Open Economy AS/AD Model: Floating Exchange Rate

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Questions

How do the previous results change when exchange rates are floating?

Key result:

When prices are flexible, floating and fixed exchange rates produce similar results

at least in the medium run.

Why?

Changing prices can mimic the effects of changing exchange rates.

Foreign exchange market clearing

What Determines Capital Flows?

Exchange rates move in response to international capital flows.

Capital flows respond to **risk adjusted returns** of investing at home vs abroad.

Factors that cause capital to flow into the U.S.:

1. high U.S. interest rate;
2. expected appreciation of the dollar;
3. increasing risk of investing abroad: political instability, external debt, ...

Uncovered Interest Parity (UIP)

A popular theory of exchange rate movements: UIP

Definition

UIP holds, when the dollar returns of investing at home and abroad are the same.

UIP Math

Return of holding dollars: $1+i_{\$}$

Return of holding FX:

- interest: $1+i_{¥}$
- capital gain from holding ¥ = ¥ appreciation = $\frac{E(t+1)}{E(t)}$
- where E is in $\$/¥$ ($E\uparrow$ means the ¥ appreciates)

Equal returns:

$$1+i_{\$} = (1+i_{¥})\frac{E(t+1)}{E(t)} \tag{1}$$

or (approximately)

$$i_{\$} = i_{¥} + x \tag{2}$$

where $x = E(t+1)/E(t) - 1$ is ¥ appreciation.

UIP Intuition

Suppose that

- two currencies pay the same interest: $i_{\$} = i_{¥}$
- investors expect the ¥ to appreciate by 5 pct over the next year.

Expected dollar return of

- investing at home: $i_{\$}$
- investing abroad: $i_{¥} + 5\%$

Investors move funds out of \$ into ¥. Then

- either interest rates adjust
- or the ¥ appreciates

until $i_{\$} = i_{¥} + x$.

Implications

If we see that a currency pays higher interest, investors expect it to depreciate in the future.

Intuition...

Example

Dollar: $i_{\$} = 0.05$
¥: $i_{¥} = 0.02$
Expectation: ¥ will appreciate by 3%

Risk Premiums

If currencies differ in risk, UIP subtracts a risk premium from the foreign currency return.

$$1 + i_{\$} = (1 + i_{¥} - RP_{¥}) \frac{E(t+1)}{E(t)} \tag{3}$$

or (approximately)

$$i_{\$} = i_{¥} - RP_{¥} + x \tag{4}$$

Higher risk premium must be offset via higher interest rate $i_{¥}$.

Risk Premiums

The same from the foreign perspective

$$i_{¥} = i_{\$} - RP_{\$} - x \tag{5}$$

Therefore:

$$RP_{\$} = -RP_{¥} \tag{6}$$

The **risk premium must be negative** for one country.

How is this possible?

Digression: What is Risk?

Is risk just **payoff volatility**?

- Then all risk premiums would be positive (≥ 0)
- Counter-example: What type of "asset" has high payout volatility and low expected returns?

Insight: some types of payoff fluctuations are good.

Which ones are bad (risk)?

Digression: What is Risk?

Example

Your income fluctuates.
When do you want to receive payments?

Compare two assets:

- Asset A pays you \$10,000 when you are poor.
- Asset B pays you \$10,000 when you are rich.

Both assets have the same payoff variance.

But A is clearly better than B (insurance).

Digression: What is Risk?

Example

There are two stocks:
A's value rises by 10% when it rains; otherwise it falls by 10%
B's value falls by 10% when it rains; otherwise it rises by 10%
Which asset is riskier?
Hint: It's a trick question.

Digression: What is Risk?

Insight

Risky assets pay high returns when you are already rich (stocks).
(Better than) Safe assets pay high returns when you are poor (insurance).
Risk is correlation of returns with your other sources of income.

When might foreign currencies have negative risk?

- Hint: think inflation risk.

Summary

1. Risky assets must pay higher (expected) returns.
2. Risk is not payoff volatility (think insurance).
3. Assets that pay in bad states of the world are desirable ("safe").
4. There is nothing wrong with negative risk premiums (think insurance).
5. It makes sense for one currency in the UIP equation to have negative risk.

