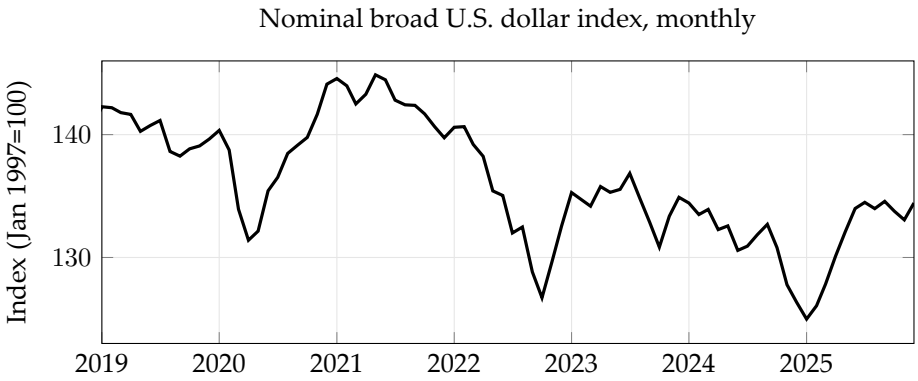
ECON 1550: International Finance

A Tour of the Class

What is International Finance?

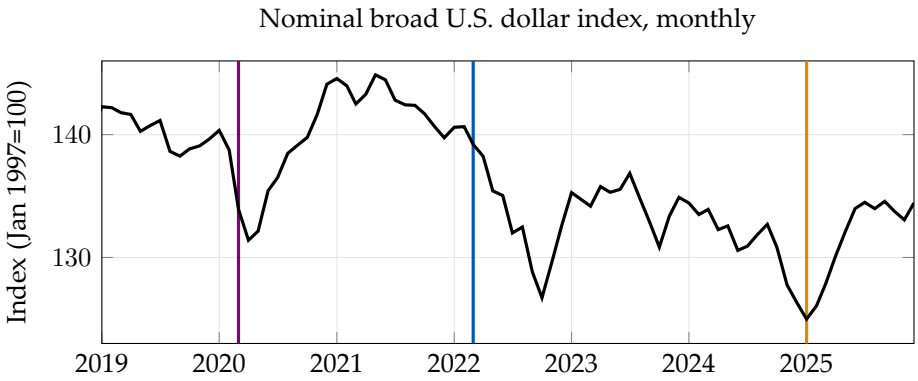
- Extension of Intermediate Macro to open economies
- Open economies:
  - Imports and Exports
  - $Y = C + I + G$ becomes $Y = C + I + G + EX - IM$
- Why finance?
  - Exports and imports must be paid for!
  - If a country imports more than it exports, it must issue IOUs
  - IOUs are *financial assets*
  - $EX - IM$ = change in net foreign wealth

Dollar Exchange Rate: 2019–present



Source: Board of Governors of the Federal Reserve System (US) via FRED (TWEXBMTH and TWEXBGSMTH, spliced).

Dollar Exchange Rate: 2019–present



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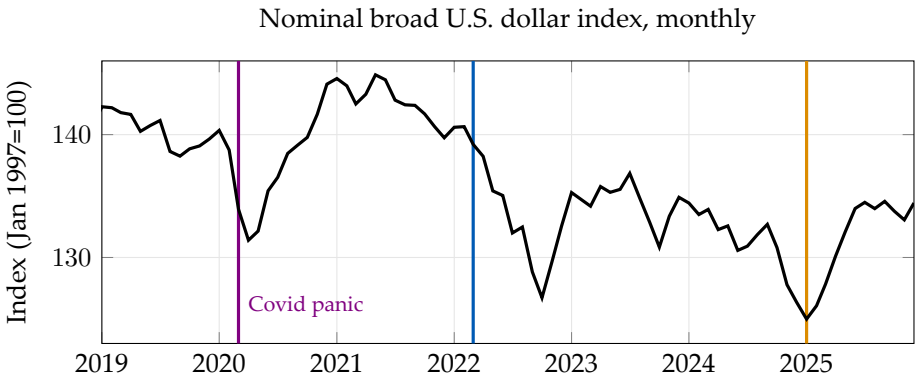
Dollar Exchange Rate: 2019–present



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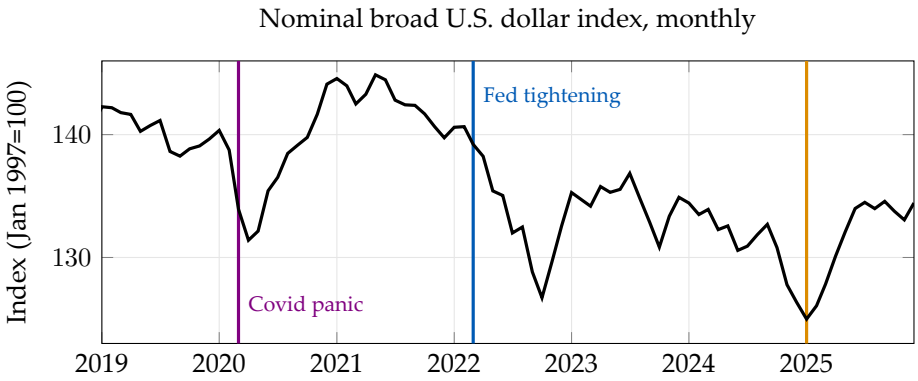
Dollar Exchange Rate: 2019–present



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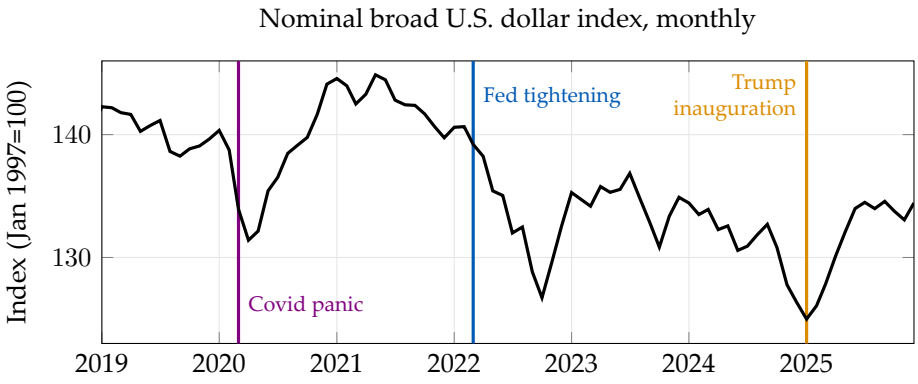
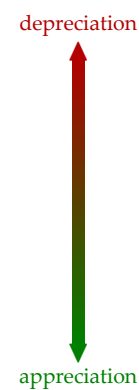
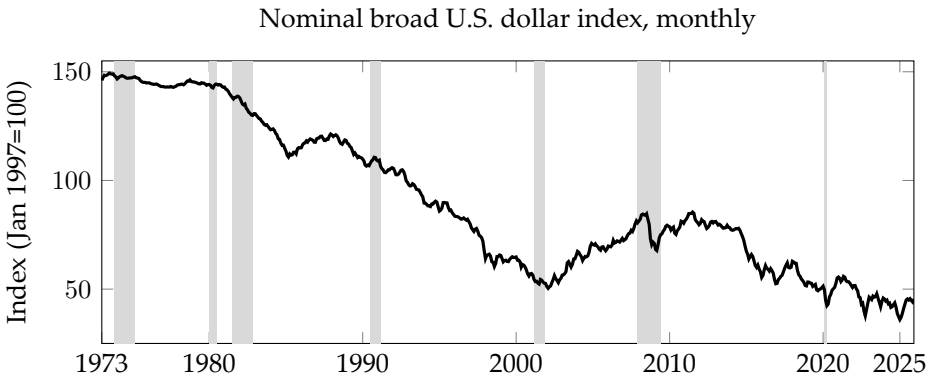
Dollar Exchange Rate: 2019–present





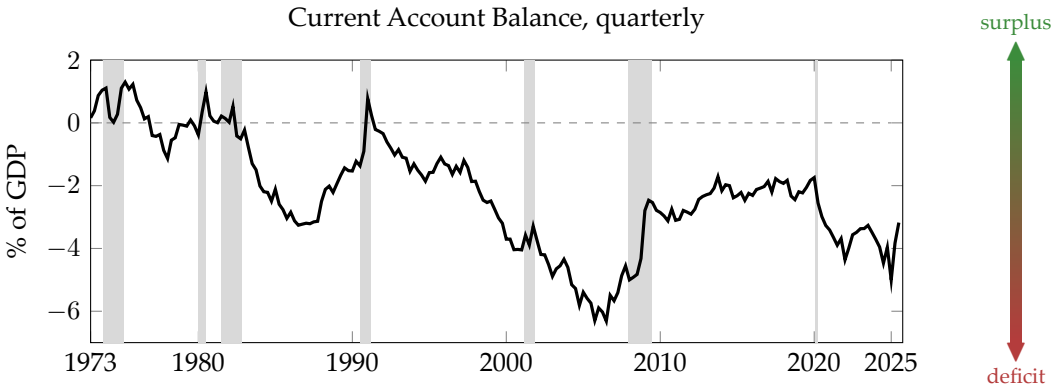
Source: Board of Governors of the Federal Reserve System (US) via FRED (TWEXBMTH and TWEXBGSMTH, spliced).

Dollar Exchange Rate: 1973–present

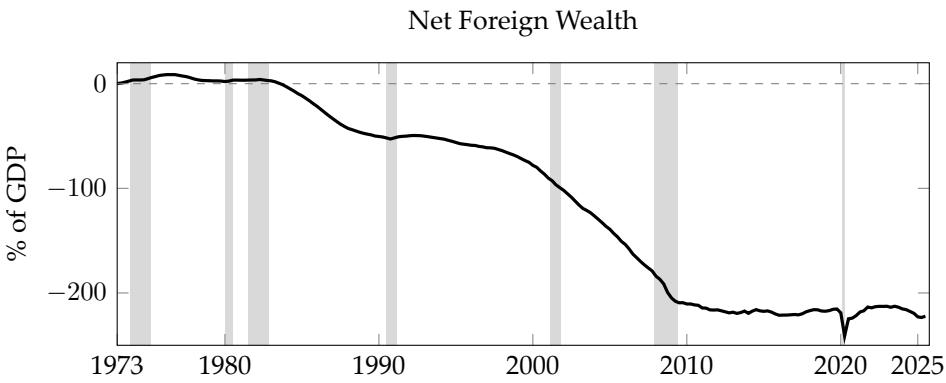


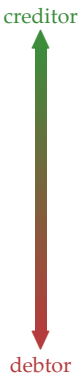
Source: Board of Governors of the Federal Reserve System (US) via FRED (TWEXBMTH and TWEXBGSMTH, spliced).

U.S. Current Account Balance: 1973–present



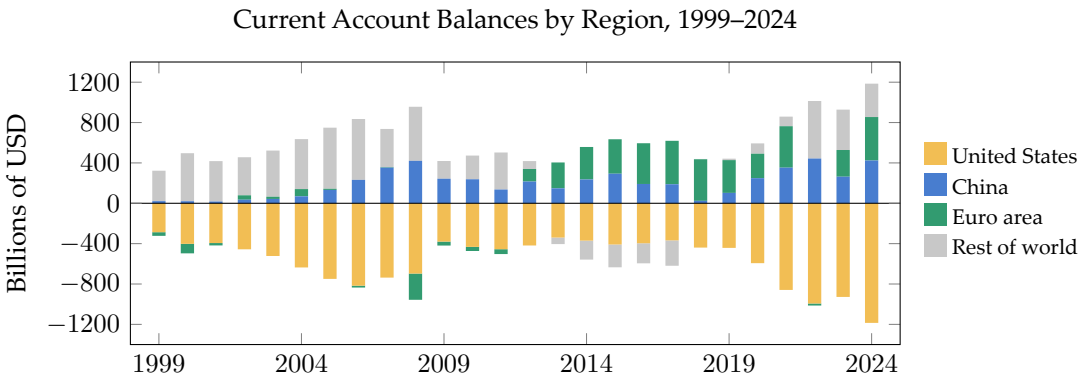
Net Foreign Wealth





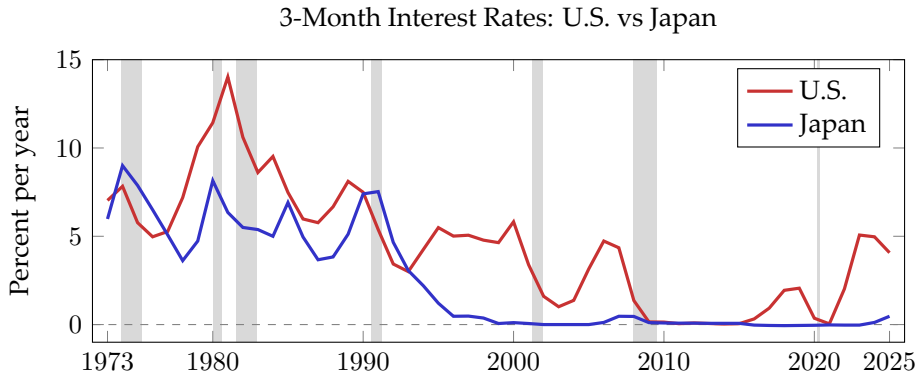
Source: BEA via FRED (NETFI, GDP). Constructed NFW = cumulative current account / GDP.

Global External Imbalances



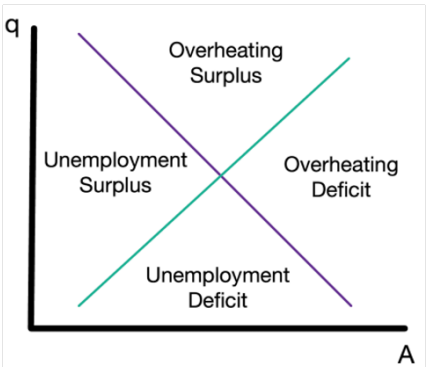
Source: IMF DataMapper API, WEO, indicator BCA (current account balance, billions USD). Rest of world = residual to balance global accounts.

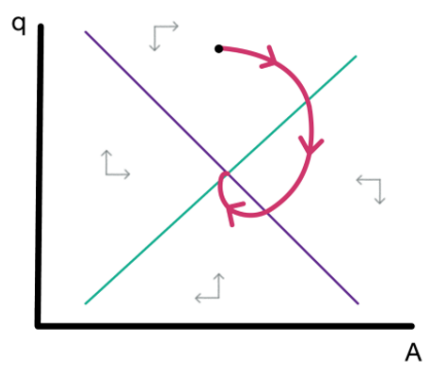
Large Interest Rate Differentials



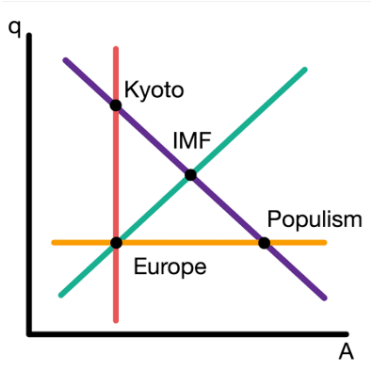
Source: FRED. US: TB3MS (3-month T-bill). Japan: IRSTCB01JPM156N (central bank rate, 1973–84), IRSTCI01JPM156N (call money rate, 1985–present). Annual averages.

