more (to Y_2)
- In practice, central bank is likely to at least partially offset increase in G, so interest rates will rise somewhat (there will be crowding out)



How effective is fiscal policy?

- If central bank keeps i fixed, then it is **extremely effective**
  - Leakage of imports abroad makes the multiplier smaller than in the closed economy case though
- If central bank keeps M fixed, then it is **not particularly effective**
  - Crowding out effect from higher interest rate on I and C
  - Smaller multiplier because of leakage
  - Increase in e drives down NX

Is monetary policy actually sovereign?

- Hopefully, with a floating exchange rate, central banks will actually be able to set their domestic interest rate i as they like
  - We've seen how they can use that to pursue output stabilization
- But now there is another interest rate that shows up $i^{\star}$
- How does this impact our open economy?
- Do they actually get to implement their own monetary policy?
- $i^{\star} \uparrow$ does two things:
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  - Changes the slope of IP curve:

$$e = \frac{1+i}{1+i^{\star}} e^{e} \qquad (4)$$

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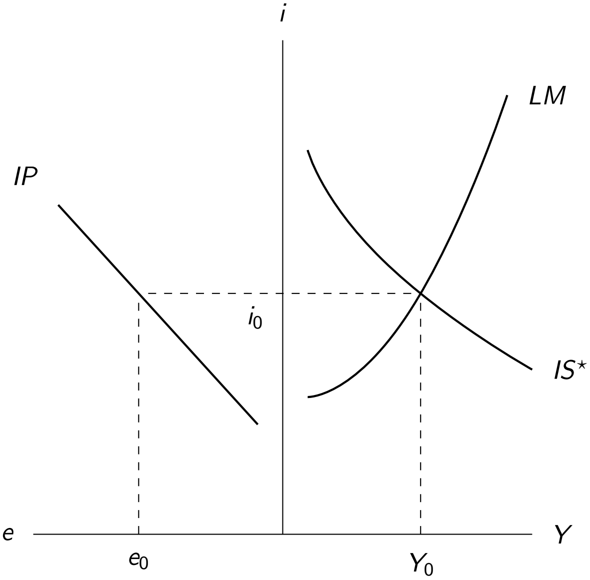
Impact of $i^\star$

- Increase slope of IP, and shift $IS^\star$ out
- If central bank holds M constant, then we will move to Y_1 and e_1
  Higher interest abroad makes lending at in our country less attractive, so currency depreciates. However, it falls less than at our original $IS^\star$ curve
- If central bank holds i constant, there would be a larger effect (like in the case of fiscal policy)
- In practice though, this would be rather inflationary
- Central bank will probably increase i to keep output constant
- This means they follow $i^\star$ even if they don't have to



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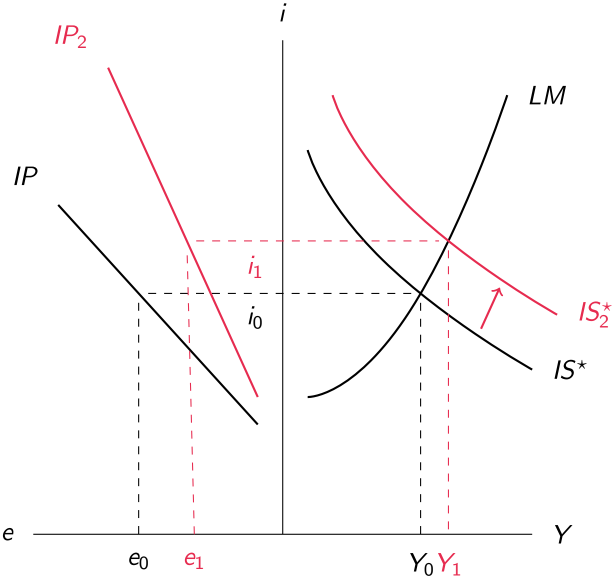