How shocks affect the exchange rate

Solve the UIP condition

$$1 + i_{\$} = (1 + i_{¥} - RP_{¥}) \frac{E(t+1)}{E(t)} \tag{7}$$

for today's spot rate:

$$E(t) = E(t+1) \frac{1 + i_{¥} - RP_{¥}}{1 + i_{\$}} \tag{8}$$

The foreign currency appreciates when:

1. it becomes less risky
   $RP_{¥} \downarrow \Longrightarrow E(t) \uparrow$
2. the foreign interest rate rises:
   $i_{¥} \uparrow \Longrightarrow E(t) \uparrow$.
3. The ¥ is expected to be more valuable in the future:
   $E(t+1) \uparrow \Longrightarrow E(t) \uparrow$

How shocks affect the exchange rate

Intuition: Good news such as lower risk or a higher interest rate make the ¥ attractive to investors. Its value rises.

Example

Start from $i_{\$} = i_{¥}$.
Investors view the ¥ as riskier: $RP \uparrow$
Violation of UIP: $i_{\$} > i_{¥} - RP$.
Traders sell ¥s until UIP is restored.
That requires $i_{\$} = i_{¥} - RP + x$.
To compensate for the risk, investors need to expect ¥ appreciation.

Is the ¥ strong when the interest rate is high?

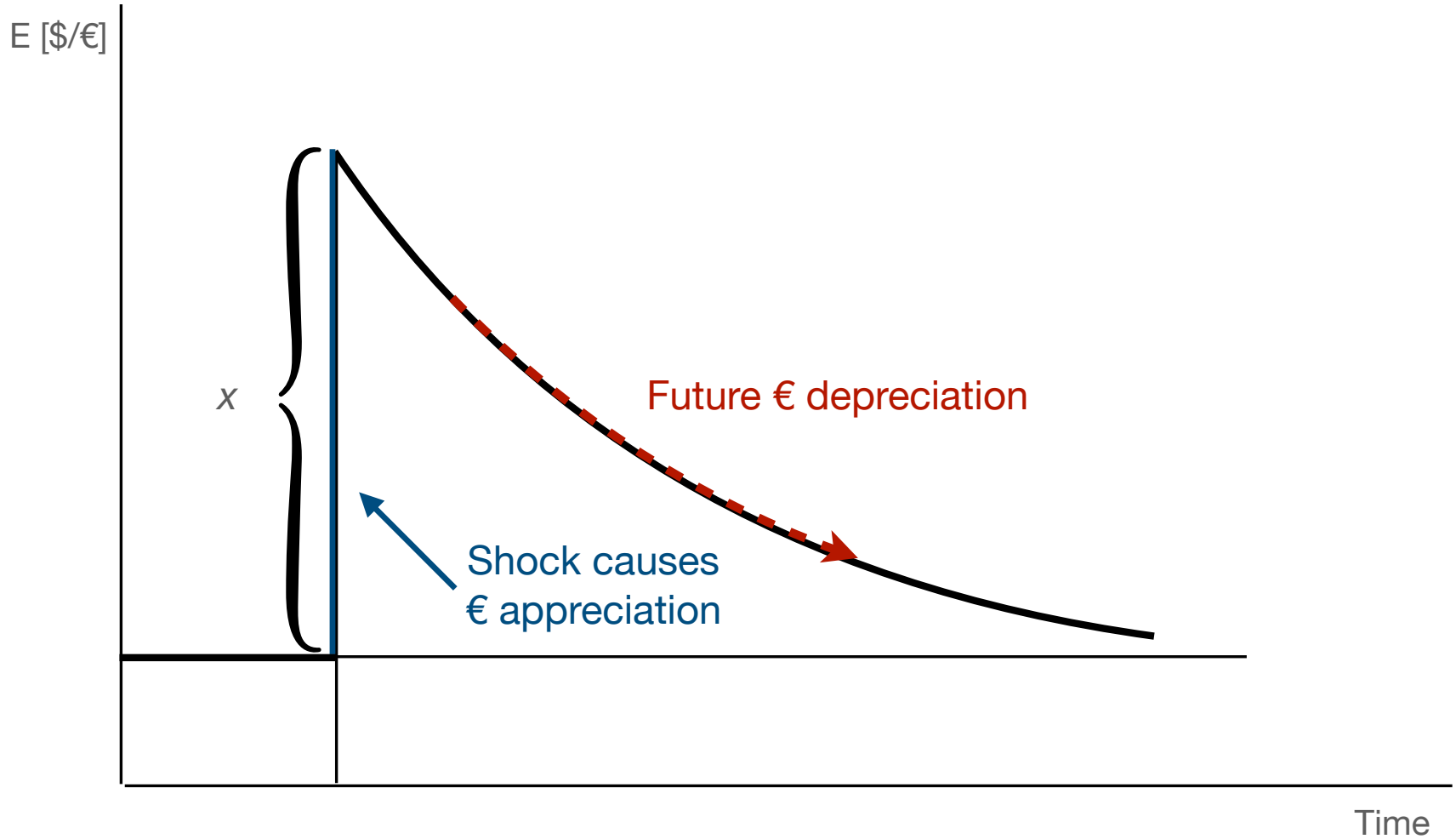
$$E(t) = E(t+1)\frac{1+i_{¥}-RP_{¥}}{1+i_{\$}} \tag{9}$$