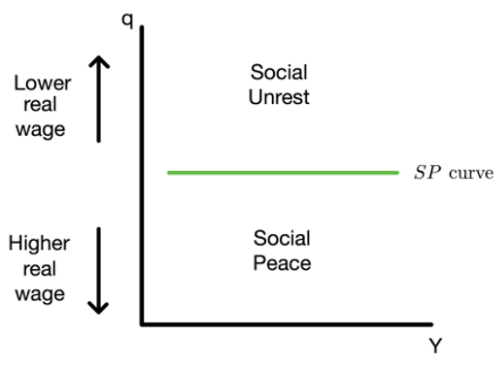
Exchange Rate Dynamics





Policy Trade-offs





Takeaways

- **To remember:** International finance connects exchange rates, trade balances, interest rates, and policy choices
- **To do for Friday:**
  - Read the note “Models in Economics”
  - Complete the “Getting Started” module on Canvas

ECON 1550: International Finance

Models in Economics

Bottom line to remember

"All models are wrong, some models are useful"

Example: Uncovered Interest Parity (UIP)

$$R_{\$} = R_{¥} + \frac{E^e_{\$/¥} - E_{\$/¥}}{E_{\$/¥}}$$

- Does not fit the data well
- We can still use it to determine $E_{\$/¥}$ given $R_{\$}$, $R_{¥}$, and $E^e_{\$/¥}$
- Combined with goods and money market equilibrium, we can understand (some or all) effects of monetary policy on $E_{\$/¥}$

Example: UIP (continued)

$$R_{\$} = R_{¥} + \frac{E^{e}_{\$/¥} - E_{\$/¥}}{E_{\$/¥}} + rp$$

- How much did we miss? Add an error term and call it **risk premium**
- If rp is independent of monetary policy, we did not miss anything
- If rp depends on monetary policy, we still captured one channel

Types of Variables

Endogenous

- Explained within the model

Exogenous

- Taken as given
- Not explained by the model

Parameters

- Exogenous; do not depend on policy

Types of Equations

Identities	• Hold by definition or construction
Behavioral	• Capture behavior that we include in a model • Hold by assumption
Equilibrium conditions	• Supply equals demand • Hold by “economic logic”

Solving a Model, Solving for a Variable

- "Solving for a variable" means expressing that variable in terms of exogenous variables only
- "Solving a model" means solving for all endogenous variables

Example 1

Exogenous variables

Variable	Description
T	taxes
Y	income
c_1	marginal propensity to consume

Endogenous variables

Variable	Description	Equation	Type of equation
C	consumption	$C = c_1 Y_D$	behavioral
Y_D	disposable income	$Y_D \equiv Y - T$	identity

Solution and Intuition

Example 2

Exogenous variables

Variable	Description
C	consumption
Y	income
c_1	marginal propensity to consume

Endogenous variables

Variable	Description	Equation	Type of equation
T	taxes	$Y_D \equiv Y - T$	identity
Y_D	disposable income	$C = c_1 Y_D$	behavioral

Solution and Intuition

Example 2

Exogenous variables

Variable	Description
C	consumption
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Endogenous variables

Variable	Description	Equation	Type of equation
T	taxes	$Y_D \equiv Y - T$	identity
Y_D	disposable income	$C = c_1 Y_D$	behavioral

Solution and Intuition

Shocks

- Changes in exogenous variables
- Including changes in parameters
- Usually unforeseen, unforeseeable, or random

ECON 1550: International Finance

IS-LM-PC in one day

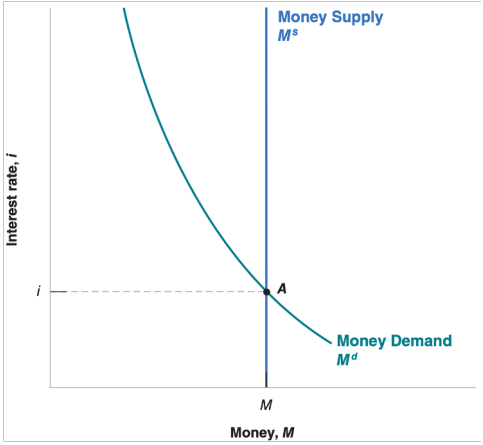
Announcements

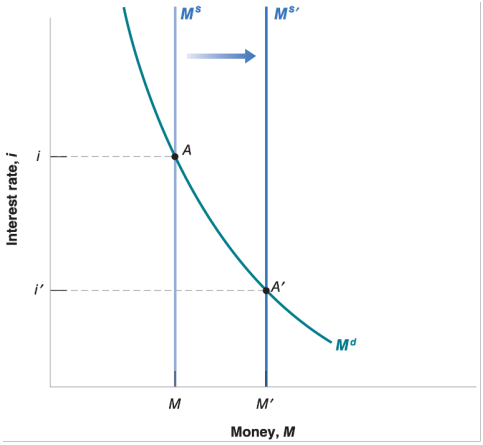
- Problem Set 1 due next Wednesday
- Read pages 13–23 of textbook before Friday lecture
- Office hours for this week on Canvas
- Section will be announced
- Review of Intermediate Macro note posted on Canvas

Agenda

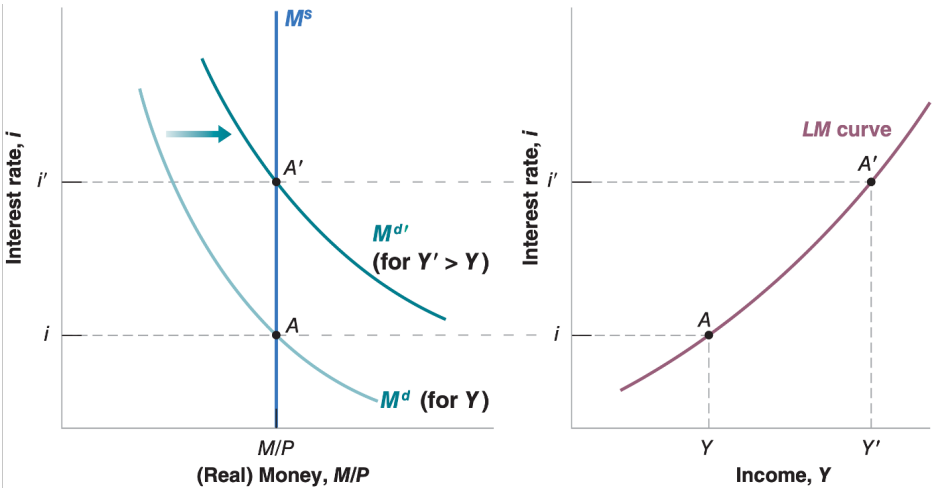
- Close loop on Tour of the class and models
- IS-LM
- IS-LM-PC

Exogenous money supply…

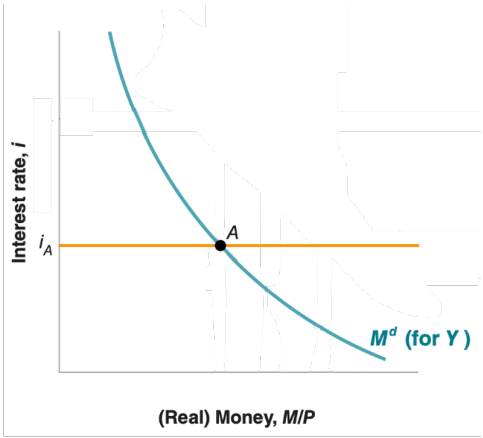


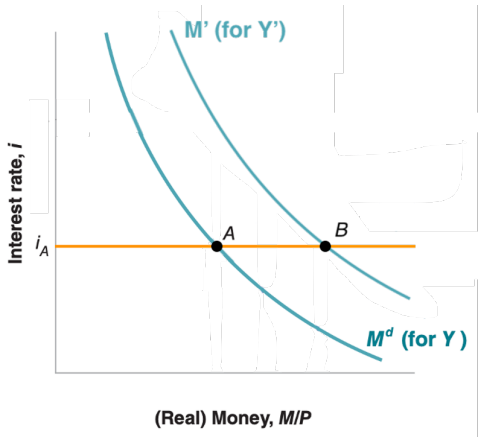


…leads to an upward sloping LM

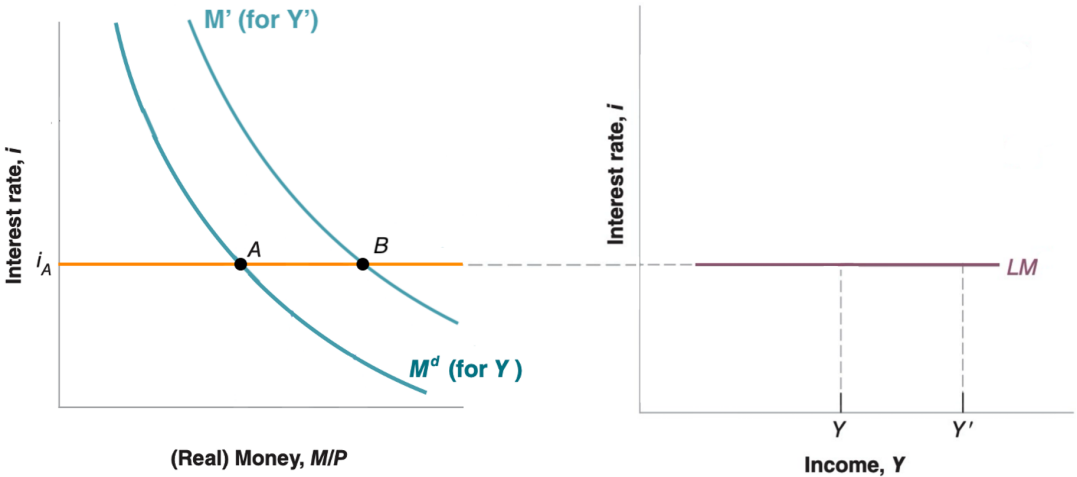


Exogenous interest rates…

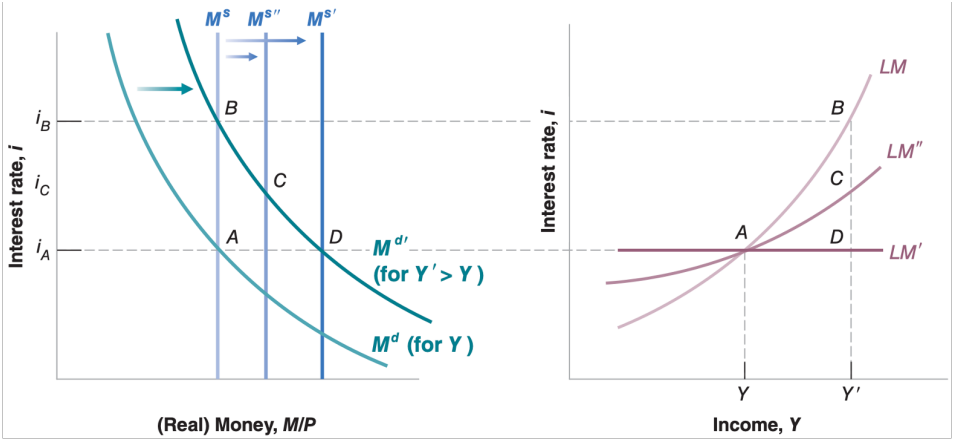




…lead to a flat LM



Endogenous Money Supply



A Model for the Labor Market

(Wage setting) $W = P^e F(u, z)$

(Price setting) $P = (1 + m)W$

(Definition of expected inflation) $\pi^e = P^e/P - 1$

(Linear function F) $F(u, z) = 1 - \alpha u + z$

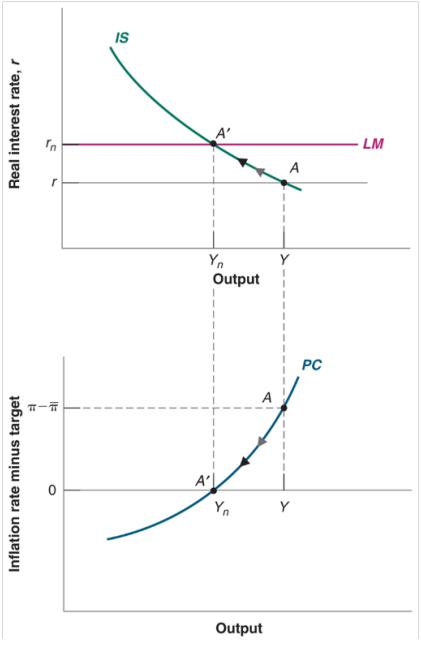
Phillips Curve

- Three equivalent forms

$$\pi = \pi^e - \alpha(u - u^n)$$

$$\pi = \pi^e + \alpha(Y - Y^n)$$

$$\pi = \pi^e + (m + z) - \alpha u$$



ECON 1550: International Finance

National Income Accounting for Open Economies

Announcements

- Problem Set 1 due today before midnight
- Solutions and Problem Set 2 posted right after
- Read pages 58–67 of textbook before Wednesday lecture
- Fill in survey for office hours and section (right now!)

Office Hours and Section Availability

Please fill in your availability:

https://www.when2meet.com/?34820140-APJfJ

Agenda

- Balance of payments account
- Exchange rate determination with asset approach

Macro Review: GDP

Gross Domestic Product (GDP) measures the total value of:

- **Production:** All final goods and services produced within a country
- **Income:** All income earned from production within a country
- **Value added:** Sum of value added at each stage of production

All three approaches yield the same number.

Closed Economy

$$Y = C + I + G$$

- All output is either consumed, invested, or purchased by government
- No trade with the rest of the world

Open Economy with GDP

$$GDP = C + I + G + \underbrace{EX - IM}_{NX}$$

- EX = Exports (domestic goods sold abroad)
- IM = Imports (foreign goods purchased domestically)
- NX = Net exports (trade balance)

GDP and GNP

- **GDP:** Value of production *within a country's borders*
  - Regardless of who owns the factors of production
- **GNP:** Value of production by *a country's residents*
  - Regardless of where production takes place
- **Relationship:**

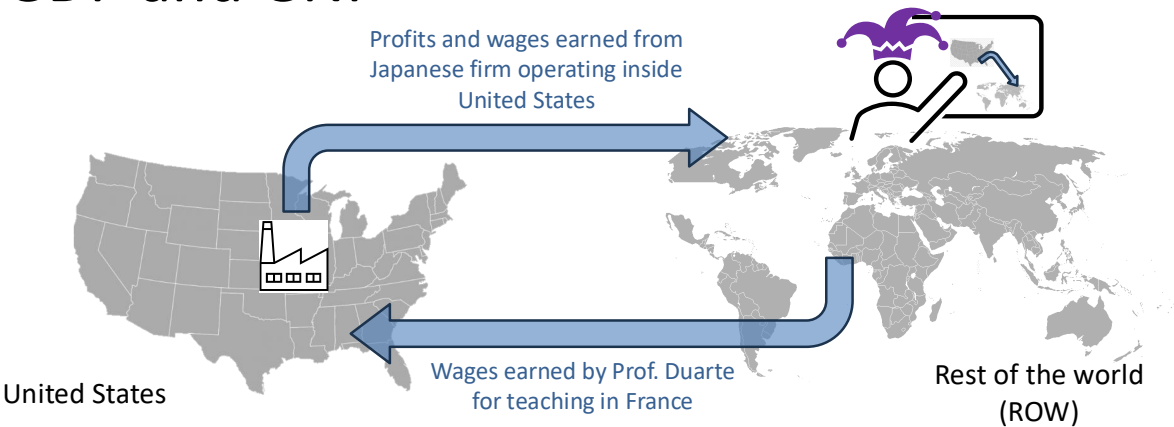
$$\text{GNP} = \text{GDP} + \text{Net Income from Abroad}$$

Open Economy with GNP

$$GNP = C + I + G + CA$$

- CA = Current account
- $CA = NX +$ Net income from abroad

GDP and GNP



Net Income = wages from Prof. Duarte teaching in France — profits and wages from firm operating inside US

United States GNP = United States GDP + Net Income

National Saving: Closed Economy

National saving = output not used for consumption or government spending

$$\begin{aligned} S &\equiv Y - C - G \\ &= (C + I + G) - C - G \\ &= I \end{aligned}$$