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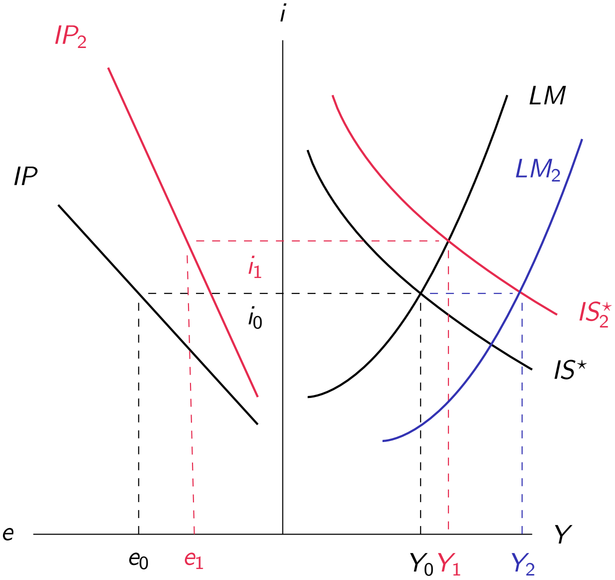

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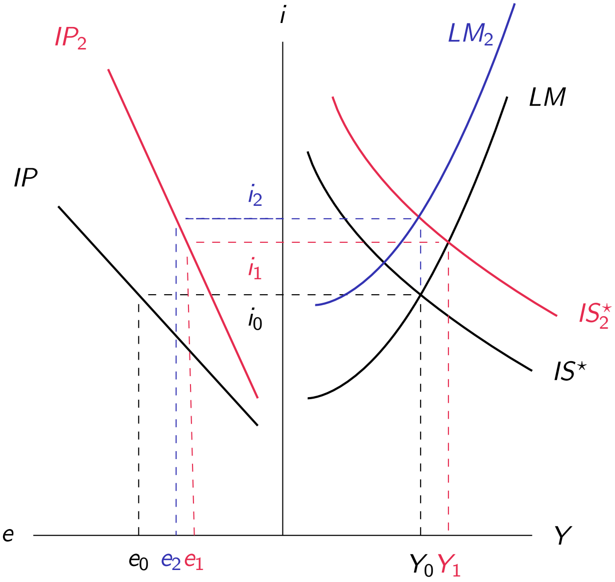

Endogenous Expectations

- Up until now, we've assumed that e^e is exogenous, but that is too strong an assumption.
  - A central bank who pursues tight monetary policy today (high interest rates) may convince people that interest rates will be high tomorrow In fact, they may be explicitly trying to convince people of that
  - We ought to suppose that e^e could depend on e
- In general, this will tend to make the $IS^\star$ curve flatter:
  - If $e^e(e)$ is an increasing function, then it will show up in the slope of the $IS^\star$ curve

$$Y = C(Y-T, Y^e-T^e, i-\pi^e, A)+I(i-\pi^e, Y^e, K)+G+NX\left(\frac{1+i}{1+i^\star}\frac{e^e(e)P}{P^\star}, Y^\star, Y\right) \quad (\text{IS}^\star)$$

  - If $\frac{\partial e^e}{\partial i} > 0$ then an increase in i, which increases e, increases it even more through the expectations channel.
- Higher interest rates will cause an appreciation in the currency *today* through their direct effect, as well as by convincing people that e will appreciate in the future

