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:

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?

How does FX market clearing work with floating exchange rates?

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

Definition

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

Basic idea:

1. Start from $i = i^*$. Investors hold either currency.
2. Suppose $i \uparrow$ so that $i > i^*$.
3. Investors move capital into the home markets
   They buy domestic bonds.
4. Capital flows continue until both currencies offer the same rate of return.

When do capital flows stop?

Capital flows stop when both currencies offer **the same rate of return**.

How do returns get equalized?

1. **Interest rates may change.**
   Investors buy home bonds $\Longrightarrow i \downarrow$
   They sell foreign bonds $\Longrightarrow i^* \uparrow$
   Until $i = i^*$ holds again.
2. **Exchange rates adjust.**
   Investors bid up the value of the home currency.
   Higher dollar value **may** imply that dollar depreciates in the future.
   Depreciation implies capital losses for investors.
   Home country rate of return falls below i.

Our model has the second channel (not the first).

UIP Math

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

Return of holding FX:

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

Equal returns:

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

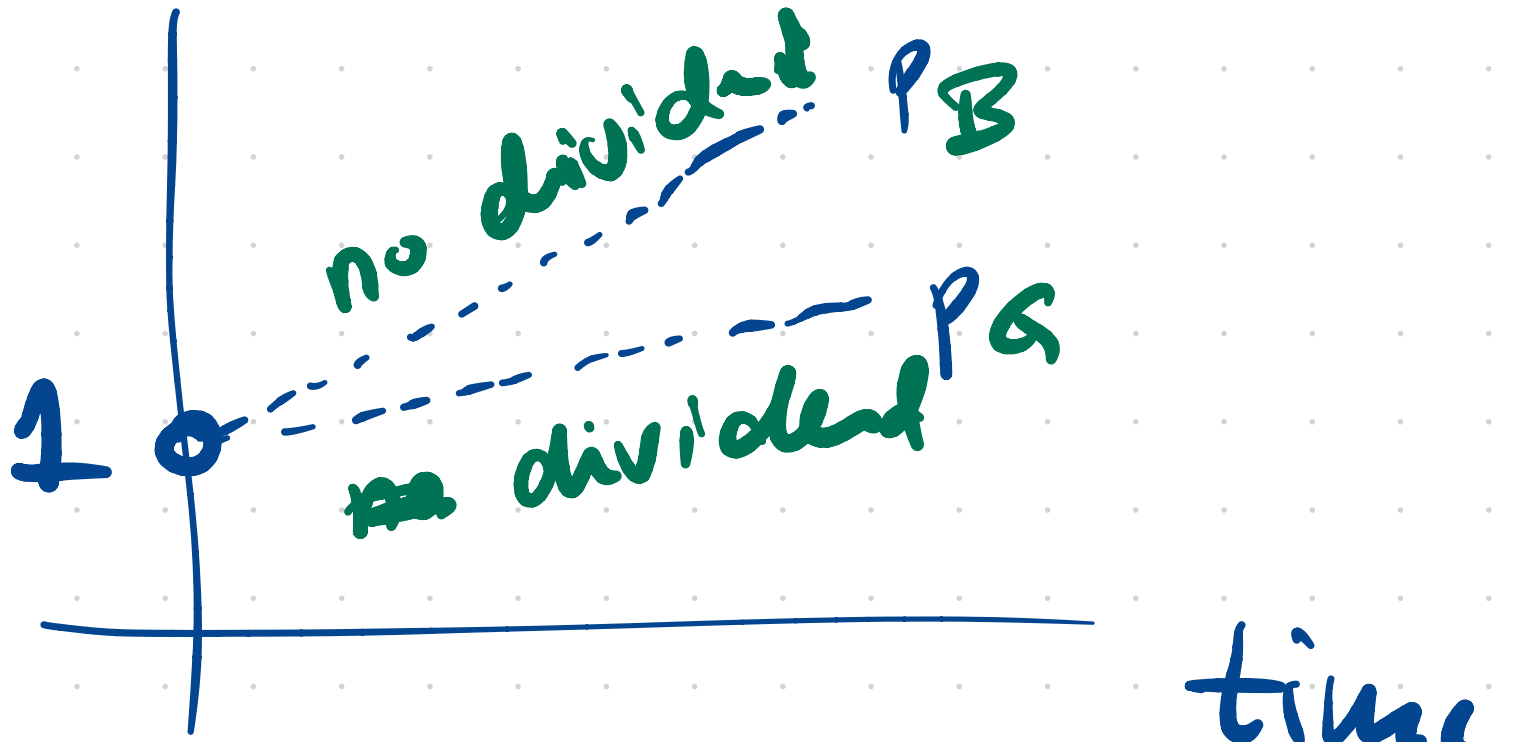
or (approximately)