In a closed economy: $S = I$

National Saving: Open Economy

Starting from $Y = C + I + G + NX$:

$$S \equiv Y - C - G$$

$$= I + NX$$

In an open economy: $S = I + NX$

National Saving: Open Economy

Rearranging: $S - I = NX$

- If $S > I$: Trade surplus, country is a net lender
- If $S < I$: Trade deficit, country is a net borrower

Private Saving

Private saving = disposable income that is saved, not consumed

$$S^p \equiv Y - T - C$$

Public (Government) Saving

Government saving = tax revenue minus government spending

$$S^g \equiv T - G$$

- If $T > G$: Budget surplus ($S^g > 0$)
- If $T < G$: Budget deficit ($S^g < 0$)

Total Saving

Total national saving:

$$\begin{aligned} S &= S^p + S^g \\ &= (Y - T - C) + (T - G) \\ &= Y - C - G \end{aligned}$$

Using $S = I + NX$ from before, we get:

$$S^p + S^g = I + NX$$

Balance of Payments

Current Account	-200
Capital Account	-1
Financial Account	-201

Current Account		Capital Account		Financial Account
(-200)	$+$	(-1)	$=$	-201

Balance of Payments

Current Account	-200
Capital Account	-1
Financial Account	-201
Statistical discrepancy	0

$$\underset{\text{Discrepancy}}{\text{Statistical}} = \underset{\text{Account}}{\text{Financial}} - \left(\underset{\text{Account}}{\text{Current}} + \underset{\text{Account}}{\text{Capital}} \right)$$

$$0 = -201 - [\,(-200) + (-1)\,]$$

U.S. Balance of Payments Accounts for 2025-Q3	($ bn)
Current Account	-226
Capital Account	-1
Financial Account	-410
Statistical discrepancy	-183

$$\underset{\text{Discrepancy}}{\text{Statistical}} = \underset{\text{Account}}{\text{Financial}} - \left(\underset{\text{Account}}{\text{Current}} + \underset{\text{Account}}{\text{Capital}} \right)$$

$$-183 = -410 - [\,(-226) + (-1)\,]$$

Source: BEA

Current Account

1 Exports total
2 Goods
3 Services
4 Income receipts (primary income)
5 Imports total
6 Goods
7 Services
8 Income payments (primary income)
9 Net unilateral transfers (secondary income)
10 **Balance on current account**

Capital Account

11 Balance on capital account

	Financial Account
12	Net U.S. acquisition of foreign financial assets
13	Official reserve assets
14	Other assets
15	Net U.S. incurrence of domestic liabilities
16	Official reserve assets
17	Other liabilities
18	Financial derivatives, net
19	**Net financial flows**
20	**Statistical discrepancy**

Bottom line to remember

Whenever goods cross borders, assets move in the opposite direction.

ECON 1550: International Finance

Exchange Rates and the Foreign Exchange Market: An Asset Approach

A model of exchange rate determination

Exogenous variables

Variable	Description
R	Domestic interest rate
R^*	Foreign interest rate
E^e	Expected exchange rate

Endogenous variables

Variable	Description	Equation	Type of equation
E	Exchange rate	$R = R^* + \frac{E^e - E}{E}$	Equilibrium condition

A model of exchange rate determination

- Two investment opportunities
  - Domestic bond with return $R_{\$}$ in Dollars
  - Foreign bond with return R^* in Euros
- To be indifferent between the two investments, the **uncovered interest parity condition** must hold:

$$\text{(UIP):}\ R_{\$} = R^* + \frac{E^e_{\$/\text{EUR}}}{E_{\$/\text{EUR}}} - 1$$

Exchange Rates

Bonds

Realized vs Expected Returns

Expected Returns of Foreign Bond

Approximations

Uncovered Interest Parity

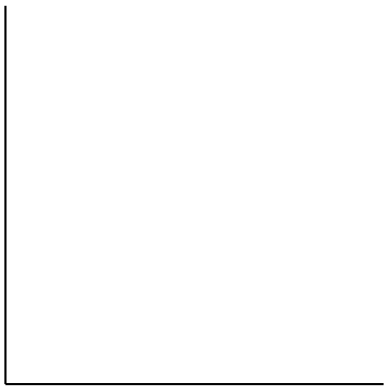
- For both strategies to have the same expected return

$$1 + R_{\$} = \frac{E^e_{\$/\text{EUR}}}{E_{\$/\text{EUR}}}(1 + R^*)$$

- Approximating

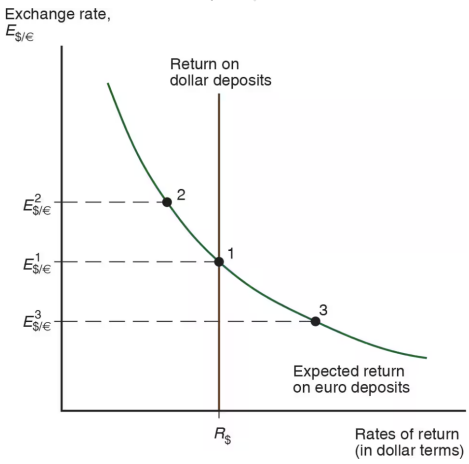
$$R_{\$} = R^* + \frac{E^e_{\$/\text{EUR}}}{E_{\$/\text{EUR}}} - 1$$

Equilibrium in Foreign Exchange Market



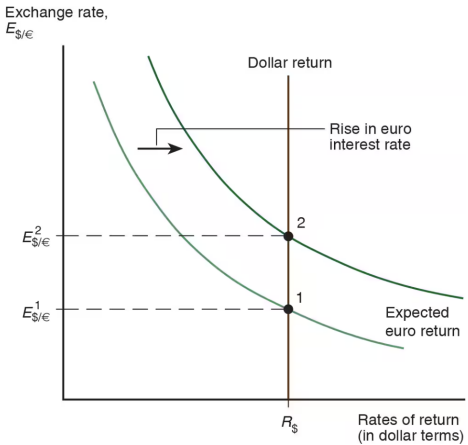
UIP: $R_{\$} = R^* + \dfrac{E^e_{\$/\text{EUR}}}{E_{\$/\text{EUR}}} - 1$

Equilibrium in Foreign Exchange Market



$$\text{UIP: } R_\$ = R^* + \frac{E^e_{\$/\text{EUR}}}{E_{\$/\text{EUR}}} - 1$$

Shocks: Rise in Euro Interest Rate



The carry trade

- Borrowing at "low" rate R and lending at "high" rate R^* is a **carry trade**

$$\begin{array}{c}\text{expected return} \\ \text{on carry trade}\end{array} = R^* + \left(\frac{E^e}{E} - 1\right) - R + \text{risk premium}$$

- Risk: Future exchange rate is not known when we start the carry trade, E^e can be different from the realized future exchange rate

Empirical Failure of UIP

Eight currency portfolios sorted by interest rate differential (portfolio 1 = lowest rates, portfolio 8 = highest).

High interest rate currencies earn higher mean excess returns and have higher Sharpe ratios.

Annual data, 1953–2002, US investor perspective.

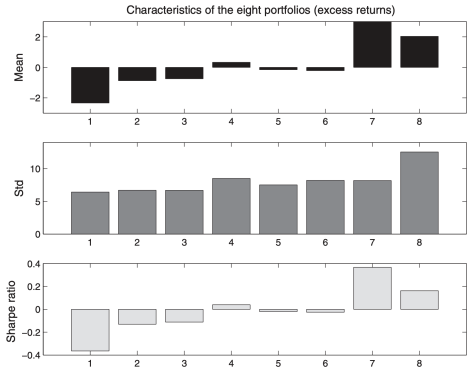


FIGURE 1. EIGHT CURRENCY PORTFOLIOS

Source: Lustig & Verdelhan (2007), *American Economic Review*

Explanations For Carry Risk Premium

- Crash risk / peso problem
- Correlation with consumption
- Global Volatility Risk
- Liquidity
- Constrained intermediaries

Crash Risk

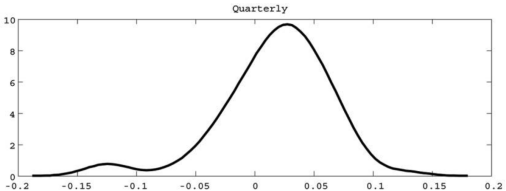


Fig. 1. U.S. dollar/Japanese yen exchange rate from 1996 to 2000

Kernel density of excess returns on a carry trade portfolio (long three high interest currencies, short three low interest currencies). Right: USD/JPY exchange rate, 1996–2000.

Source: Brunnermeier, Nagel, and Pedersen (2008), *NBER Macroeconomics Annual*

Consumption Risk

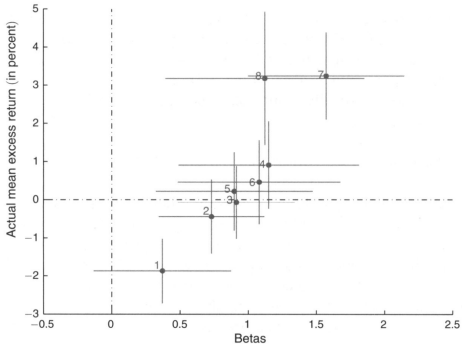


FIGURE 3. DURABLE CONSUMPTION GROWTH BETAS AND AVERAGE CURRENCY EXCESS RETURNS

The dots represent point estimates; the lines represent one standard deviation above and below. The sample is 1953–2008, annual data. Higher consumption betas correspond to higher currency excess returns.

Source: Lustig & Verdelhan (2011), *American Economic Review*

Global Volatility Risk

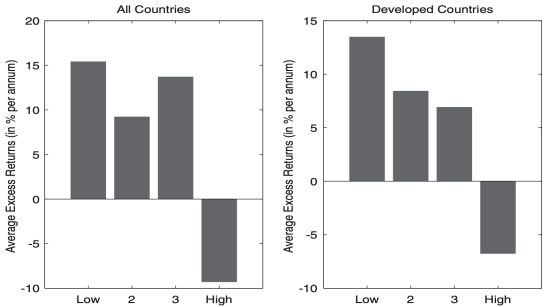
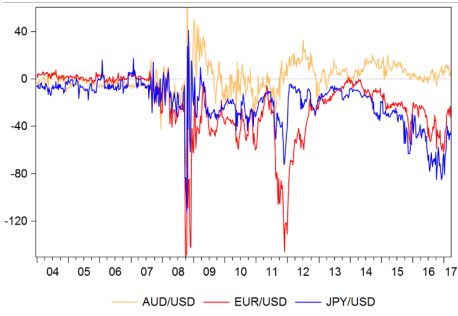


Figure 2. Excess returns and volatility. The figure shows mean excess returns for carry trade portfolios conditional on global FX volatility innovations being within the lowest to highest quartile of its sample distribution (four categories from "Low" to "High" shown on the x-axis of each panel). The bars show average excess returns for being long in portfolio 5 (largest forward discounts) and short in portfolio 1 (lowest forward discounts). The left panel shows results for all countries, while the right panel shows results for developed countries. The sample period is November 1983 to August 2009.

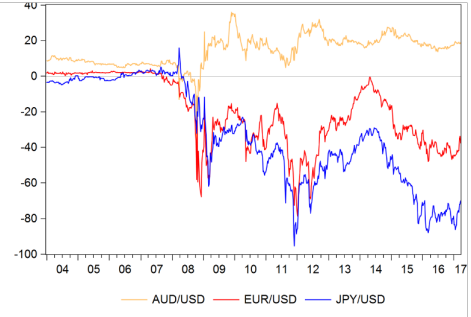
Mean excess returns for carry trade portfolios conditional on global FX volatility innovations being within the lowest to highest quartile. Carry trade earns high returns when volatility is low, but suffers large losses when volatility is high.

Source: Menkhoff, Sarno, Schmeling, and Schrimpf (2012), *Journal of Finance*

Violations of *Covered* Interest Parity



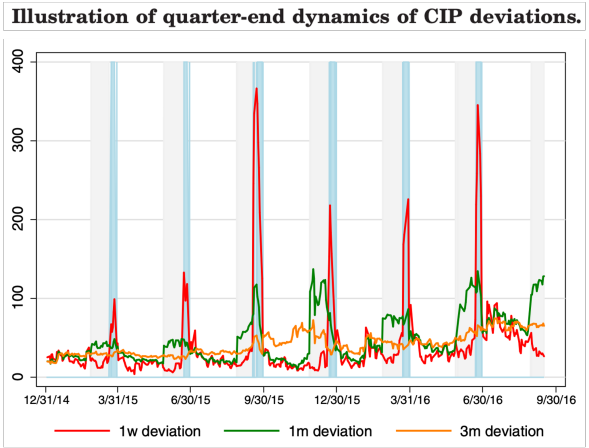
3-month basis: b_{3m}

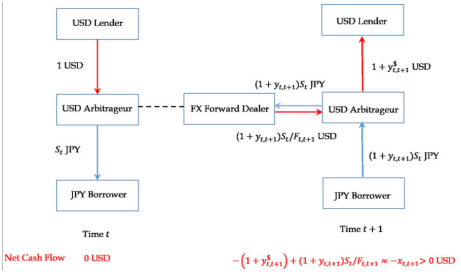


3-year basis: b_{3y}

Source: Sushko, Borio, McCauley, and McGuire, "The Failure of Covered Interest Parity"

Intermediaries are Constrained





Source: Du, Tepper, and Verdelhan, "Deviations from Covered Interest Rate Parity," *Journal of Finance*

ECON 1550: International Finance

Money, Interest Rates, and Exchange Rates

A model of the money market

Exogenous variables

Variable	Description
Y	Real income
M^s	Money supply
P	Price level

Endogenous variables

Variable	Description	Equation	Type of equation
R	Domestic interest rate	$M^d/P = L(R, Y)$	Behavioral equation
M^d	Money demand	$M^d = M^s$	Equilibrium condition

Description of the Money Market

- There are only two assets: money and domestic bonds
- Money
  - Can be used for transactions
  - Pays no interest
- Bonds
  - Cannot be used for transactions
  - Pay interest $i \geq 0$

Money Demand

- Money demand is higher when:
  - Higher price level $P \rightarrow$ need more money to buy goods
  - Lower nominal interest rate $R \rightarrow$ bonds less attractive
  - Higher income $Y \rightarrow$ want more money to buy more
- Capture idea with a behavioral equation

$$M^d = P \times L(\underset{(-)}{R}, \underset{(+)}{Y})$$

Real money demand

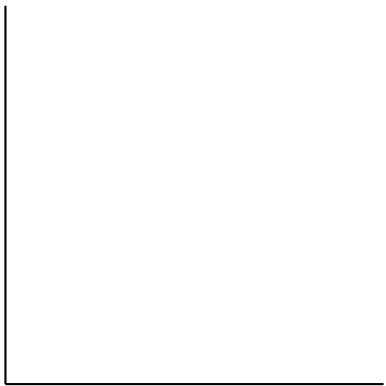
- Convenient to write in terms of real money demand

$$\frac{M^d}{P} = L(R, Y)$$

and real money supply

$$\frac{M^s}{P}$$

Equilibrium in money market



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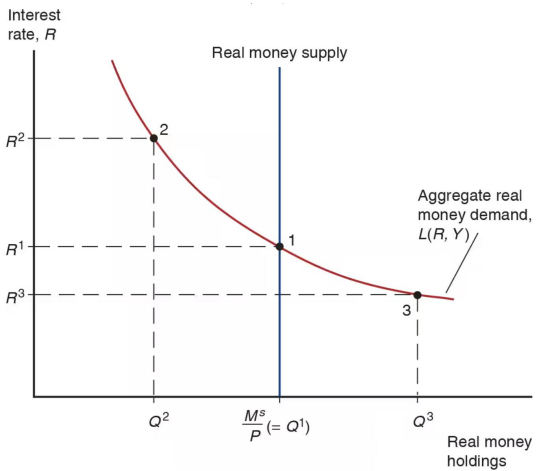

Money is defined by its function

- Medium of exchange
- Store of value
- Unit of account

Many types of money 1/2

- Commodity money: a physical commodity (like gold) that is used as money
- Convertible paper money: a piece of paper that can be exchanged by a commodity

Many types of money 2/2

- Fiat money: issued by a central bank, not backed by any commodity
- Digital currency: not backed by any commodity, privately issued, electronic payments

Fiat money

1. Central bank liabilities are special because they are the unit of account.
2. Currency is a promise to deliver future central bank liabilities.