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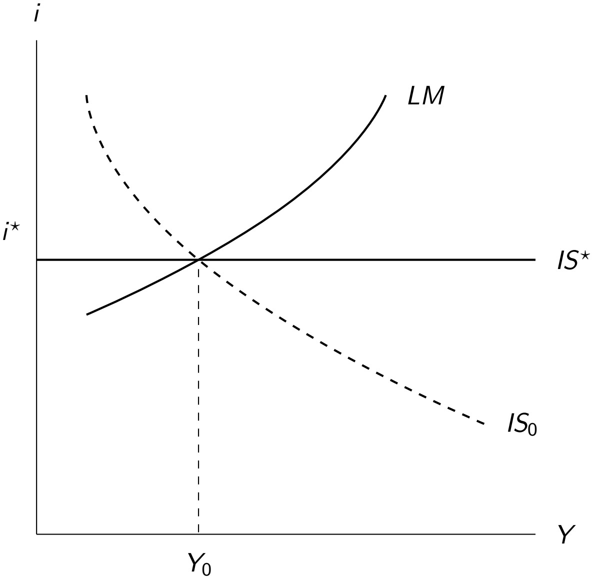
Extreme Case: $e^e = e$

- If $e^e = e$ (called **extrapolative expectations**) then people assume that all changes to the exchange rate are permanent
- Interest parity requires
$$e = \frac{1+i}{1+i^\star} e^e \implies i = i^\star$$
- This is like with fixed exchange rates, but here M is *exogenous*, and e is *endogenous*
- So this means we functionally have a horizontal $IS^\star$ curve
- There is only one interest rate that is an equilibrium: the LM curve completely determines output
$$\frac{M}{P} = \frac{Y}{V(i^\star)} \qquad \text{(LM)}$$

Increase in G when $e^e = e$

- What happens now when government spending increases?
- An increase in G would push the IS (not $IS^\star$) curve up
- However, we know that the $IS^\star$ curve is flat.
- Currency must appreciate, so increase in G is completely offset by decline in NX
- IS curve shifts back in after accounting for appreciation in e
- Fiscal policy is **entirely ineffective** at increasing output, even in the short-run



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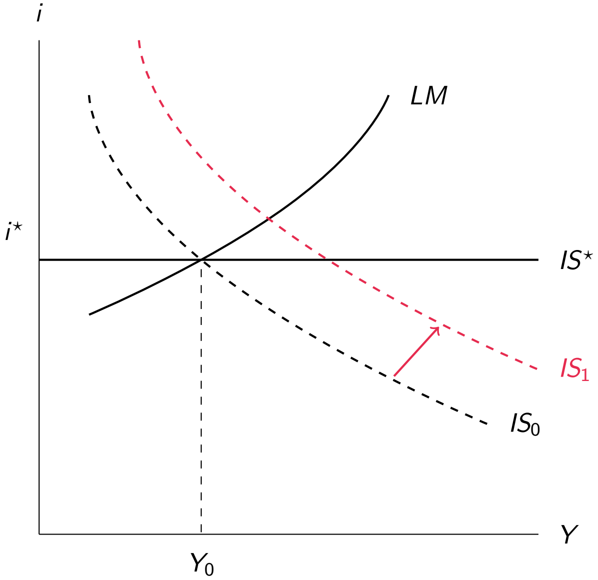