$$i_{\$} = i_{¥} + x \tag{2}$$

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

Blue : no dividend; P_B

Green : dividend; P_G



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 $i_{\$} = i_{¥} + x$.

E(t+1) ↑ by 5%

E(t) = E(t+1)

Need $x = 0$

same

$i_{\$} = i_{¥} + x$

Implications

If we see that a currency pays higher interest, should investors expect it to appreciate or depreciate in the future?

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

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

$ appreciation
¥ depreciation

$-x$ is the rate of dollar appreciation.

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: Which common "asset" has high payout volatility and negative 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 when you are already rich (stocks).
(Better than) Safe assets pay 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 [$E(t) \uparrow$] when:

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

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.

Sell ¥ ⇒ E(t) ↓

IF E(t+1) fixed, then: ¥ expected to appreciate

Is the ¥ strong when the interest rate is high?

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

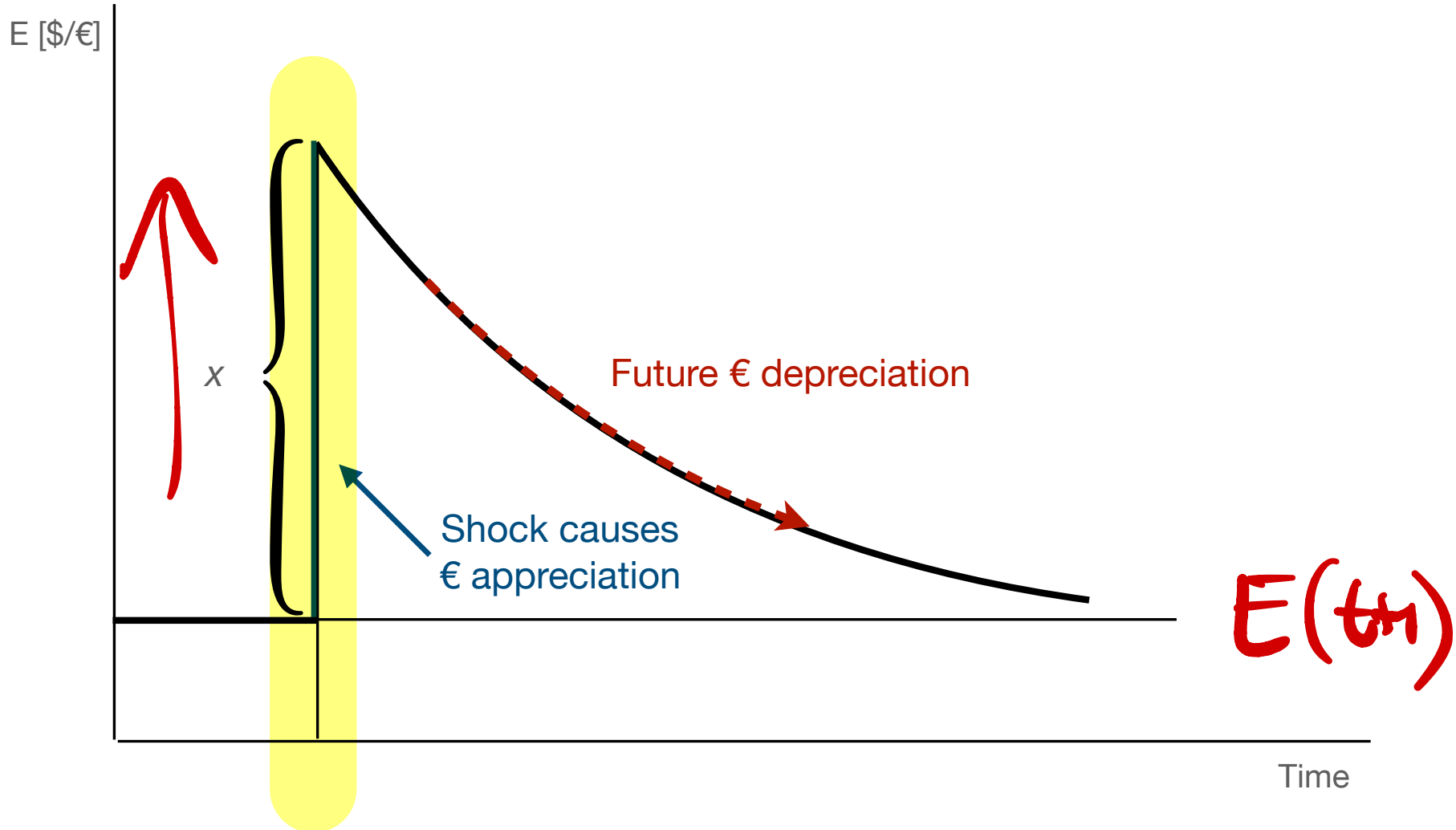
Example

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: When $i_{¥}$ ↑ : $E(t)$ ↑

While $i_{¥}$ high: E ↓ over time

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.

$$E(t) = E(t+1) \cdot \frac{1 + i^{\$} - e^{\$}}{1 + i}$$

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

Comments

What differs compared with fixed exchange rates?

1. M is now controlled by the Central Bank (exogenous).
2. UIP takes the place of $i = i^*$ for FX market clearing.

The model is hard to analyze graphically

- 4 equations in 4 variables

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

Simplified Equilibrium

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.

Now E is eliminated from the model.

We have

- 3 equations: IS, LM, AS
- 3 unknowns: Y, P, i

Simplified Equilibrium

Step 2: Use LM to substitute out i.

LM implies a positive relationship between i and P:

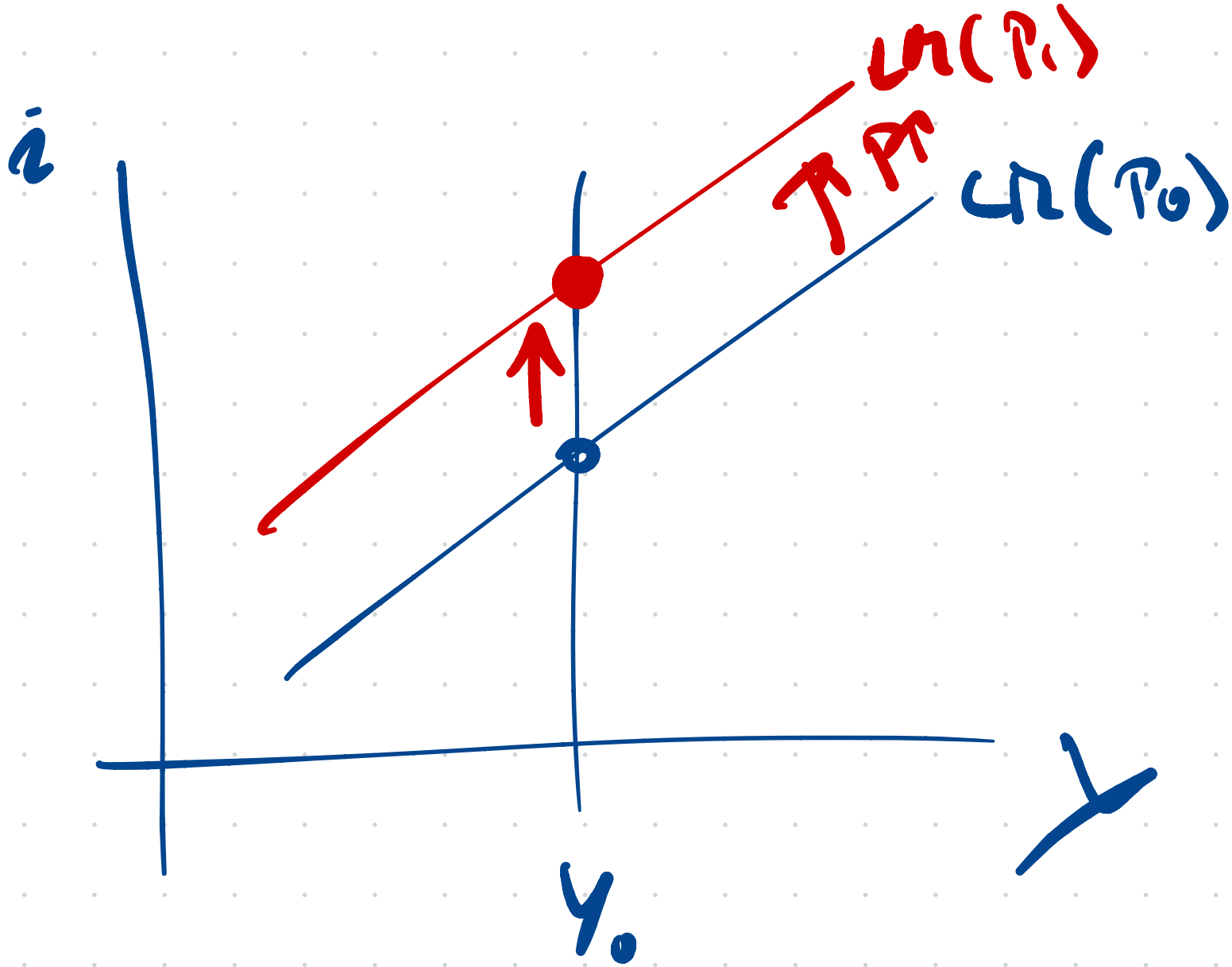
$$L(i) = \frac{M}{PY} \tag{15}$$

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


i
LM(P1)
↑P
LM(P0)
Y
Y0

Simplified Equilibrium

Substitute into IS:

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

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.

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

$P \uparrow$

(1) Direct effect $NX \downarrow$

(2) Via i: $i \uparrow$

\$ appreciates

$NX \downarrow$

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