Assets	Liabilities
\$0	\$0

$t = 0$

Assets	Liabilities
\$1 currency	\$1 money

$t = 1$

Assets	Liabilities
\$1 bonds	\$1 money

$t = 2$

Monetary policy

- Deposits at the Fed are called reserves
- “The” interest rate is just interest on reserves

ECON 1550: International Finance

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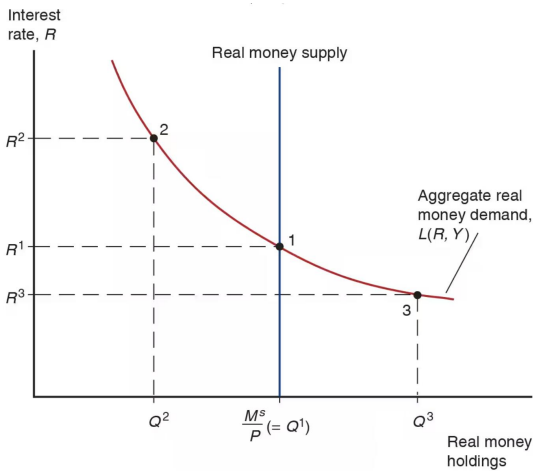

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$t = 0$

Assets	Liabilities
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$t = 1$

Assets	Liabilities
$1 bonds	$1 money

$t = 2$

Monetary policy

- Deposits at the Fed are called reserves
- “The” interest rate is just interest on reserves

Short-run FX and money market model

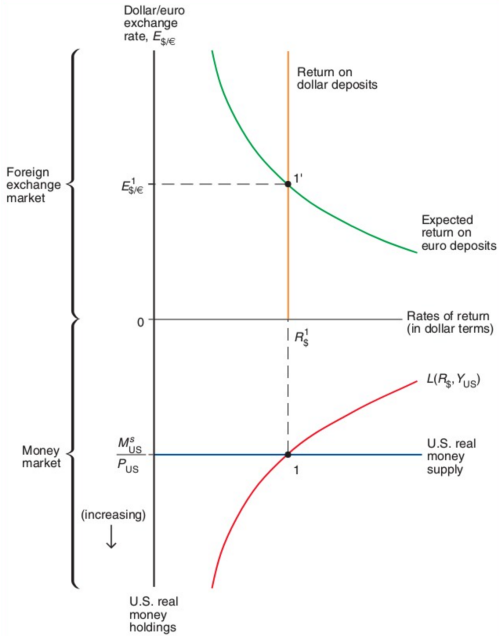
Exogenous variables

Variable	Description
R^*	Foreign interest rate
E^e	Expected exchange rate
Y	Real income
M^s	Money supply
P	Price level

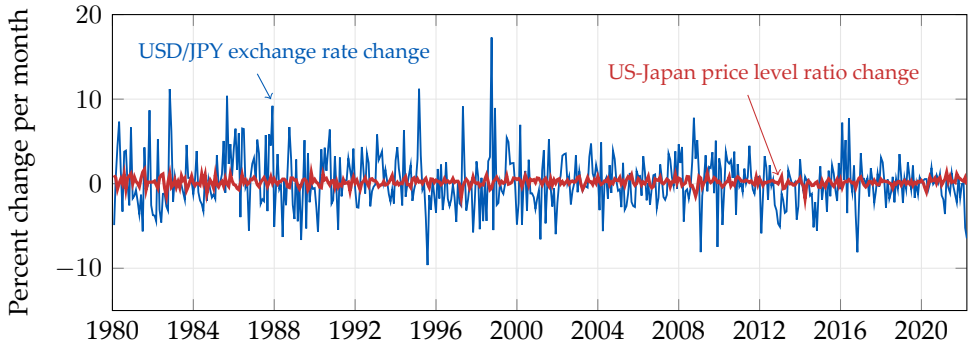
Endogenous variables

Variable	Description	Equation	Type of equation
E	Exchange rate	$R = R^* + \frac{E^e - E}{E}$	Equilibrium condition
R	Domestic interest rate	$M^d/P = L(R, Y)$	Behavioral equation
M^d	Money demand	$M^d = M^s$	Equilibrium condition

Short-run equilibrium in FX and money markets



Exchange rates are very volatile



Source: FRED/CPIAUCSL; FRED/CPALCY01JPM661N; FRED/DEXJPUS (end-of-month, inverted to USD/JPY).

Conceptual definition of long-run equilibrium

- Hypothetical equilibrium that would result if economy runs indefinitely with no shocks
- Equivalently, the hypothetical equilibrium that would occur if prices were perfectly flexible and always adjusted instantaneously and frictionlessly

Definition of the long run in the model

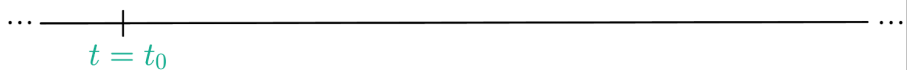
1. In the long run, $E = E^e$
   - By definition of the long run, all variables constant
   - By assumption of rational expectations, expectations must be correct in the long run
   - In the model, it means $E_{LR} = E^e_{LR}$

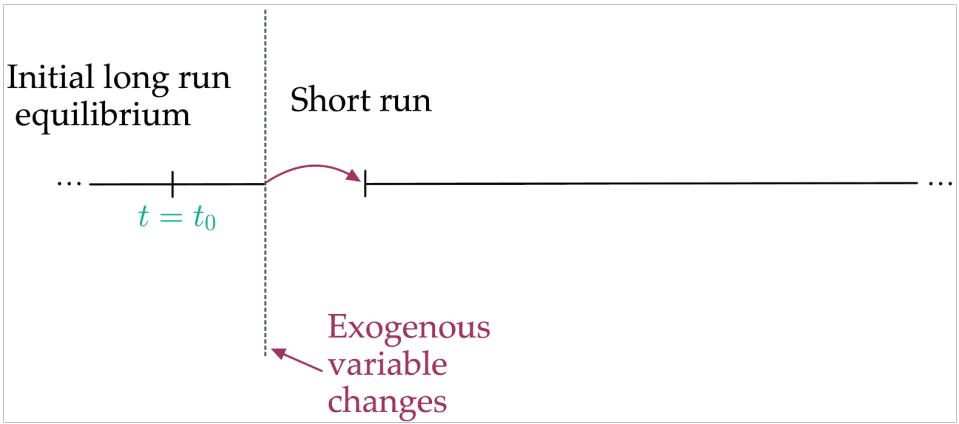
Assumptions about the short run

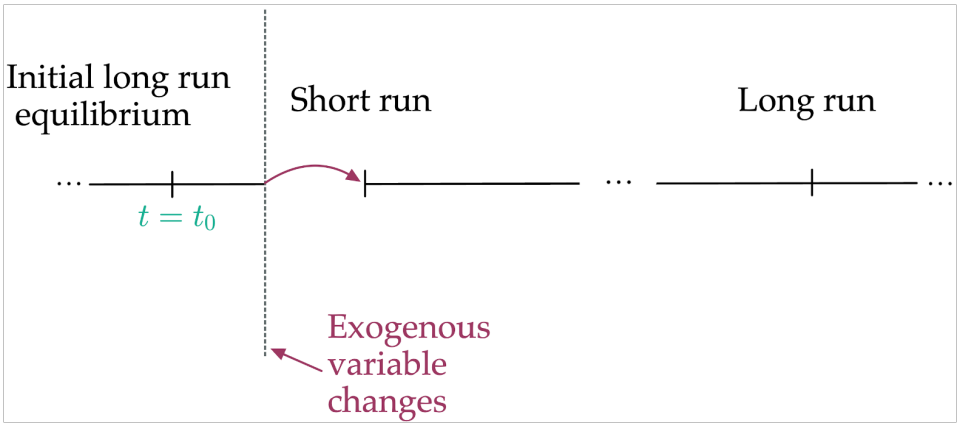
1. In the short run, P is fixed
   - Because prices are "sticky"
   - In the model, it means $P_0 = P_{SR}$

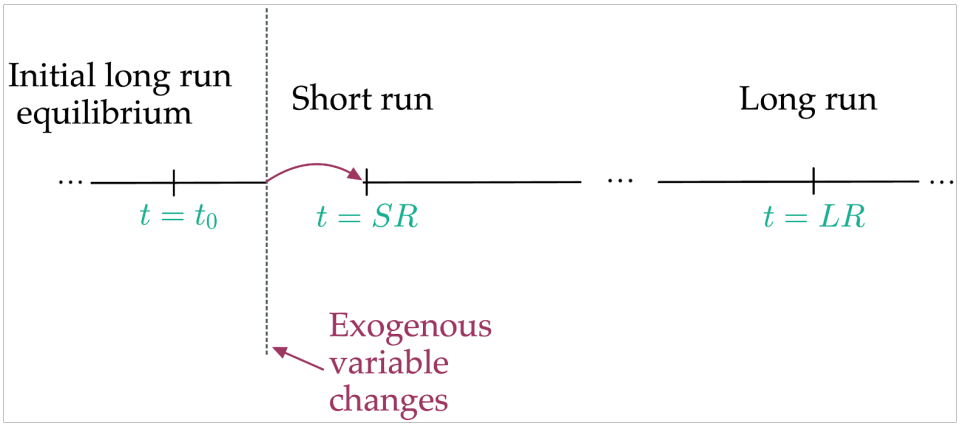
2. In the short run, E^e equals long-run E
   - By assumption of rational expectations
   - In the model, it means $E^e_{SR} = E_{LR}$

Initial long run equilibrium




Initial long run equilibrium
Short run
$t = t_0$
Exogenous variable changes


Initial long run equilibrium
Short run
Long run
$t = t_0$
Exogenous variable changes


Initial long run equilibrium
Short run
Long run
$t = t_0$
$t = SR$
$t = LR$
Exogenous variable changes

Results in the long run (1/3)

1. Long-run interest rate R_{LR} from FX market
   - Using $E_{LR} = E^e_{LR}$ and UIP:

$$R_{LR} = R^* + \frac{E^e_{LR}}{E_{LR}} - 1$$

$$\Rightarrow R_{LR} = R^*$$

Results in the long run (2/3)

2. Long-run price level P_{LR} from the money market
   - Using $R_{LR} = R^*$ and money market equilibrium condition:

$$\frac{M^s}{P_{LR}} = L(R_{LR}, Y) = L(R^*, Y)$$

$$\Rightarrow \quad P_{LR} = \frac{M^s}{L(R^*, Y)}$$

Results in the long run (3/3)

3. Long-run exchange rate E_{LR} from PPP (purchasing power parity)
   - Because E_{LR} is a nominal price, in the long run it moves proportionally to the price level:

$$E_{LR} \propto P_{LR}$$

Results in the short run (1/2)

1. Short-run exchange rate E_{SR} from UIP with $E^e = E_{LR}$
   - Using UIP and the short-run assumptions:

$$R = R^* + \frac{E_{LR} - E_{SR}}{E_{SR}} \quad \Rightarrow \quad E_{SR} = \frac{E_{LR}}{1 + R - R^*}$$

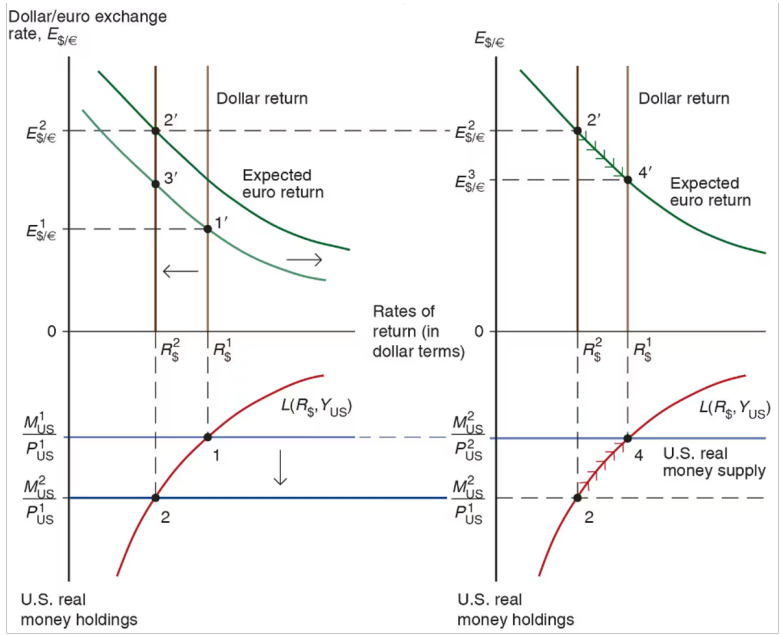
Results in the short run (2/2)

2. Short-run domestic interest rate R_{SR} from the money market
   - Using money market equilibrium condition and P fixed at P_0 in the short run:

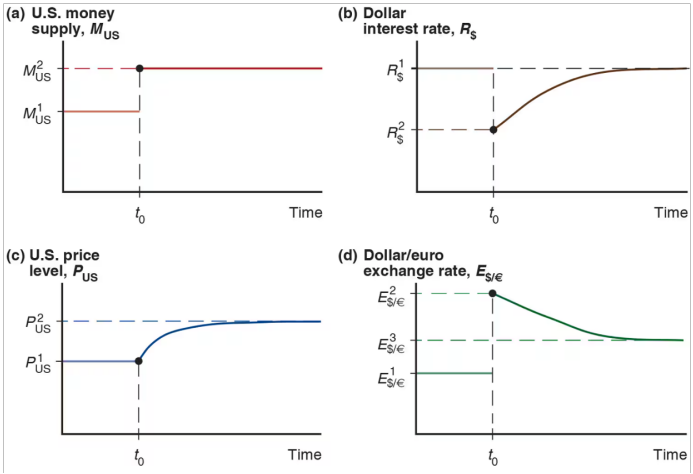
$$\frac{M^s}{P_{SR}} = L(R_{SR}, Y) \quad \Rightarrow \quad \frac{M^s}{P_0} = L(R_{SR}, Y),$$

   which can be solved for R_{SR}

Permanent Money Supply Changes



Exchange Rate Overshooting



Long-run FX and money market model

Exogenous variables

Variable	Description
Y^n	Potential output
M^s	Money supply
R^*	Foreign interest rate

Endogenous variables

Variable	Description	Equation	Type of eq
E	Exchange rate	$R = R^* + \frac{E^e - E}{E}$	Eq. condition
M^d	Money demand	$M^d/P = M^s/P$	Eq. condition
E^e	Expected exchange rate	$E^e = E$	Behavioral
R	Domestic interest rate	$P = \frac{M^d}{L(R,\, Y^n)}$	Eq. condition
P	Price level	P fixed in the short run	Behavioral

Overshooting

1. Properties of initial, SR, LR equilibria
2. Dynamic FX and money market model
3. Example
   - Solve with equations
   - Solve graphically

Properties of initial, SR, and LR equilibria

Long run:

- $E^e = E$

  $\Rightarrow E_0^e = E_0$ and $E_{LR}^e = E_{LR}$

- E proportional to P and M^s

  $\Rightarrow E_0 = kM_0^s$ and $E_{LR} = kM_{LR}^s$ (k is a parameter)

Properties of initial, SR, and LR equilibria

Short run:

- Prices are fixed

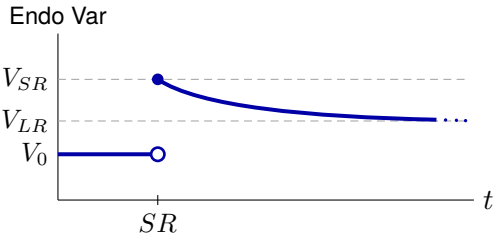
  $\Rightarrow P_{SR} = P_0$

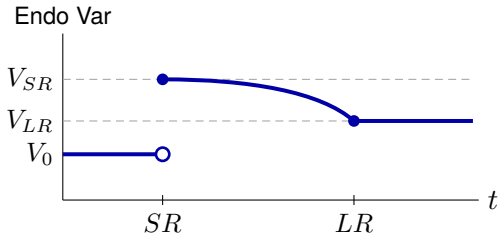
- Rational expectations

  $\Rightarrow E^e_{SR} = E_{LR}$

Transition between SR and LR

- Slow monotonic transition between SR value and LR value
- No indication of shape





Dynamic FX and money market model

Exogenous variables

Variable	Description
M^s	Path of money supply
R^*	Path of foreign interest rate
Y	Path of income (GNP)
k	Long-run proportionality constant for E and M^s

Endogenous variables

Variable	Description
E	Exchange rate
E^e	Expected exchange rate
P	Price level
R	Domestic interest rate
M^d	Money demand

Equations that apply at all times

$$\text{(UIP)} \;:\; R = R^* + \frac{E^e}{E} - 1 \qquad \text{(equilibrium condition)}$$

$$\text{(MD)} \;:\; \frac{M^d}{P} = L(\underset{(-)}{R},\ \underset{(+)}{Y}) \qquad \text{(behavioral)}$$

$$\text{(MS = MD)} \;:\; \frac{M^s}{P} = \frac{M^d}{P} \qquad \text{(equilibrium condition)}$$

Equations that apply in SR equilibria only

(Sticky P) : $P_{SR} = P_0$ (behavioral)

(RE) : $E^e_{SR} = E_{LR}$ (behavioral)

Equations that apply in LR equilibria only

(PPP) or (Flex P) : $E_0 = kM_0^s, \quad E_{LR} = kM_{LR}^s$ (behavioral)

(Defn LR) or (RE) : $E_0^e = E_0, \quad E_{LR}^e = E_{LR}$ (behavioral)

Example

Need to specify:

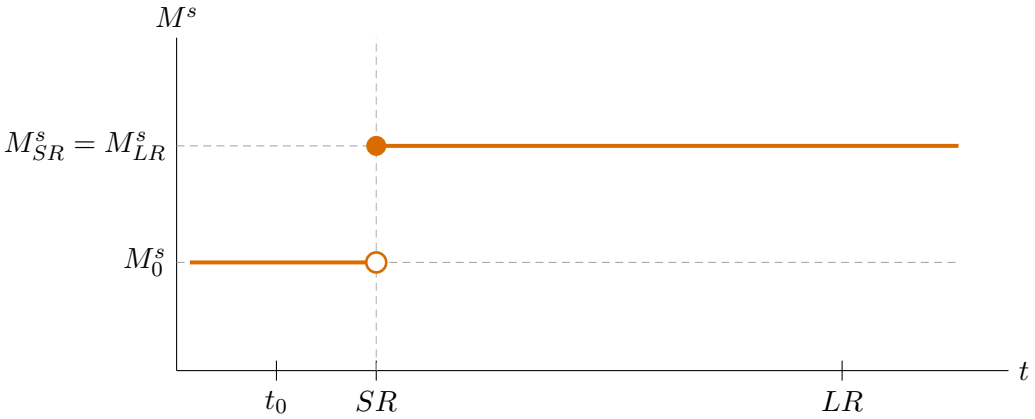
1. Function $L(R, Y)$
2. Path of exogenous variables

Assume:

1. $L(R, Y) = \dfrac{Y}{1 + R}$
2. $R^* = 0.08,\ Y = 1,\ k = 1$

$$\{M_0^s,\ M_{SR}^s,\ M_{LR}^s\} = \{1,\ 1.05,\ 1.05\}$$

Example: Permanent increase in M^s



Solution steps

1. Solve initial LR equilibrium ($t = t_0$)
2. Solve LR equilibrium ($t = LR$)
3. Solve SR equilibrium ($t = SR$)

Solution sub-steps

LR (steps 1 and 2)

(a) Flex P / PPP $\longrightarrow E$

(b) Defn LR / RE $\longrightarrow E^e$

(c) UIP $\longrightarrow R$

(d) MS = MD $\longrightarrow P$

SR (step 3)

(a) P fixed $\longrightarrow P$

(b) MS = MD $\longrightarrow R$

(c) RE $\longrightarrow E^e$

(d) UIP $\longrightarrow E$

Step 1: Solve initial LR equilibrium ($t = t_0$)

(a) Flex P / PPP $\rightarrow E$: $E_0 = kM_0^s = 1 \cdot 1 = 1$

(b) Defn LR / RE $\rightarrow E^e$: $E_0^e = E_0 = 1$

(c) UIP $\rightarrow R$: $R_0 = R^* + \dfrac{E_0^e}{E_0} - 1$

$= 0.08 + \dfrac{1}{1} - 1 = 0.08$

Step 1: Solve initial LR equilibrium ($t = t_0$)

(d) MS = MD $\rightarrow P$:

$$\frac{M_0^s}{P_0} = \frac{Y_0}{1 + R_0}$$

$$\Rightarrow P_0 = M_0^s \cdot \frac{1 + R_0}{Y_0}$$

$$= 1 \times 1.08 = 1.08$$

Solution for t_0: $P_0 = 1.08,\ R_0 = 0.08,\ E_0^e = 1,\ E_0 = 1$

Step 2: Solve LR equilibrium ($t = LR$)

(a) Flex P / PPP $\rightarrow E$: $E_{LR} = kM^s_{LR} = 1 \cdot 1.05 = 1.05$

(b) Defn LR / RE $\rightarrow E^e$: $E^e_{LR} = E_{LR} = 1.05$

(c) UIP $\rightarrow R$: $R_{LR} = R^*_{LR} + \dfrac{E^e_{LR}}{E_{LR}} - 1$

$$= 0.08 + \frac{1.05}{1.05} - 1 = 0.08$$

Step 2: Solve LR equilibrium ($t = LR$)

(d) MS = MD $\rightarrow P$:

$$\frac{M^s_{LR}}{P_{LR}} = \frac{Y_{LR}}{1 + R_{LR}}$$

$$\Rightarrow P_{LR} = M^s_{LR} \cdot \frac{1 + R_{LR}}{Y_{LR}}$$

$$= 1.05 \times 1.08 = 1.134$$

Solution for LR: $P_{LR} = 1.134,\ R_{LR} = 0.08,\ E^e_{LR} = 1.05,\ E_{LR} = 1.05$

Step 3: Solve SR equilibrium ($t = SR$)

(a) P fixed $\rightarrow P$: $P_{SR} = P_0 = 1.08$

(b) MS = MD $\rightarrow R$:

$$\frac{M^s_{SR}}{P_{SR}} = \frac{Y_{SR}}{1 + R_{SR}}$$

$$\Rightarrow \frac{1.05}{1.08} = \frac{1}{1 + R_{SR}}$$

$$\Rightarrow 1 + R_{SR} = \frac{1.08}{1.05}$$

$$\Rightarrow R_{SR} = \frac{1.08}{1.05} - 1 \approx 0.02857$$

Step 3: Solve SR equilibrium ($t = SR$)

(c) RE $\rightarrow E^e$: $\quad E^e_{SR} = E_{LR} = 1.05$

(d) UIP $\rightarrow E$: $\quad R_{SR} = R^*_{SR} + \dfrac{E^e_{SR}}{E_{SR}} - 1$

$$\Rightarrow \; 0.02857 = 0.08 + \frac{1.05}{E_{SR}} - 1$$

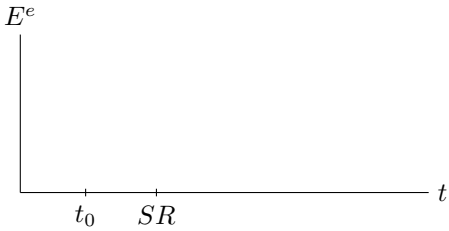
$$\Rightarrow \; E_{SR} = \frac{1.05}{0.02857 - 0.08 + 1} = \frac{1.05}{0.94857} \approx 1.1069$$

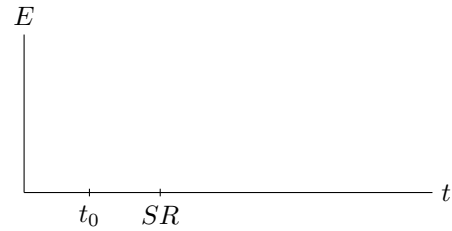
Solution for SR: $P_{SR} = 1.08,\ R_{SR} \approx 0.029,\ E^e_{SR} = 1.05,\ E_{SR} \approx 1.107$

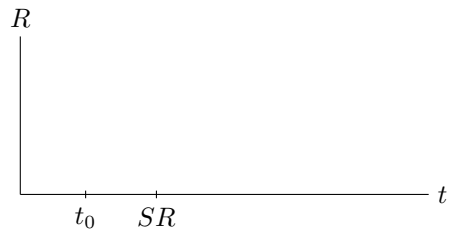
Example: solution summary

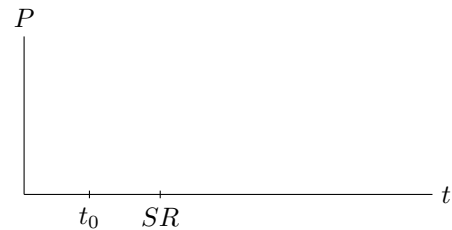
	t_0	SR	LR
P	1.08	1.08	1.134
R	0.08	0.029	0.08
E^e	1	1.05	1.05
E	1	1.107	1.05

Paths of solution

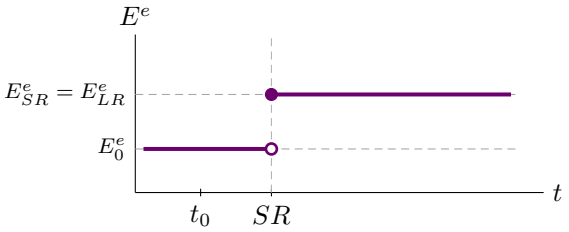


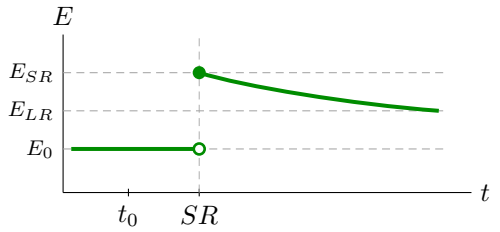


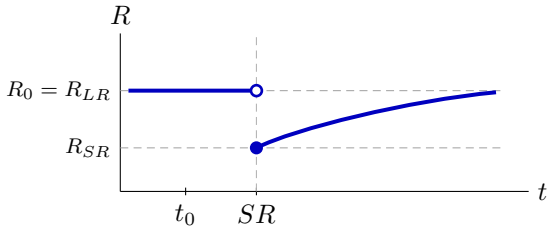


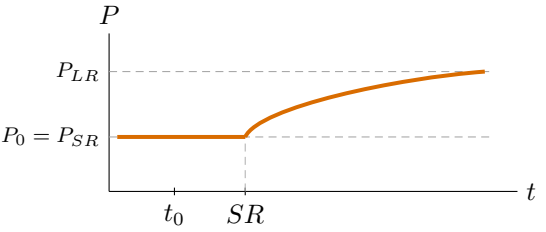


Paths of solution

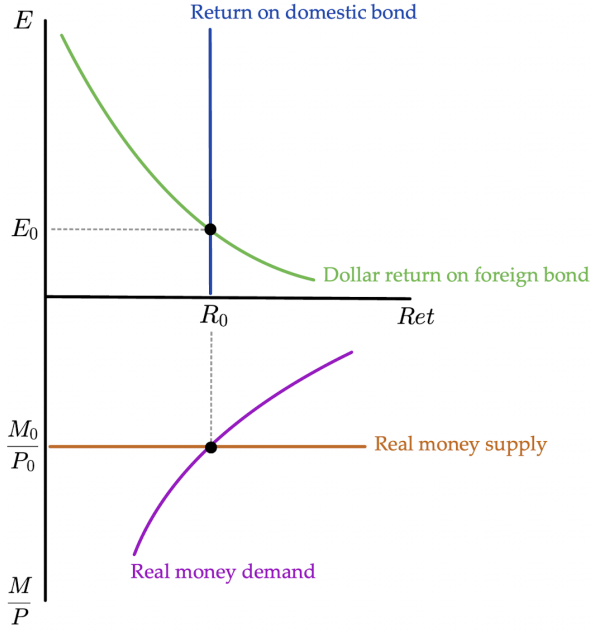




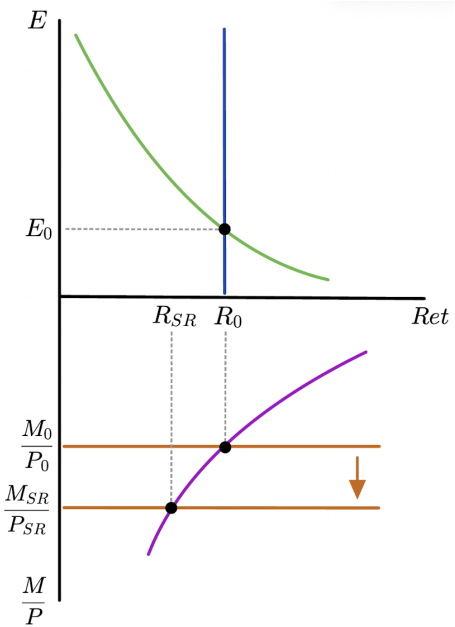




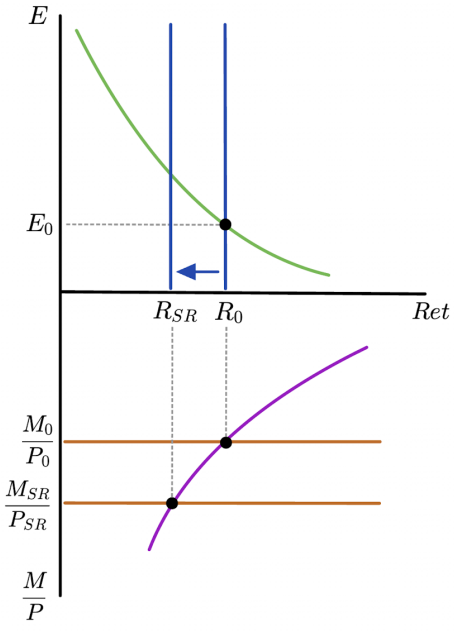
Solve with plots: Initial LR equilibrium