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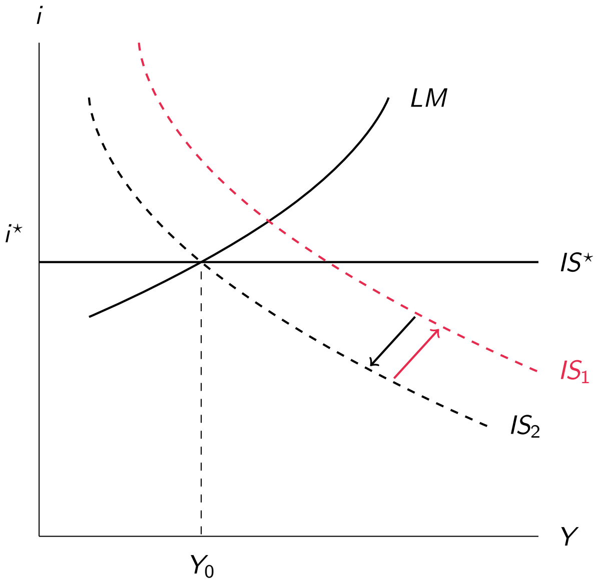
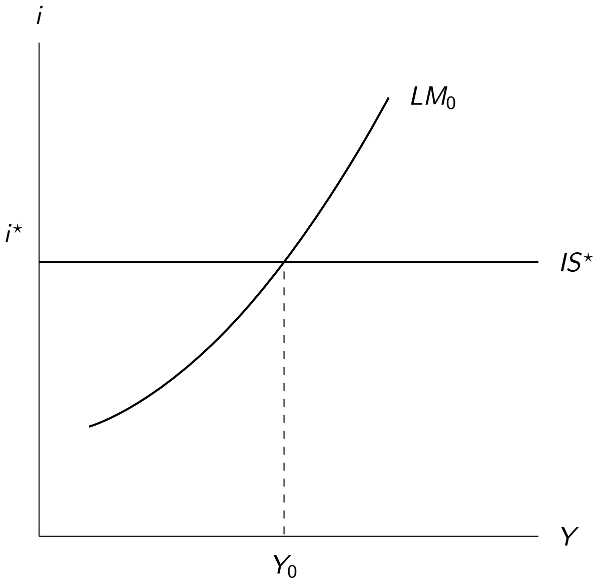


Increase in M when $e^e = e$

- LM curve shifts out
- In the short-run output adjusts fully – Monetary policy is **extremely effective**
- Operates entirely through changes to the exchange rate: higher M causes depreciation, increasing NX
- Larger effect size than with downward sloping IS curve
  - No change in interest rates possible to help clear money market
  - Full change happens through Y
- In the long run, prices adjust and so real exchange rate rises and we return to Y_0



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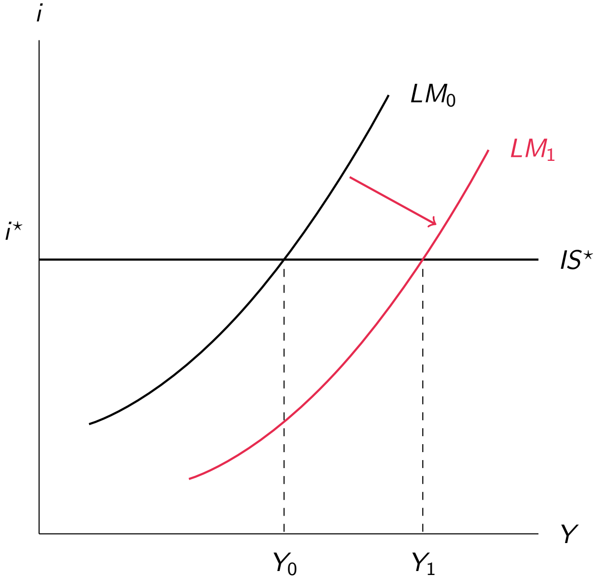

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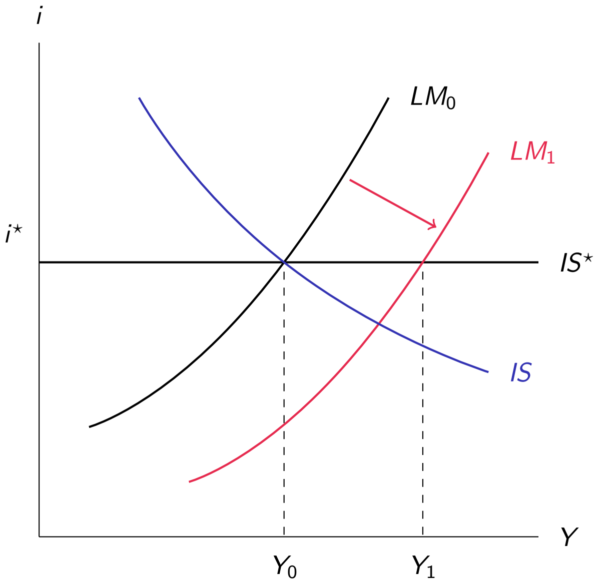