- higher M/P lowers i
- channels: investment and currency depreciation

What shifts AD?

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

Foreign expansion: $Y^* \uparrow$

- $NX \uparrow$ shifts AD right.

Foreign interest rate:

- higher i^* shifts AD right
- tricky math...
- intuition: dollar depreciates $\implies NX \uparrow$

Policy Analysis

Fiscal Policy Shock

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

- AD shifts right.

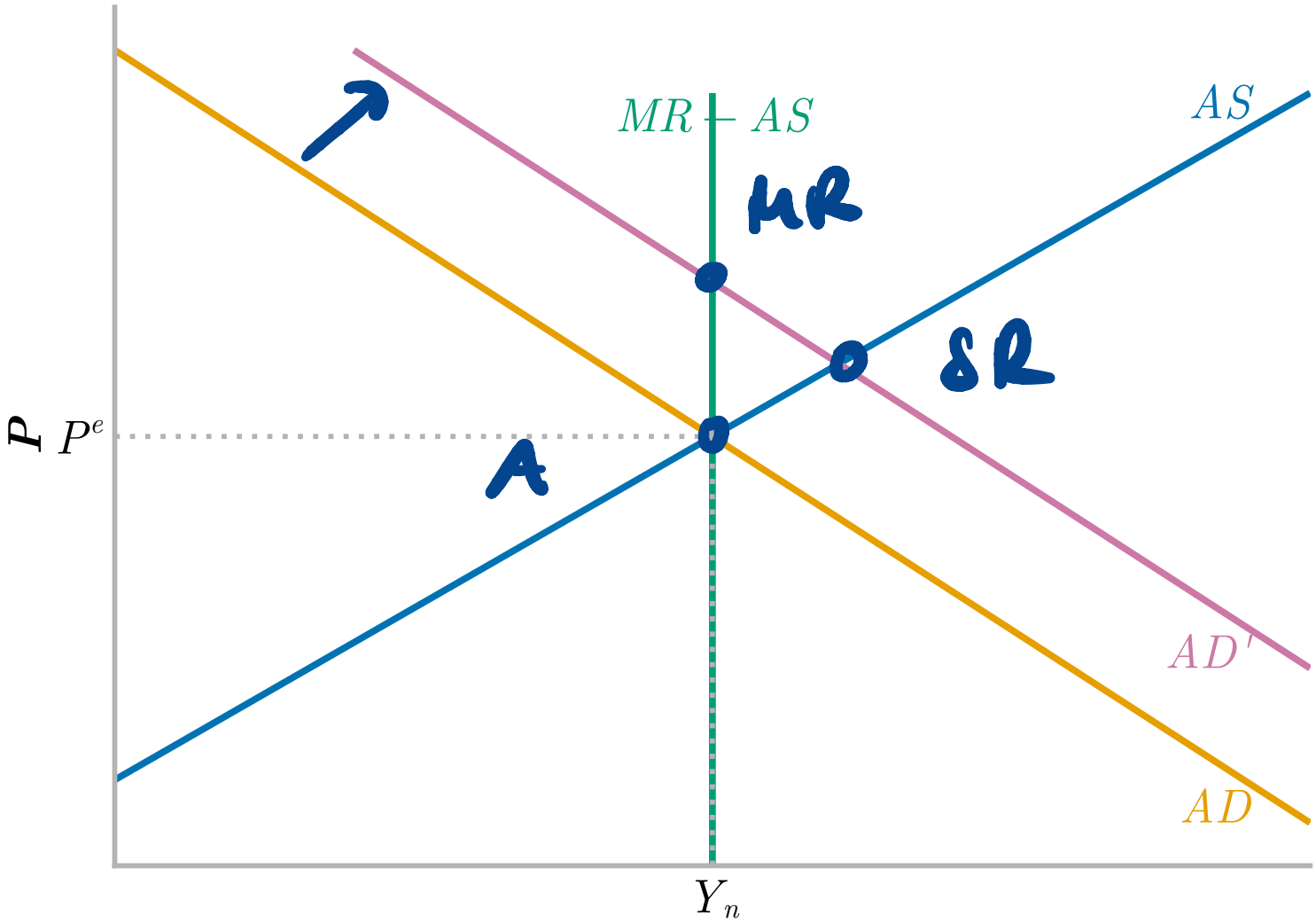
SR: higher Y and P.