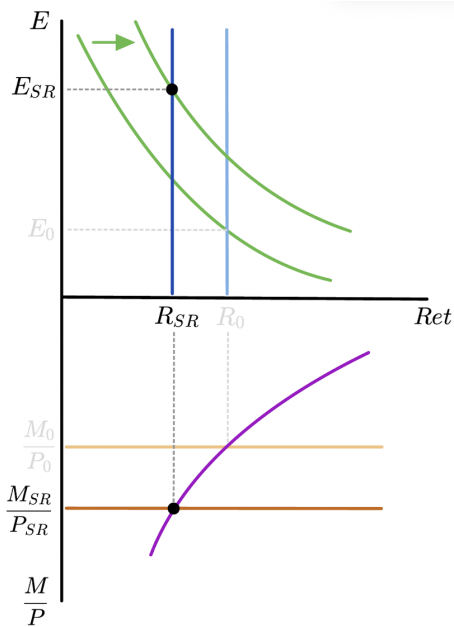
Higher M^s
lowers R



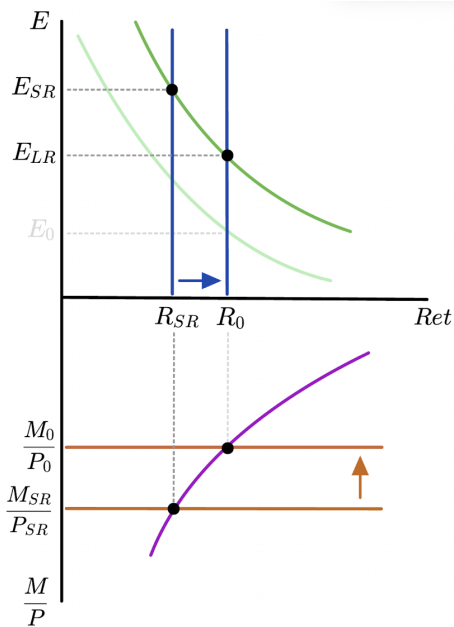
Lower R causes depreciation



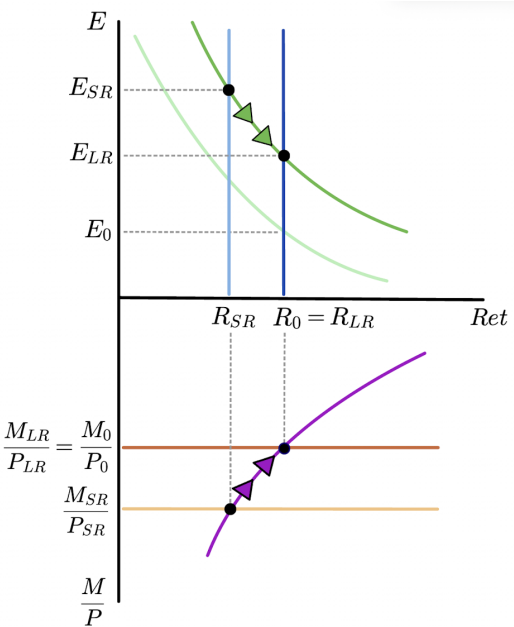
Higher E^e shifts dollar return on foreign bond



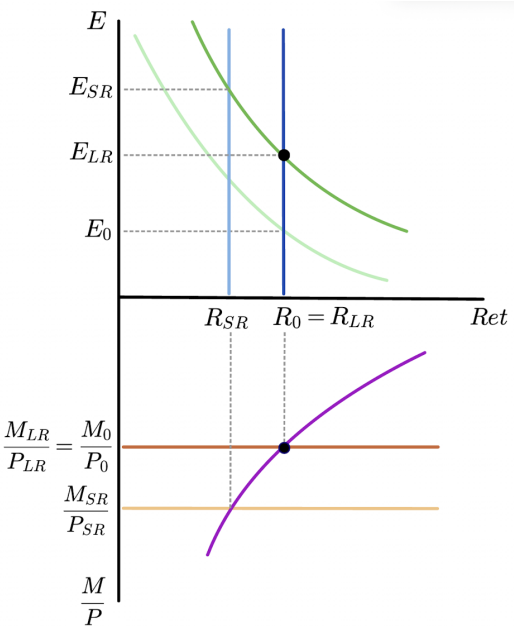
SR equilibrium



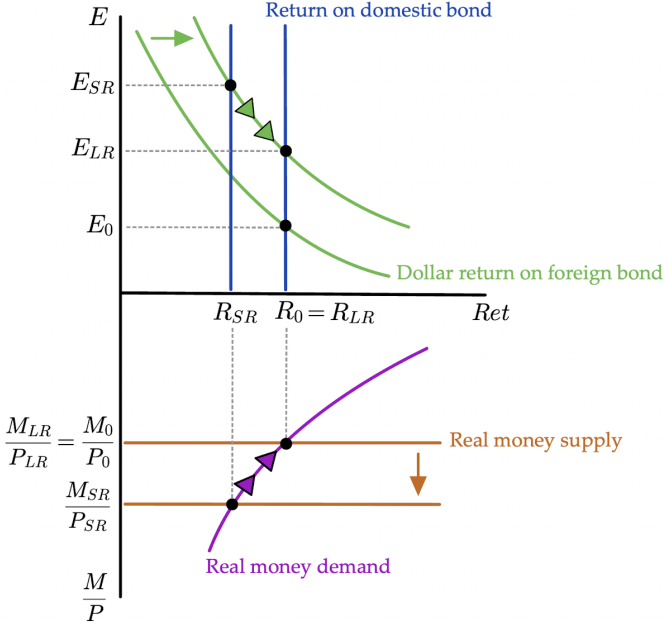
Transition between SR and LR



Final LR equilibrium



Solve with plots: All steps together



Equilibrium Determination Map

	Initial	SR	LR
E	flex P / PPP	FX mkt	flex P / PPP
E^e	defn LR	RE	defn LR
R	FX mkt	money mkt	FX mkt
P	money mkt	fixed P	money mkt

PPP = purchasing power parity $\Rightarrow E \propto P \propto M^s$

defn LR = definition of the long run $\Rightarrow E_0^e = E_0$ and $E_{LR}^e = E_{LR}$

RE = rational expectations $\Rightarrow \begin{cases} E_{SR}^e = E_{LR} \\ E_0^e = E_0 \text{ and } E_{LR}^e = E_{LR} \end{cases}$

ECON 1550 International Finance

Price Levels and the Exchange Rate in the Long Run

Law of One Price (LOOP)

- The LOOP holds if for every good i with dollar price P^i_{US} and euro price P^i_E, we have

$$P^i_{US} = E_{\$/€} \times P^i_E$$

- This is a theory of exchange rate determination:

$$E_{\$/€} = \frac{P^i_{US}}{P^i_E}$$

Purchasing Power Parity (PPP)

- PPP holds if

$$P_{US} = E_{\$/€} \times P_E$$

  where P_{US} is the US price level and P_E is the euro area price level

- This is also a theory of exchange rate determination:

$$E_{\$/€} = \frac{P_{US}}{P_E}$$

Relative PPP

- Relative PPP holds if

$$\frac{E_{\$/€,t} - E_{\$/€,t-1}}{E_{\$/€,t-1}} = \pi_{US,t} - \pi_{E,t}$$

  where π_t is inflation $\pi_t = P_t/P_{t-1} - 1$

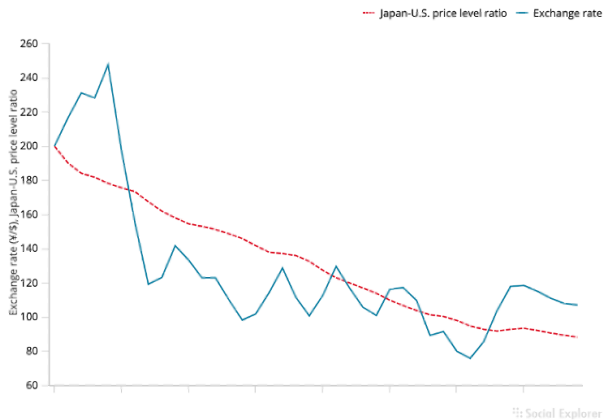
- This is also a theory of exchange rate determination

$$E_{\$/€,t} = (\pi_{US,t} - \pi_{E,t} + 1)E_{\$/€,t-1}$$

Relative PPP does not hold very well in the real world

Figure 16-2

The Yen/Dollar Exchange Rate and Relative Japan–U.S. Price Levels, 1980–2019



The graph shows that relative PPP does not track the yen/dollar exchange rate during 1980–2015.

Source: IMF, *International Financial Statistics*. Exchange rates and price levels are end-of-year data.

Problems With PPP

- Price levels of different countries report different baskets of goods
  - E.g. GDP deflator is the basket of goods in GDP for each country
- Deviations from perfectly competitive frictionless markets
  - Transport costs and trade barriers
  - Monopoly power

Expected Relative PPP

- Expected relative PPP (or relative PPP in expectations)

$$\frac{E^e_{\$/€} - E_{\$/€}}{E_{\$/€}} = \pi^e_{US} - \pi^e_E$$

  where π^e is *expected* inflation $\pi^e = P^e/P - 1$

- This is also a theory of exchange rate determination

$$E_{\$/€} = \frac{E^e_{\$/€}}{\pi^e_{US} - \pi^e_E + 1}$$

Relationships

- LOOP $\Rightarrow$ PPP $\Rightarrow$ Relative PPP $\Rightarrow$ Expected relative PPP
- Expected relative PPP + UIP $\Rightarrow$ Fisher effect

$$\frac{E^e_{\$/€} - E_{\$/€}}{E_{\$/€}} = \pi^e_{US} - \pi^e_E \quad \text{and} \quad R_\$ = R_€ + \frac{E^e_{\$/€} - E_{\$/€}}{E_{\$/€}}$$

imply

$$R_\$ - R_€ = \pi^e_{US} - \pi^e_E$$

Common variables across all models

Exogenous variables

Variable	Description
R^*	Foreign interest rate
$M^s,\ M^{s*}$	Money supply
$g_M,\ g_{M^*}$	Money supply growth rates

Endogenous variables

Variable	Description	Equation	Type of equation
P	Price level	$M^s/P = L(R, Y)$	Behavioral + eq. condition
P^*	Foreign price level	$M^{s*}/P^* = L(R^*, Y^*)$	Behavioral + eq. condition
π, π^*	Inflation	$\pi = g_M - g_L$	Definition
r^e, r^{e*}	Real interest rates	$r^e = R - \pi^e$	Definition

Model 1: PPP

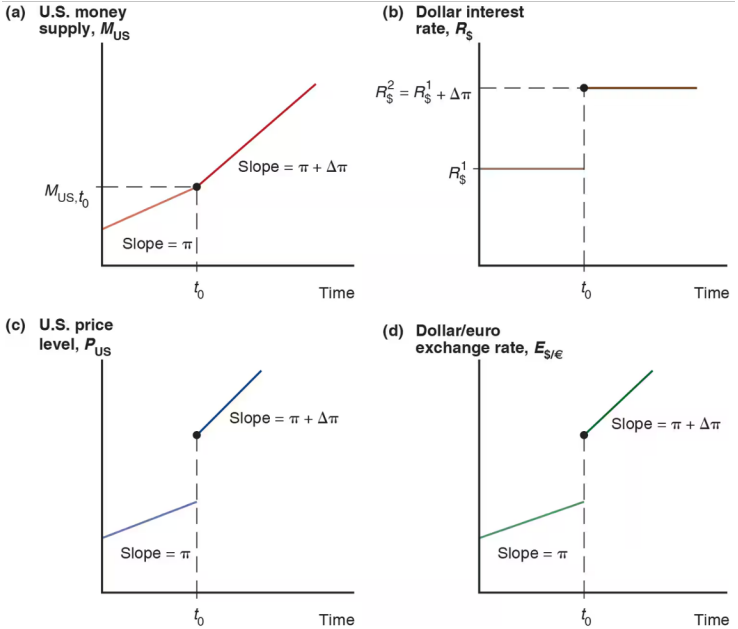
Exogenous variables

Variable	Description
R	Domestic interest rate
$Y,\ Y^*$	Real incomes

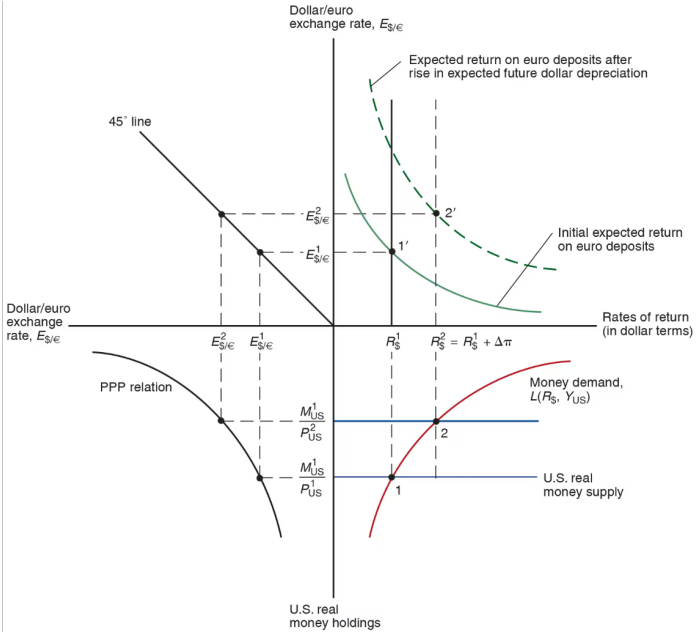
Endogenous variables

Variable	Description	Equation	Type of equation
E	Exchange rate	$E = P/P^*$	Behavioral

Changes in growth rate of money supply



Changes in growth rate of money supply



Model 2: PPP^e + UIP

Exogenous variables

Variable	Description
$Y,\ Y^*$	Real incomes

Endogenous variables

Variable	Description	Equation	Type of equation
$E^e/E-1$	Expected depreciation	$E^e/E-1=\pi^e-\pi^{e*}$	Behavioral
R	Interest rate	$R=R^*+E^e/E-1$	Eq. condition

Model 3: real E + relative output

- The real exchange rate

Model 3: real E + relative output

- Real exchange rate calculation

Model 3: real E + relative output

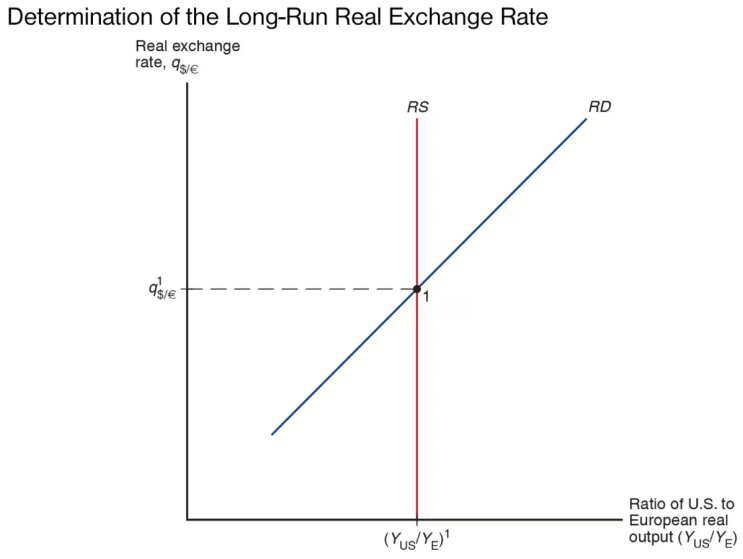
Exogenous variables

Variable	Description
RS	Relative output supply
q	Real exchange rate

Endogenous variables

Variable	Description	Equation	Type of equation
Y/Y^*	Relative output	$RD(q) = RS$	Eq. cond.
E	Nominal exchange rate	$E = qP/P^*$	Definition

Model 3 equilibrium



ECON 1550 International Finance

Output and the Exchange Rate in the Short Run

Behavioral equations in the goods market

$$Y = C + I + G + CA$$

$$\text{DEMAND FOR DOMESTIC GOOD} = C + I + G + CA$$

$$\text{SUPPLY FOR DOMESTIC GOOD} = Y$$

Demand for domestic goods

DEMAND FOR DOM GOODS $= C + I + G + CA = D$

DOMESTIC DEMAND FOR GOODS $\equiv A = C + I + G$

$A + EX - IM = A + CA = D$

Demand for domestic goods

$C = C(Y_D)$ (+1) CONSUMPTION (OF DOM. AND FOREIGN)

$Y_D \equiv Y - T$ DISPOSABLE INCOME

$I = \bar{I}$ EXOGENOUS INVESTMENT

$G = \bar{G}$ " GOV. PURCHASES

} BOTH DOM AND FOR. GOODS

$CA = CA(q, Y-T, Y^*)$

$q \equiv \frac{EP^*}{P} = \frac{\text{DOLLAR PRICE OF FOREIGN GOOD}}{\text{DOLLAR PRICE OF DOM GOOD}}$

Demand for domestic goods

$CA = EX - IM$

$EX = EX(q, Y^*)$

(+1 (+1

$IM = IM(q, Y_D)$

(-) (+1

$q\uparrow$ VOLUME $\downarrow$ PRICE $q\uparrow$

VOLUME DOMINATES

$q\uparrow$ REAL DEPR.