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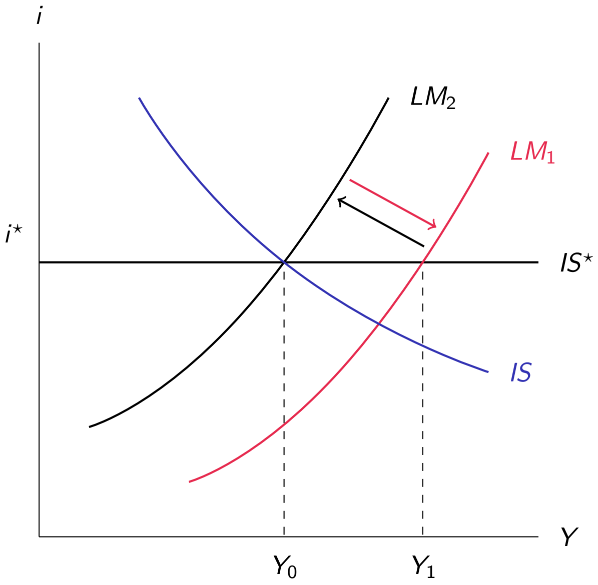


$e^e = e$: Summary

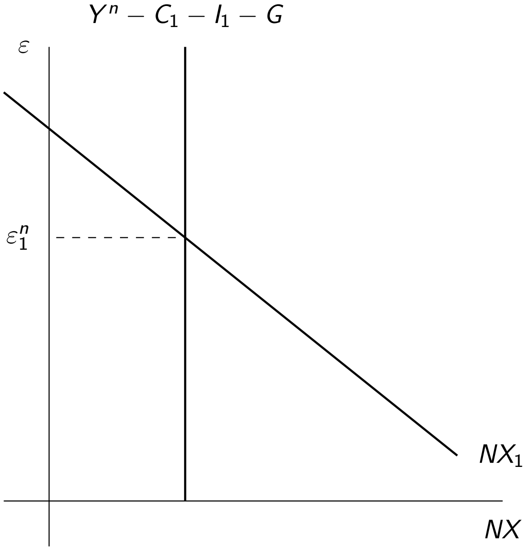
- Fiscal policy is ineffective at increasing output, even in the short run
  - Entirely offset by change in NX
- Monetary policy is *very effective* in the short run, but operates entirely through exchange rate channel
- We will see big movements in e since exchange rates are the only price that can move to clear the markets
- In general, with floating exchange rates and endogenous expectations:
  - Monetary policy is more effective
  - Fiscal policy is less effective

Section 4

Transition to the long run

How do long run transitions happen?

- Suppose consumers become more pessimistic about the future
- We know (from last week) that this leads in the long run to:
  - Higher savings and lower consumption
  - Lower ε
  - Higher NX
- How this transition happens depends on exchange rate regime



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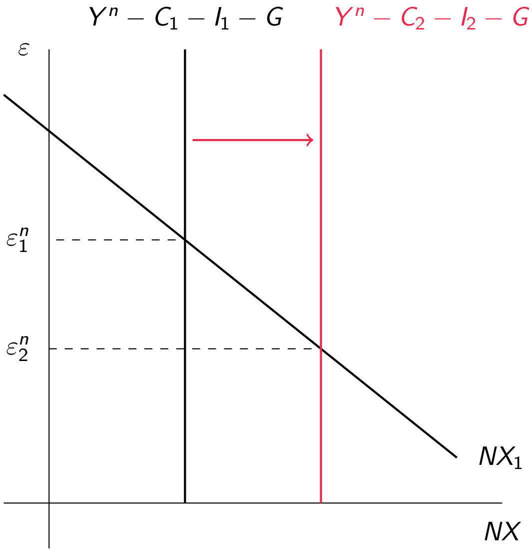