Example

Today: $i_{\$} = i_{¥} = 10$ pct and $E(t) = 1$ [\$/¥]
No risk premium.
UIP: Investors must expect E to remain constant
Shock: ¥ interest rate rises to 15%
Key assumption: No change in $E(t+1)$!

Result:

Is the ¥ strong when the interest rate is high?



x is the expected depreciation of the ¥

Is the ¥ strong when the interest rate is high?

Key point

A rise in the ¥ interest rate leads to ¥ **appreciation**.
A high ¥ interest rates means that investors expect a ¥ **depreciation** in the future.

Expectations Matter

Fact

UIP determines $E(t)$ only relative to the future $E(t+1)$.

Changes in expectations about $E(t+1)$ are reflected immediately in the spot rate.

Possibility of self-fulfilling prophecies

- Without an anchor to pin down the long-run exchange rate, any E can be an equilibrium
- Mean-reversion to PPP (purchasing power parity) provides an anchor, but it is weak.
- This is generally true for asset prices.
- This is one reason why asset prices are so volatile.

Floating Exchange Rate Model

Model

IS:

$$Y = C(Y-T) + I(Y,i) + G + NX\left(Y, Y^*, \frac{P}{EP^*}\right) \tag{10}$$

LM:

$$M/P = Y \times L(i) \tag{11}$$

AS:

$$Y = F\left(\frac{P}{P^e}\frac{1}{1+m}, z\right) \tag{12}$$

UIP:

$$E = E^e \frac{1+i^*}{1+i} \tag{13}$$

Endogenous: Y, P, i, E

Some Comments

1. **LM** is unchanged: we assume that only locals hold currency.
2. We assume that currency depreciation improves the trade balance.
3. What differs compared with fixed exchange rates?
   M is now controlled by the Central Bank (exogenous).
   UIP takes the place of $i = i^*$ for FX market clearing.

Simplified Equilibrium

The model is hard to analyze graphically (4 equations in 4 variables)

Next step: simplify into two equations that we can plot.

Step 1: Substitute UIP into IS:

$$Y = C(Y-T) + I(Y,i) + G + NX\left(Y, Y^*, \frac{1+i}{1+i^*}\frac{P}{E^e P^*}\right) \qquad (14)$$

Intuition: higher i implies dollar appreciation and lower trade balance.

Simplified Equilibrium

Step 2: Use LM to substitute out i:

- LM implies a positive relationship between i and P:

$$L(i) = \frac{M}{PY} \tag{15}$$

- Intuition: Higher prices reduce money supply.