$\frac{EP^*}{P} = q$ => HOME GOOD APPEARS CHEAPER

$IM = \overbrace{PRICE}^{\equiv q} \times VOLUME$

IM: DOM GOOD

PRICE: DOM GOOD / FOREIGN GOOD

VOLUME: FOREIGN GOOD

A short-run model of the goods market

Exogenous variables

Variable	Description
E	Nominal exchange rate
I	Investment
G	Government spending
T	Taxes
P	Price level
P^*	Foreign price level
Y^*	Foreign income

Endogenous variables

Variable	Description	Equation	Type of equation
Y	Income, production	$Y = D$	Equilibrium condition
Y_D	Disposable income	$Y_D \equiv Y - T$	Identity
EX	Exports	$\mathrm{EX} = \mathrm{EX}(\underset{(+)}{q}, \underset{(+)}{Y^*})$	Behavioral
IM	Imports	$\mathrm{IM} = \mathrm{IM}(\underset{(-)}{q}, \underset{(+)}{Y_D})$	Behavioral
CA	Current account	$\mathrm{CA} \equiv \mathrm{EX} - \mathrm{IM} = \mathrm{CA}(\underset{(+)}{q}, \underset{(-)}{Y_D}, \underset{(+)}{Y^*})$	Identity
D	Demand for domestic goods	$D \equiv C + I + G + \mathrm{CA}$	Identity
A	Domestic demand	$A \equiv C + I + G$	Identity
C	Consumption	$C = \mathrm{C}(\underset{(+)}{Y_D})$	Behavioral
q	Real exchange rate	$q \equiv \dfrac{EP^*}{P}$	Identity

DD Curve

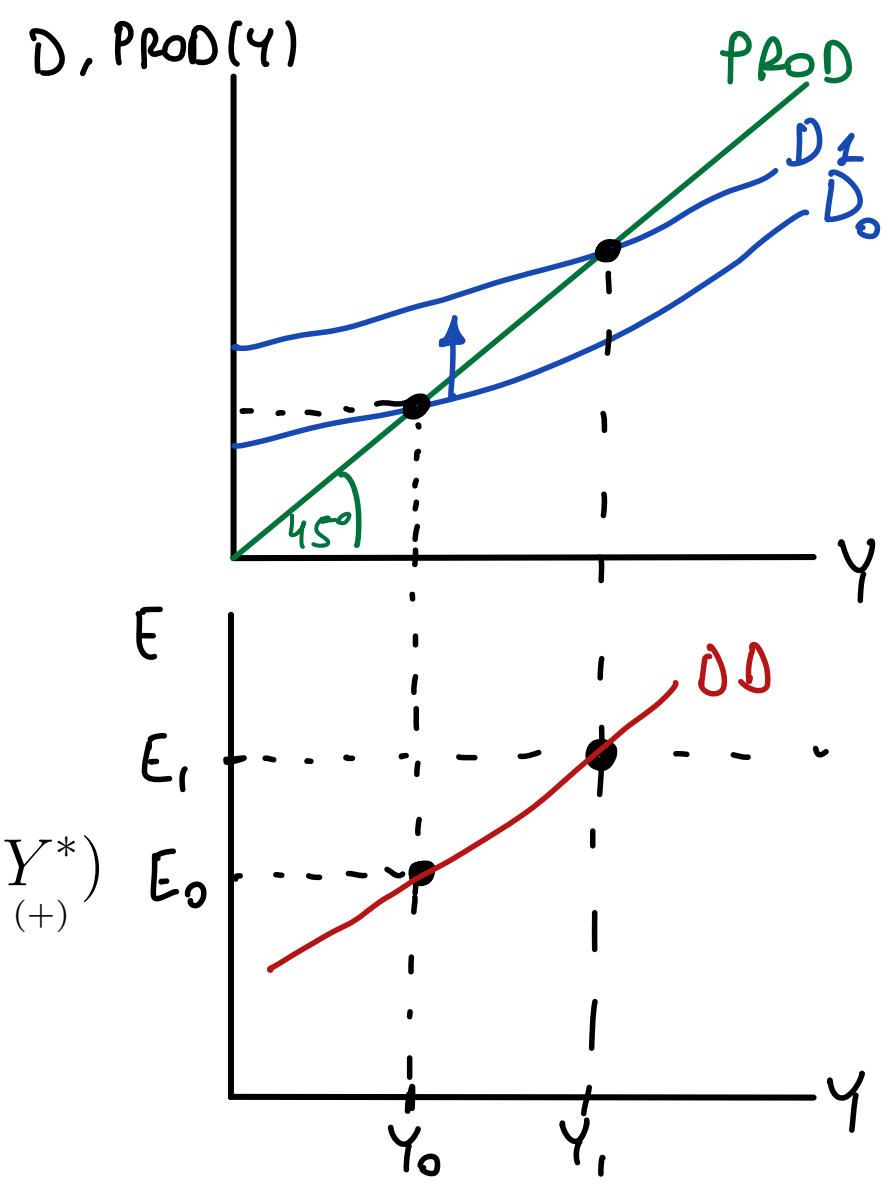
$$Y = D$$

$$Y = C + I + G + \mathrm{CA}$$

$$Y = \underset{(+)}{\mathrm{C}}(Y_D) + I + G + \underset{(+)}{\mathrm{CA}}(\underset{(+)}{q}, \underset{(-)}{Y_D}, \underset{(+)}{Y^*})$$

$$Y = \underset{(+)}{\mathrm{C}}(Y_D) + I + G + \underset{(+)}{\mathrm{CA}}(\underset{(+)}{EP^*/P}, \underset{(-)}{Y_D}, \underset{(+)}{Y^*})$$

$Y\uparrow$ $C\uparrow$ BUT $CA\downarrow$. HOWEVER, D ALWAYS $\uparrow$



$D = C + I + G + NX$ WHEN Y ↑

C ↑ NX ↓ SO D?

NOT UNCLEAR, D ↑

C: CONS. OF DOM. AND FOREIGN GOODS

C − IM = DOM DEM. FOR DOM GOOD

$NX = EX - IM$

DOES NOT CHANGE — IM GOES UP

$C = C_{DOM\ GOOD} + C_{FOREIGN\ GOOD}$

IM - DOM DEMAND FOR FOREIGN

Short-run FX and money market model

Exogenous variables

Variable	Description
R^*	Foreign interest rate
E^e	Expected exchange rate
Y	Real income
M^s	Money supply
P	Price level

Endogenous variables

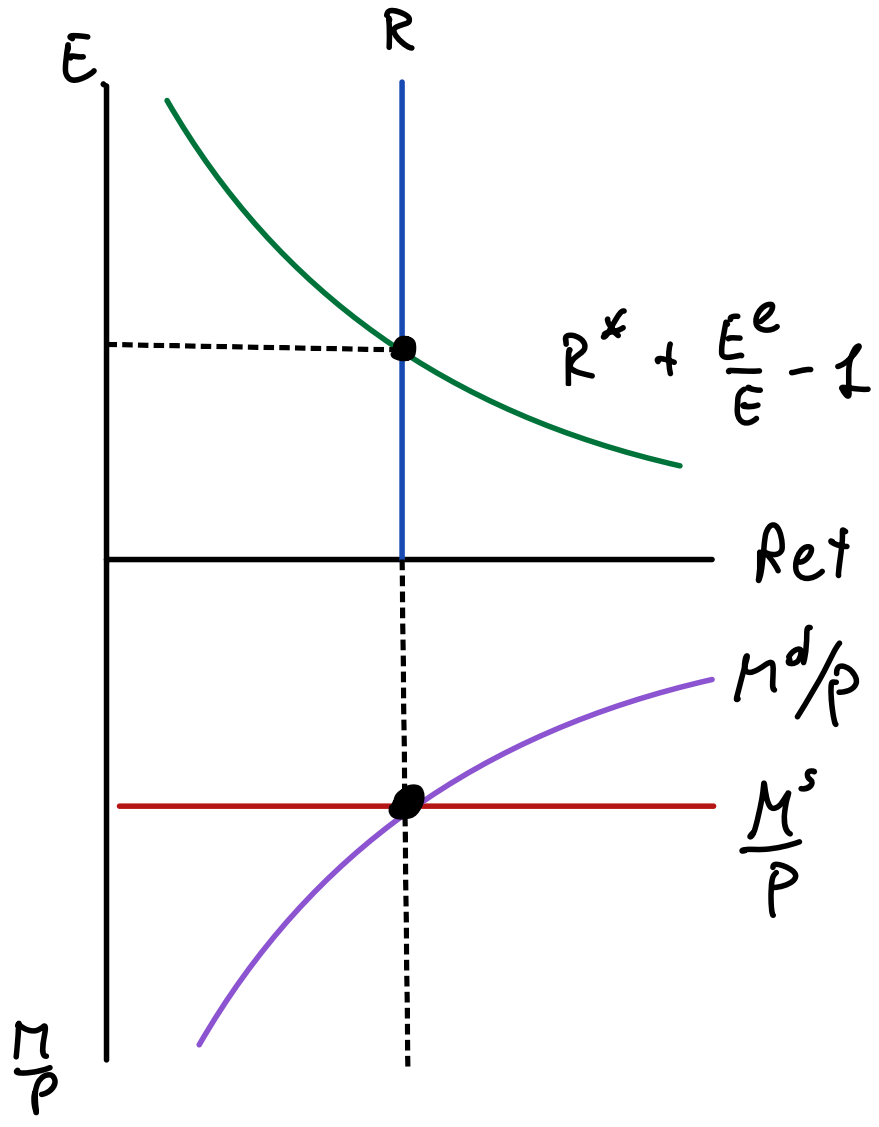
Variable	Description	Equation	Type of equation
E	Exchange rate	$R = R^* + \frac{E^e - E}{E}$	Equilibrium condition
R	Domestic interest rate	$M^d/P = \mathrm{L}(R, Y)$	Behavioral equation
M^d	Money demand	$M^d = M^s$	Equilibrium condition

AA Curve

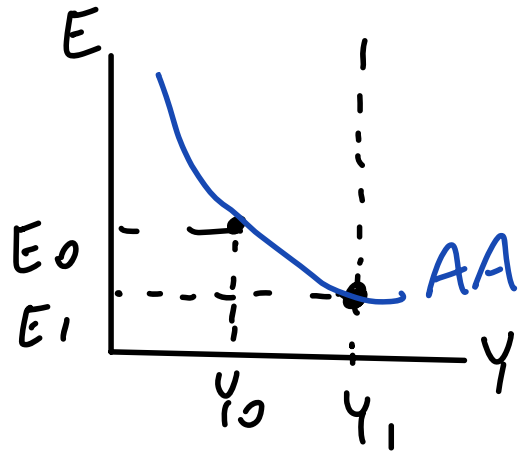
$$\text{(UIP):} \qquad R = R^* + \frac{E^e}{E} - 1$$

$$\text{(MS)} = \text{(MD)}: \qquad \frac{M^s}{P} = \underset{(-)\ (+)}{\mathrm{L}(R, Y)}$$

Y EXO, E ENDO } FIND E FOR GIVEN Y



AA Curve

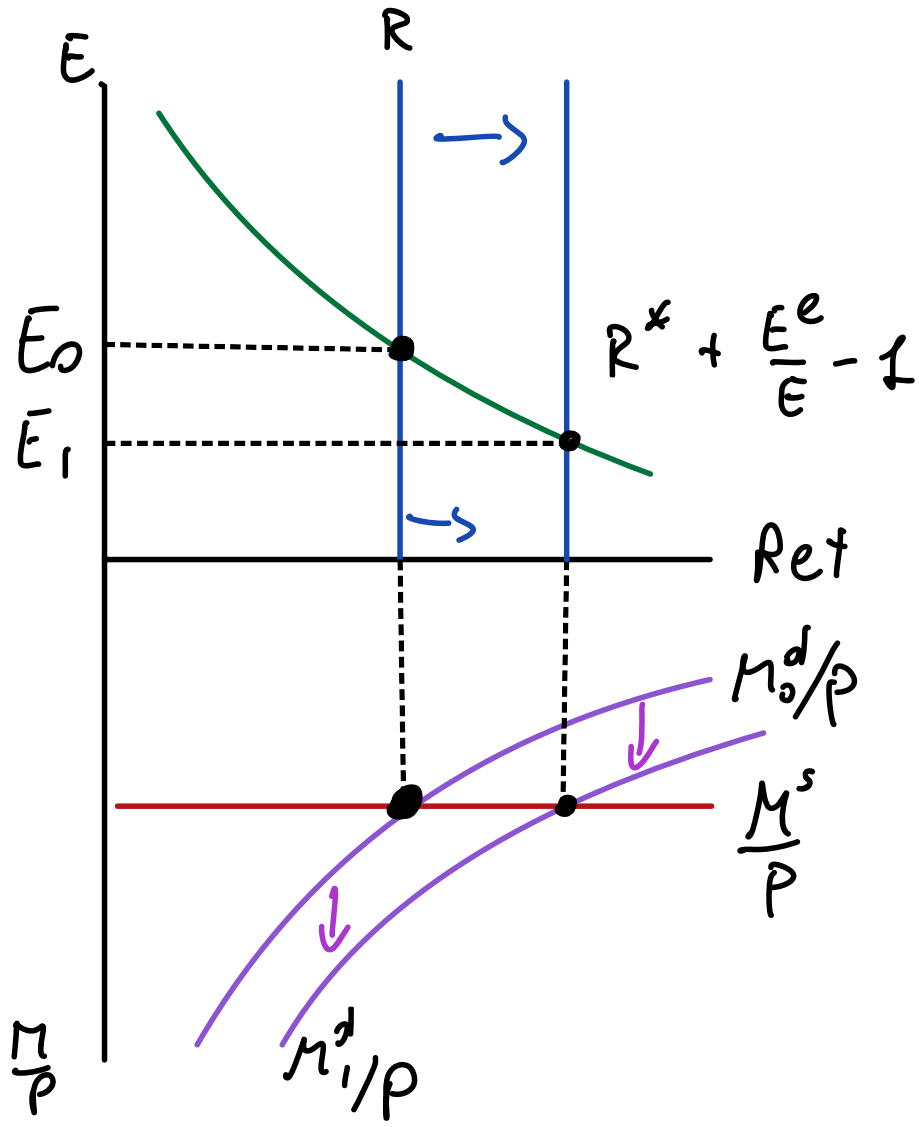


$$\text{(UIP):} \qquad R = R^* + \frac{E^e}{E} - 1$$

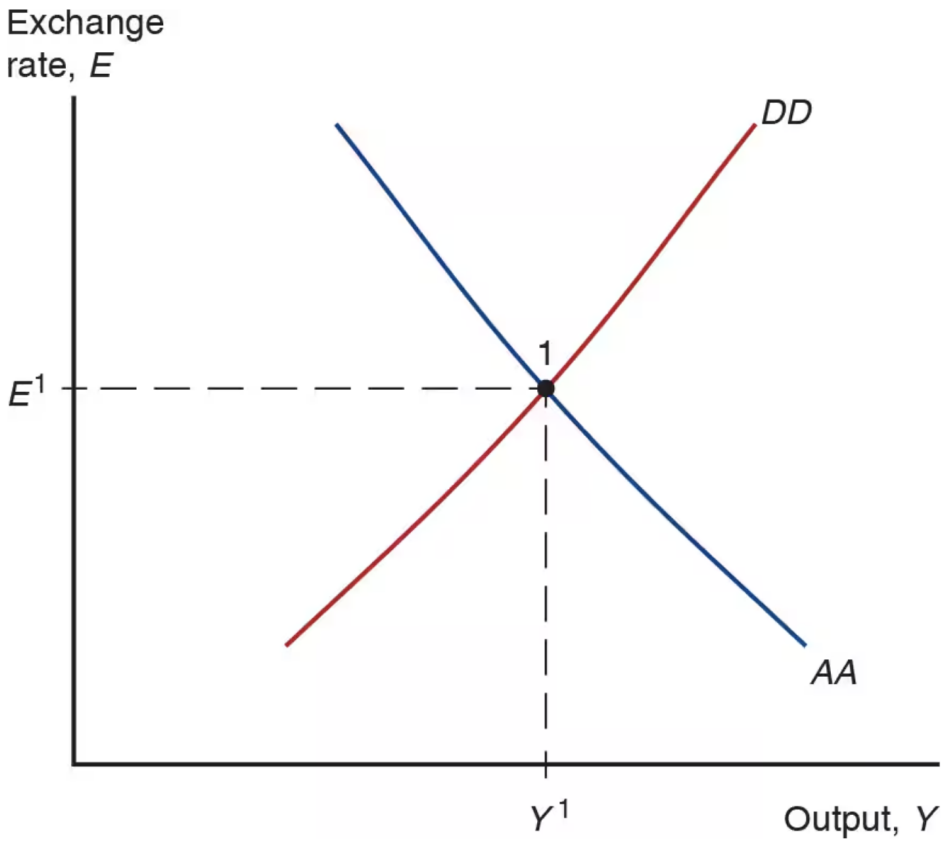
$$\text{(MS)} = \text{(MD)}: \qquad \frac{M^s}{P} = \underset{(-)\ (+)}{\mathrm{L}(R, Y)}$$