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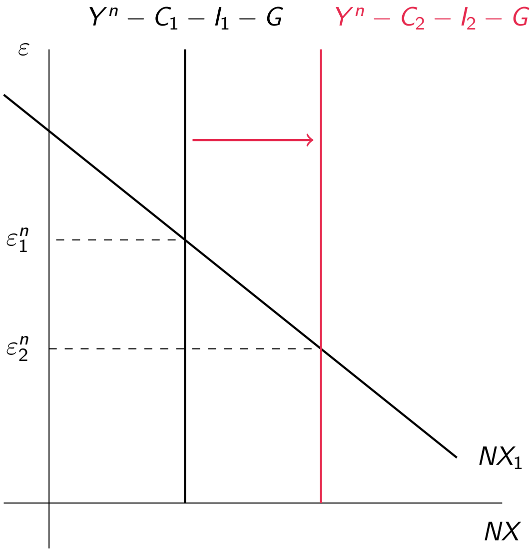


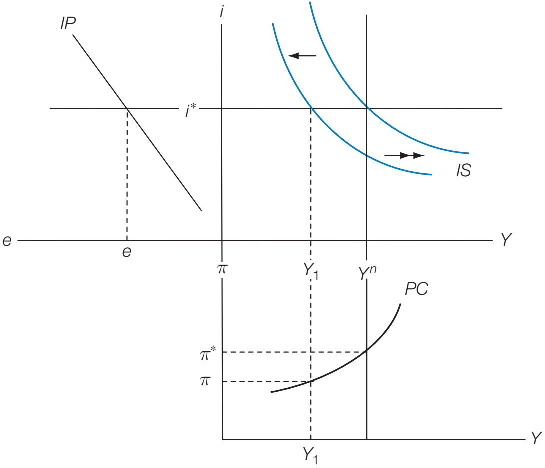
Transition to Long Run: Fixed Exchange Rate

- Suppose that $\pi = \pi^\star$ to start
- Fall in consumption shifts *IS* curve in, and production falls in the short run
- This leads to production below Y^n, so inflation falls
- Recall that with a fixed exchange rate

$$\frac{\partial \log(\varepsilon)}{\partial t} = \pi - \pi^\star$$

Growth of ε reflects changes in inflation

- So **real exchange rate falls** until output is back at its natural level
- π eventually returns to $\pi^\star$



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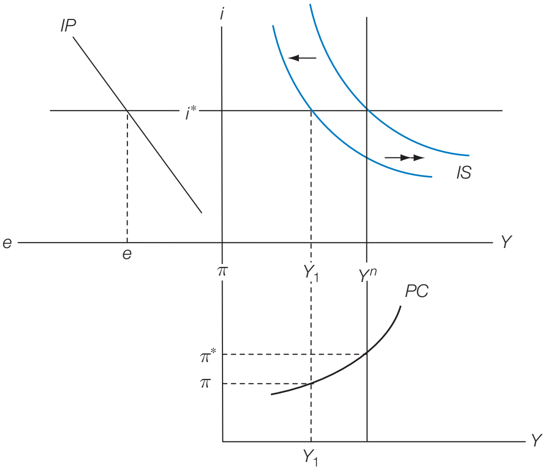

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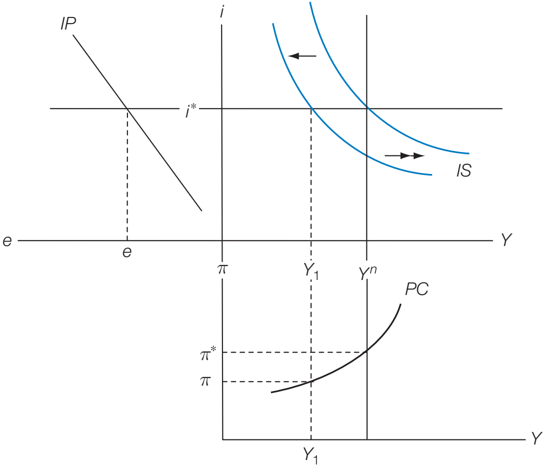