Write as

$$i = \hat{L}\left(\frac{M}{PY}\right) \tag{16}$$

- where $\hat{L}$ is downward sloping
- so that i and P are again positively related

Substitute into IS:

$$Y = C(Y-T) + I\left(Y, \hat{L}\left(\frac{M}{PY}\right)\right) + G + NX\left(Y, Y^*, \frac{P}{E^e P^*}\frac{1+\hat{L}\left(\frac{M}{PY}\right)}{1+i^*}\right)$$

Simplified Equilibrium

$$Y = C(Y-T) + I\left(Y, \hat{L}\left(\frac{M}{PY}\right)\right) + G + NX\left(Y, Y^*, \frac{P}{E^e P^*}\frac{1+\hat{L}\left(\frac{M}{PY}\right)}{1+i^*}\right)$$

This is basically a downward sloping AD curve.

To see this: $P\uparrow \Longrightarrow i\uparrow \Longrightarrow$

1. $I\downarrow$
2. dollar appreciation $\Longrightarrow NX\downarrow$

Note: I am ignoring the complication that Y appears inside of $\hat{L}$ for simplicity.

Simplified Equilibrium

AS:

$$Y = F\left(\frac{P}{P^e}\frac{1}{1+m}, z\right) \tag{17}$$

AD:

$$Y = Y^D\left(P; T, G, M, Y^*, i^*, E^e\right) \tag{18}$$

where AD contains IS, LM, and UIP.

Endogenous: Y, P

What shifts AD?

$$Y = C(Y-T) + I\left(Y, \hat{L}\left(\frac{M}{PY}\right)\right) + G + NX\left(Y, Y^*, \frac{P}{E^e P^*}\frac{1+\hat{L}\left(\frac{M}{PY}\right)}{1+i^*}\right)$$

Fiscal policy: $G \uparrow$ or $T \downarrow$ increase AD directly.

Monetary policy: $M \uparrow$ shifts AD up (higher P for given Y)

- only M/P matters

Foreign expansion: $NX \uparrow$ shifts AD right.

Higher foreign interest rate: shifts AD right

- tricky math...
- intuition: dollar depreciates $\Longrightarrow NX \uparrow$

Policy Analysis

Fiscal Policy Shock

The analysis of $G \uparrow$ looks like a closed economy.

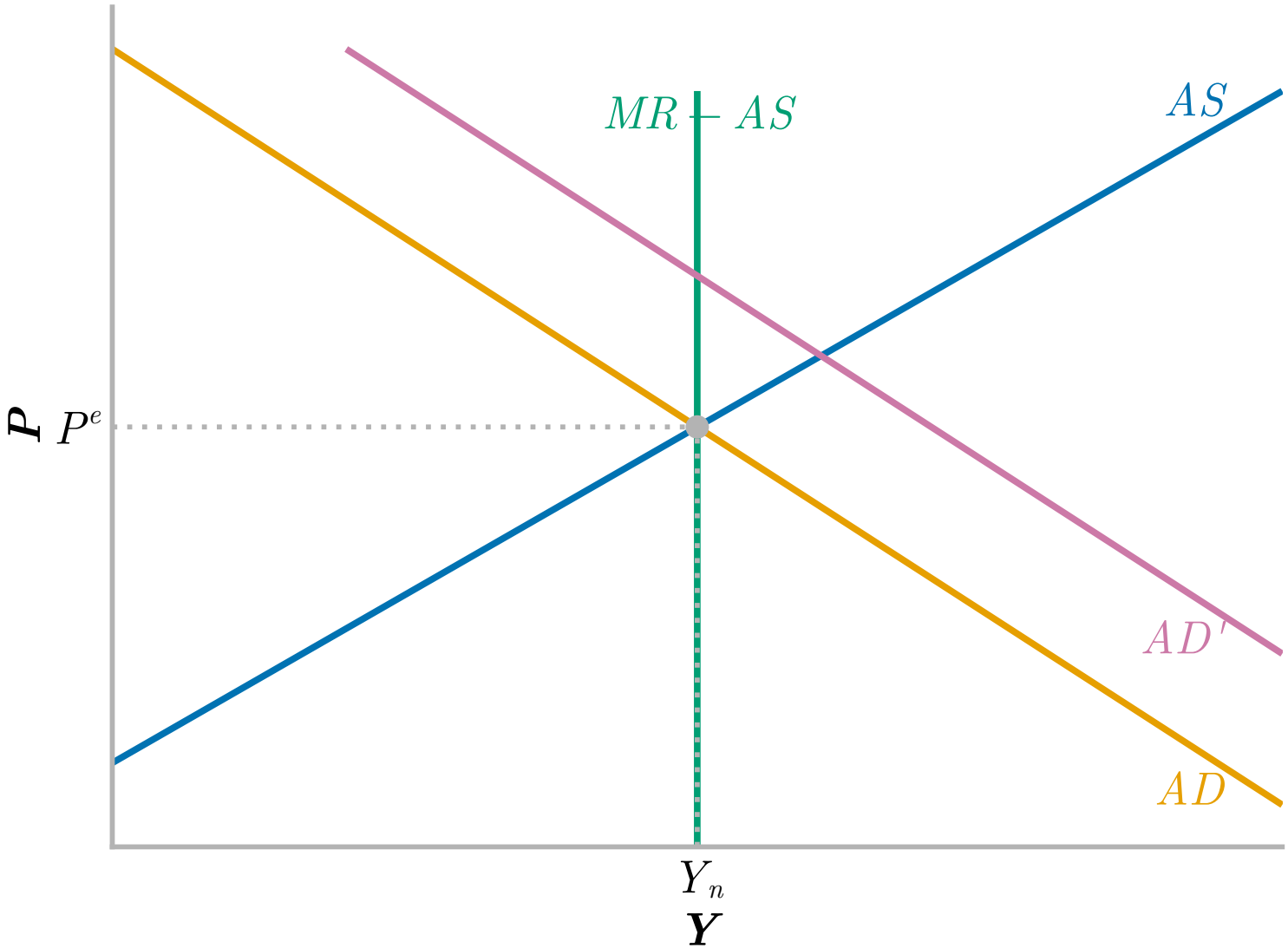
- AD shifts right.