- Therefore lower NX

MR: unchanged Y and higher P

Fiscal Policy Shock

G↑



MR
Y−
P↑
C−
G↑
I↓
i↑

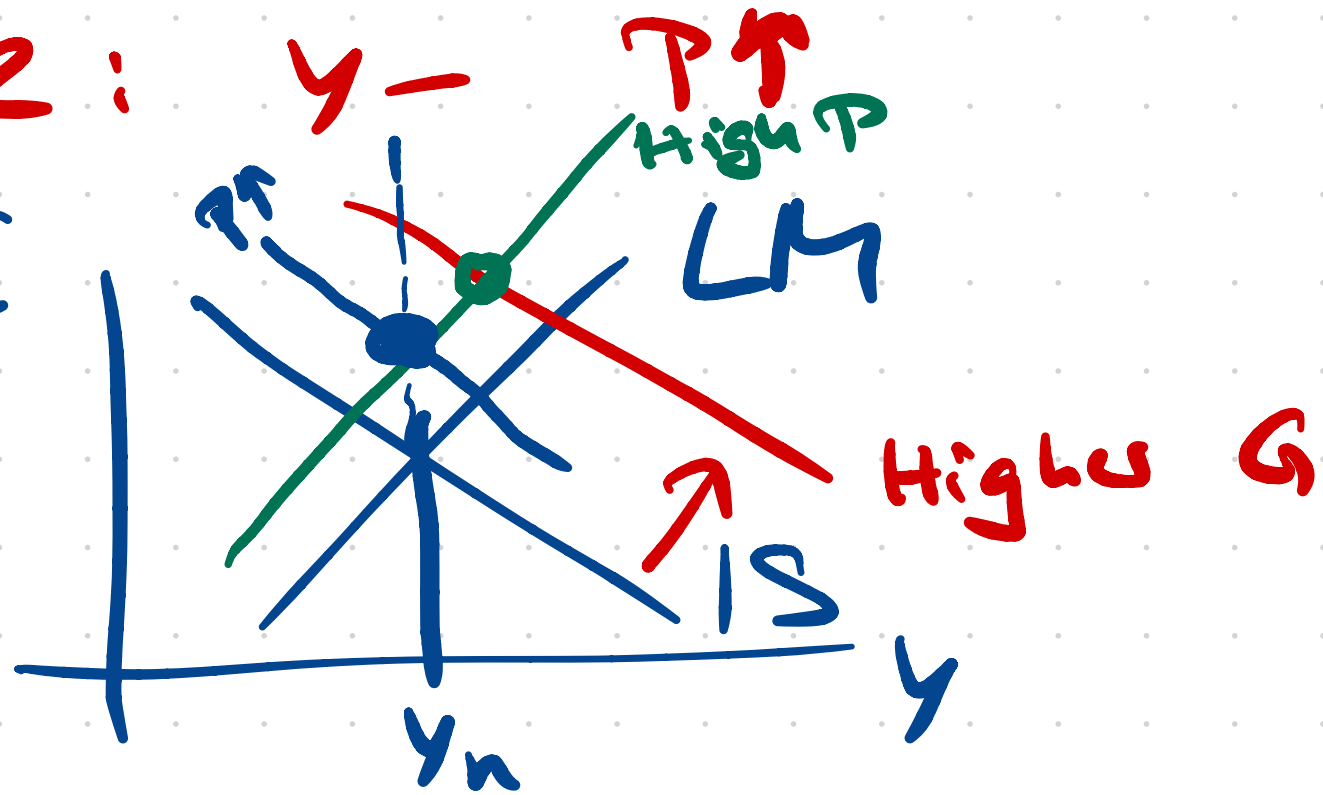
NX : $\bar{Y} = \bar{C} + I + G + NX$

G↑ : Interest rate

① $\frac{M}{P} = Y \cdot L(i)$ ⇒ i↑

↓ —

MR : Y− P↑

② 

NR: $NX\left(Y, Y^*, \frac{P}{E^e P^*}, \frac{1+i}{1+i^*}\right)$

Y —

$P \uparrow \Rightarrow NX \downarrow$

$i \uparrow \Rightarrow NX \downarrow$

($ appreciates)

Short Run

$Y \uparrow \quad P \uparrow$

$C \uparrow$

$i = L\left(\frac{M}{PY}\right)$ $\quad i \uparrow$

or $\frac{M}{P} = Y \cdot L(i)$

$I(Y, i)$?