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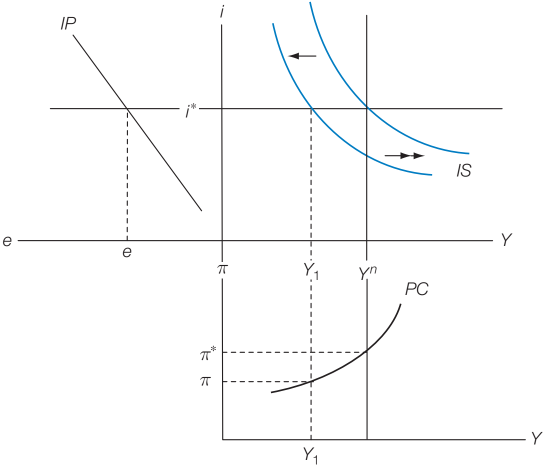
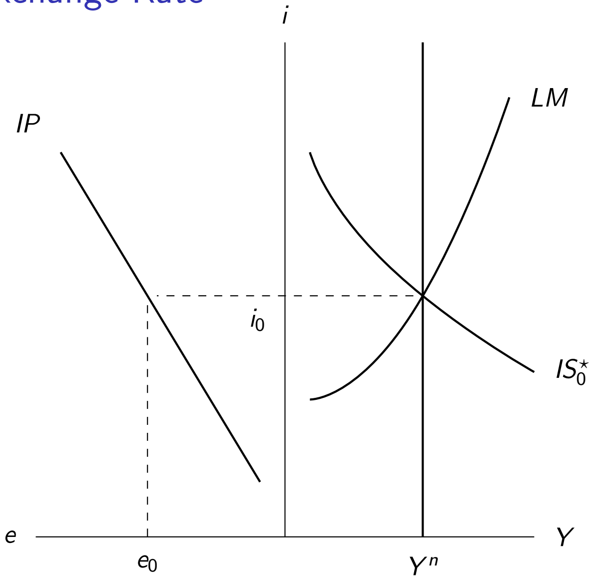


Transition to Long Run: Floating Exchange Rate

- If consumption falls, that looks like an inward shift of the $IS^\star$ curve
- If M is held constant, i will fall, which causes a depreciation in e
  - Lower i and lower e partially offset fall in consumption, but output still falls to Y_1
  - Like before, eventually lower inflation would cause ε to fall, and $IS^\star$ would shift back
- We don't have to wait
  - Note that the central bank can increase M in response
  - The corresponding shift in LM completely counteracts fall in Y
- Exchange rate can act as a **shock absorber** to keep output stabilized



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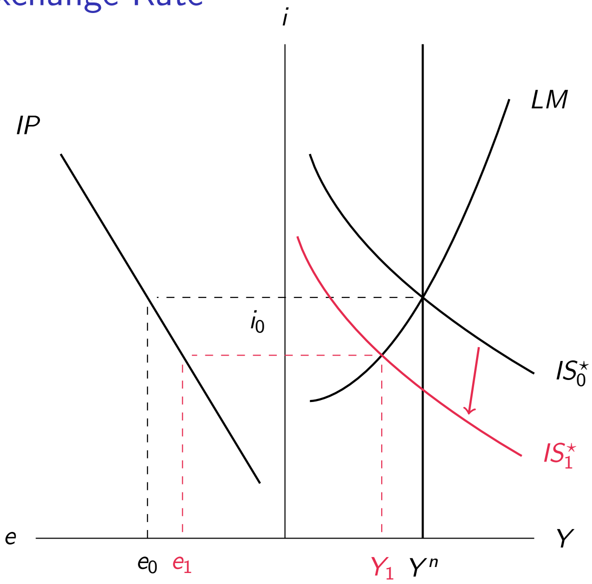

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