SR: higher Y and P.

- Therefore lower NX

MR: unchanged Y and higher P

Fiscal Policy Shock



Fiscal Shock: Medium Run

Unchanged Y and higher P.

- $C(Y-T)$ unchanged.

Higher P implies higher $i = \hat{L}\left(\frac{M}{PY}\right)$

- $I(Y,i)\downarrow$
- UIP: dollar appreciates $(i\uparrow = i^* + x\downarrow)$.

Therefore lower NX.

Full crowding out:

- $Y = C + I\downarrow + G\uparrow + NX\downarrow$

Fiscal Shock: Short Run

Higher Y and higher P.

Money market implies higher i: $(M/P)\downarrow = Y\uparrow \times L(i\uparrow)$

UIP: dollar appreciates $(i\uparrow = i^* + x\downarrow)$

- Therefore $NX\downarrow$ (income and substitution effects)

$I(Y,i)$ change is ambiguous

Fiscal policy works. Some AD spills over to the foreign country.

Tariffs

Tariff: improves NX holding everything else equal

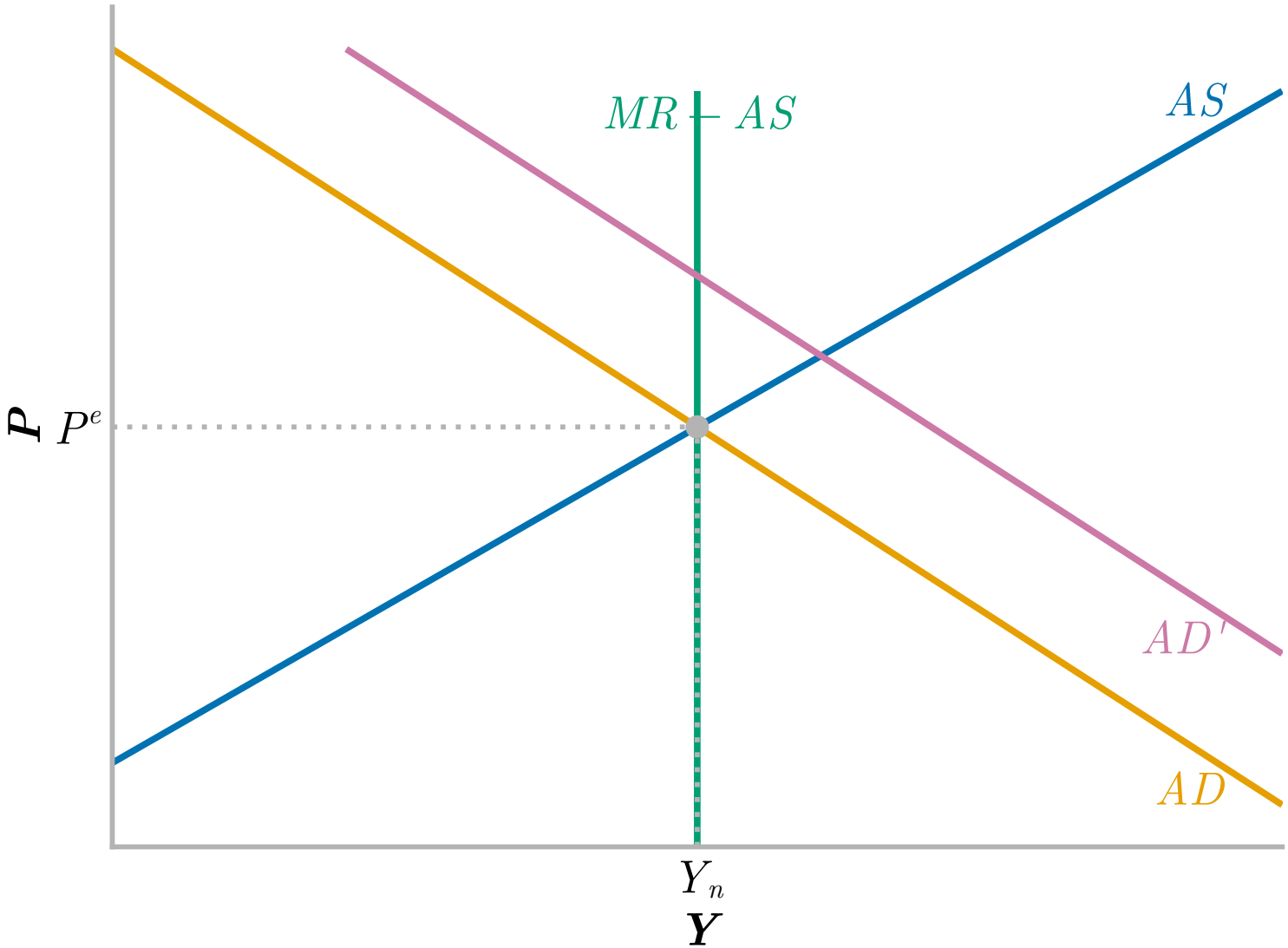
- right shift in AD

Short run: $Y \uparrow$, $P \uparrow$

Medium run: Y unchanged, $P \uparrow$

- graph looks like fiscal shock

Tariffs



Tariff: Medium Run

Money market: $i \uparrow$ because $(M/P) \downarrow = Y \times L(i \uparrow)$

- Therefore $I(Y, i) \downarrow$
- UIP: dollar appreciates.

Trade balance improves: $Y = C + I \downarrow + G + NX \uparrow$

- But the result is artificial.
- If the Fed keeps i at target, I unchanged and NX unchanged.
- Intuition?

Tariff: Short run

- Higher Y and P
  - move along AS
- $M/P = Y \times L(i) \implies i \uparrow \implies$ dollar appreciation

NX improves (that's the shock)

- but again NX/Y not clear

Summary

Qualitatively, floating exchange rates look a lot like a closed economy

Medium run is also similar to fixed exchange rates.

Price adjustments mimic exchange rate adjustments.

Tariffs may improve NX in the short run.

But in the medium run, NX is determined by saving and investment decisions.

Reading

Blanchard / Johnson, Macroeconomics, 6th ed., ch. 21

Explanations of UIP:

- Investopedia
- The Balance

Additional reading:

- Jones, Macroeconomics, ch. 15.