$NX\left(Y, Y^*, \frac{P}{EP^*}, \frac{1+i}{1+i^*}\right)$ $\downarrow$

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

same as $P^* \uparrow$

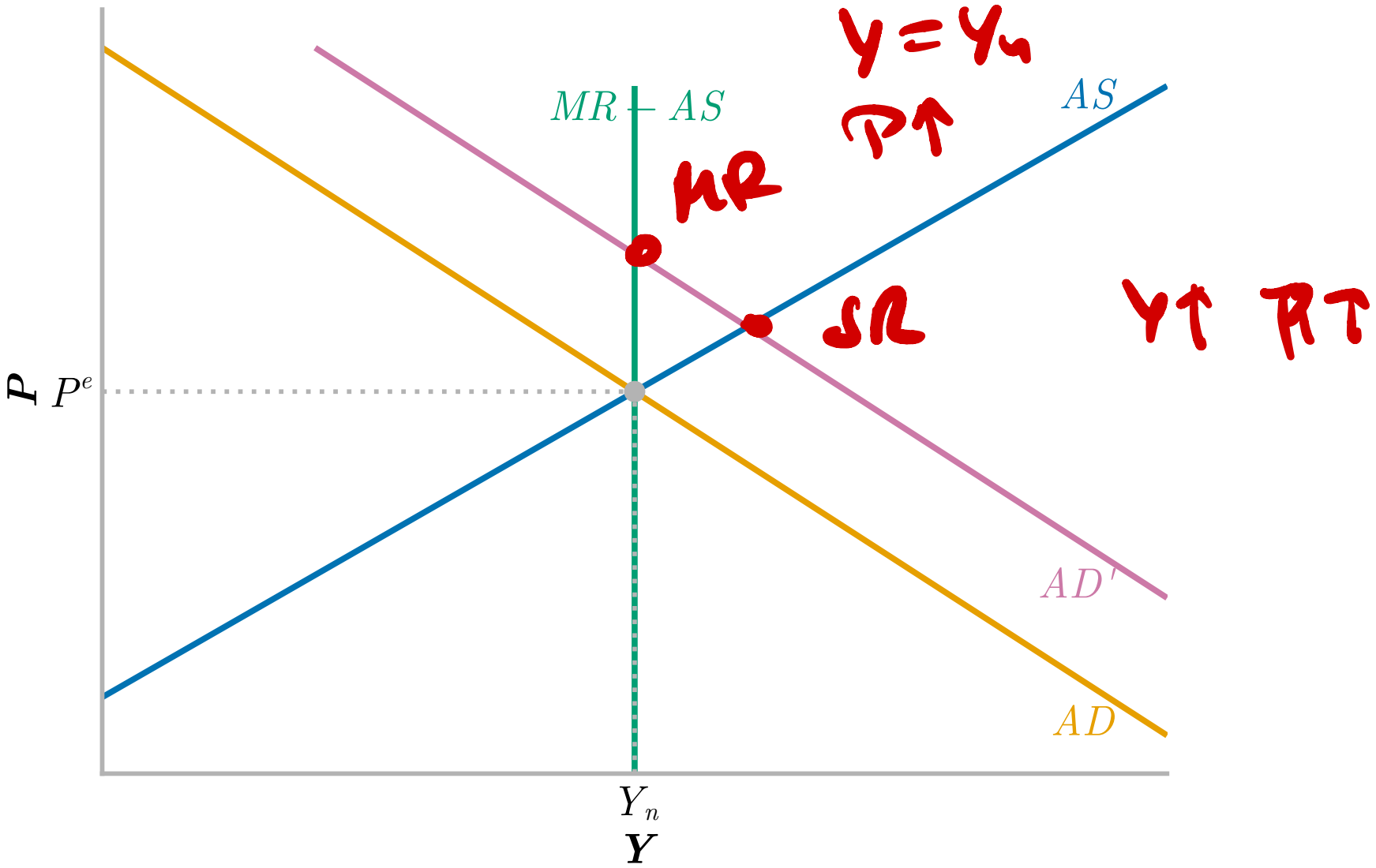
Short run: $Y \uparrow$, $P \uparrow$

Medium run: Y unchanged, $P \uparrow$

- graph looks like fiscal shock

$$NX\left(Y, Y^*, \frac{P}{EP^*}, \frac{1+i}{1+i^*}\right)$$

Tariffs



Tariffs : MR

Y— P↑

C—

i ↑ (same as G↑)

$i = \uparrow L\left(\frac{M}{PY}\right)$

I ↓

$\bar{Y} = \bar{C} + \underset{\downarrow}{I} + \bar{G} + \underset{\uparrow}{NX}$

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 probably not in the way policy makers expect.
- Tariffs "work" because they hit I.

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)

Why do tariffs "work" here?

- Because they raise i which crowds out I
- But that result is artificial.

More realistic: the Fed adjusts M to hold i constant.

Tariff: Interest rate target

Then in MR:

- $Y = Y_n$ from MR-AS
- $I(Y, i)$ unchanged (b/c i fixed)
- NX unchanged (b/c Y, C, I, G all unchanged)

Intuition:

To hold i constant, Fed has to raise M (and thus P) until the real exchange rate returns to pre-tariff levels

(the tariff inclusive price of foreign goods remains unchanged)

Conclusion: Tariffs have no clear effect on the trade balance.

Concerns about trade

Trade is very unpopular these days.

Commentators worry that

- imports **cost jobs**
- trade with low wage countries **reduces wages**
- domestic **regulations** (environmental, worker safety, etc) cause U.S. firms to lose competitiveness

What does our model have to say about these concerns?

Does trade cost jobs?

"While growing exports tend to support domestic employment, growing imports costs jobs and reduces domestic output. Thus, the size and growth of trade deficits is strongly correlated with trade-related job loss." – Robert Scott, NY Times, 2016

What does the AS/AD model have to say about this claim?

Model $Y_n = F\left(\frac{1}{1+m}, Z\right)$

Does trade lower wages?

> *"Companies that produce goods in foreign countries to take advantage of cheap labor should not be permitted to* ***dictate the wages*** *paid to American workers." – Philadelphia Inquirer, 1996*

Does trade with low wage countries force the U.S. to lower wages?

What does the model say?

$$NX\left(Y, Y^*, \frac{P}{1E^eP^*}, \frac{1+i}{1+i^*}\right)$$

Does regulation makes us not competitive

> *Each nation is "like a big corporation competing in the global marketplace" - President Clinton*

What is the difference between a company and a country?

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.