(Y_0, E_0) WITH $Y_1 > Y_0$

(Y_1, E_1) $E_1 < E_0$



Short-run Equilibrium in *AA-DD* model



GOODS

E EXO

MM + FX

Y EXO

COMBINE

Y, E ARE BOTH ENDO

Example: DD Schedule

$$\underset{(+)}{\mathrm{C}}(Y_D) = 1 + 0.75Y_D$$

$$\mathrm{EX}(\underset{(+)}{q}, \underset{(+)}{Y^*}) = 0.15 + 0.5q + 0.1Y^*$$

$$\mathrm{IM}(\underset{(-)}{q}, \underset{(+)}{Y_D}) = 0.1 - 0.2q + 0.12Y_D$$

$$Y_D = Y - T$$

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

How to find the DD schedule

EQ. COND FOR GOODS:

$Y = D$

$Y = C + I + G + CA$

$Y = 1 + 0.75(Y-T) + I + G +$

$+ 0.15 + 0.5q + 0.1Y^*$

$- 0.1 + 0.2q - 0.12(Y-T)$

Example: DD Schedule

$$\underset{(+)}{\mathrm{C}}(Y_D) = 1 + 0.75Y_D$$

$$\mathrm{EX}(\underset{(+)}{q}, \underset{(+)}{Y^*}) = 0.15 + 0.5q + 0.1Y^*$$

$$\mathrm{IM}(\underset{(-)}{q}, \underset{(+)}{Y_D}) = 0.1 - 0.2q + 0.12Y_D$$

$$Y_D = Y - T$$

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

- CAN SOLVE FOR E TO GET EXPLICIT

E = FUNCTION OF Y.

How to find the DD schedule

$$Y = 1 + 0.75(Y - T) + I + G + 0.15 + 0.5q + 0.1Y^* - 0.1 + 0.2q - 0.12(Y - T)$$

$$Y = 1 + 0.15 - 0.1 + I + G + (0.75 - 0.12)(Y - T) + (0.5 + 0.2)\frac{EP^*}{P} + 0.1Y^*$$

Example: AA Schedule

- CAN SOLVE FOR E TO GET:

E = FUNCTION OF Y

$$R = R^* + \frac{E^e - E}{E}$$

$$\frac{M^d}{P} = \frac{M^s}{P}$$

$$\frac{M^d}{P} = \mathrm{L}(\underset{(-)}{R}, \underset{(+)}{Y})$$
$$= 1.1 - R + 0.05Y$$

How to find the AA schedule

$$\frac{M^s}{P} = \frac{M^d}{P}$$

$$\frac{M^s}{P} = 1.1 - R + 0.5Y$$

$$\frac{M^s}{P} = 1.1 - R^* - \frac{E^e}{E} + 1 + 0.5Y$$

Example: AA Schedule

$$R = R^* + \frac{E^e - E}{E}$$

$$\frac{M^d}{P} = \frac{M^s}{P}$$

$$\frac{M^d}{P} = \mathrm{L}(\underset{(-)}{R}, \underset{(+)}{Y})$$
$$= 1.1 - R + 0.05Y$$

- CAN SOLVE FOR E TO GET:

E = FUNCTION OF Y

How to find the AA schedule

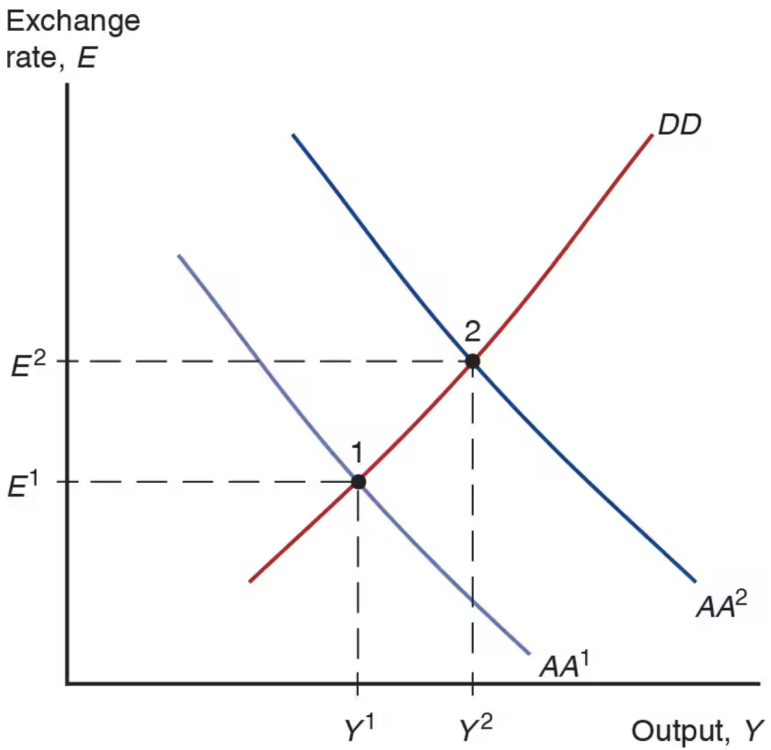
$$\frac{M^s}{P} = 1.1 - R^* - \frac{E^e}{E} + 1 + 0.5Y$$

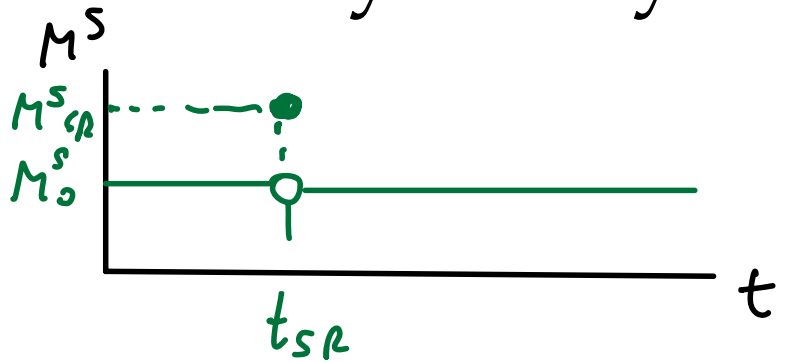
SOLVE FOR E:

$$E^e/E = 1.1 - R^* + 1 - M^s/P + 0.5Y$$

$$E = \frac{E^e}{1.1 - R^* + 1 - M^s/P + 0.5Y}$$

Temporary Change in Monetary Policy





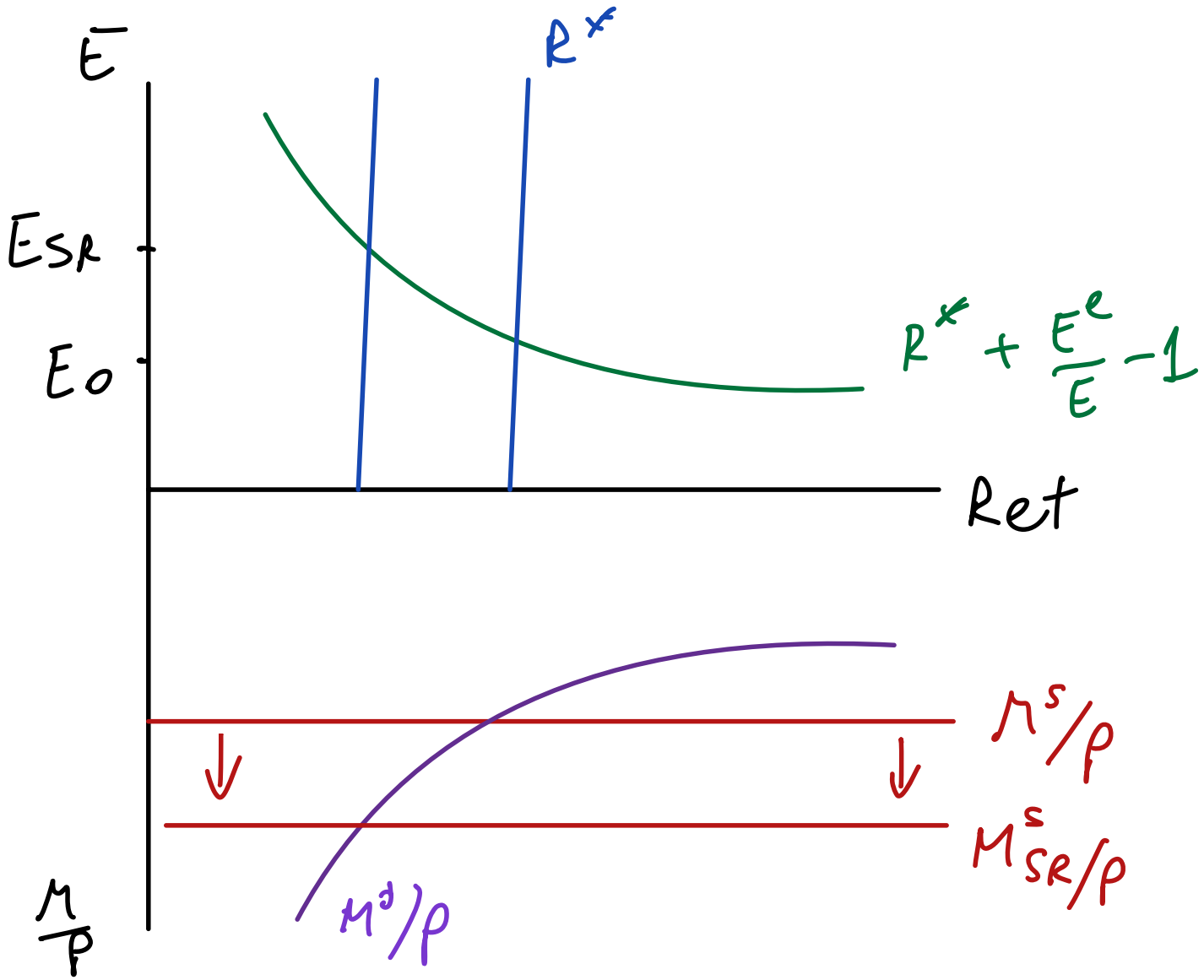
TEMPORARY SHOCKS

- KEEP LONG RUN E UNCHANGED $\Rightarrow$ $E^e_{SR} = E_{LR}$ UNCHANGED
- $P_{SR} = P_0$ FIXED

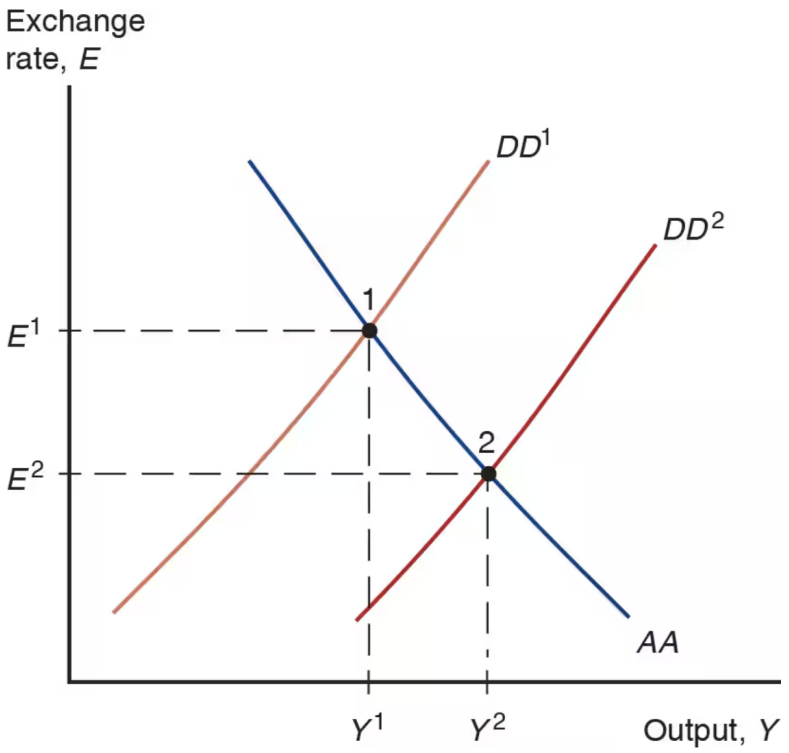
$M^S \uparrow$

LEADS TO

$E \uparrow$



Temporary Change in Fiscal Policy



G↑ IN SR ONLY

D↑ Y↑ FOR ANY $\bar{E}$

=> DD SHIFTS TO THE RIGHT

Example: DD Schedule

$$\underset{(+)}{\mathrm{C}}(Y_D) = 1 + 0.75Y_D$$

$$\mathrm{EX}(\underset{(+)}{q}, \underset{(+)}{Y^*}) = 0.15 + 0.5q + 0.1Y^*$$

$$\mathrm{IM}(\underset{(-)}{q}, \underset{(+)}{Y_D}) = 0.1 - 0.2q + 0.12Y_D$$

$$Y_D = Y - T$$

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

- Plug in given C, EX, IM, Y_D, q into the equilibrium condition for the goods market $Y = C + I + G + \mathrm{EX} - \mathrm{IM}$ to get:

$$Y = 1.05 + 0.63(Y - T) + 0.7\frac{EP^*}{P} + I + G + 0.1Y^*$$

- Solve for E to get the DD curve:

$$E = \frac{1}{0.7}\frac{P}{P^*}\left(-1.05 + 0.37Y + 0.63T - I - G - 0.1Y^*\right)$$

Example: AA Schedule

$$R = R^* + \frac{E^e}{E} - 1$$

$$\frac{M^d}{P} = \frac{M^s}{P}$$

$$\frac{M^d}{P} = \mathrm{L}(\underset{(-)}{R}, \underset{(+)}{Y}) = 1.1 - R + 0.05Y$$

- Plug in UIP into money market equilibrium condition:

$$\frac{M^s}{P} = 1.1 - \left(R^* + \frac{E^e}{E} - 1\right) + 0.05Y$$

- Solve for E to get the AA curve:

$$E = \frac{E^e}{2.1 - \frac{M^s}{P} - R^* + 0.05Y}$$

Full AA-DD Model

$$\text{DD Schedule:} \quad Y = \text{C}(Y - T) + I + G + \text{CA}(EP^*/P, Y - T, Y^*)$$

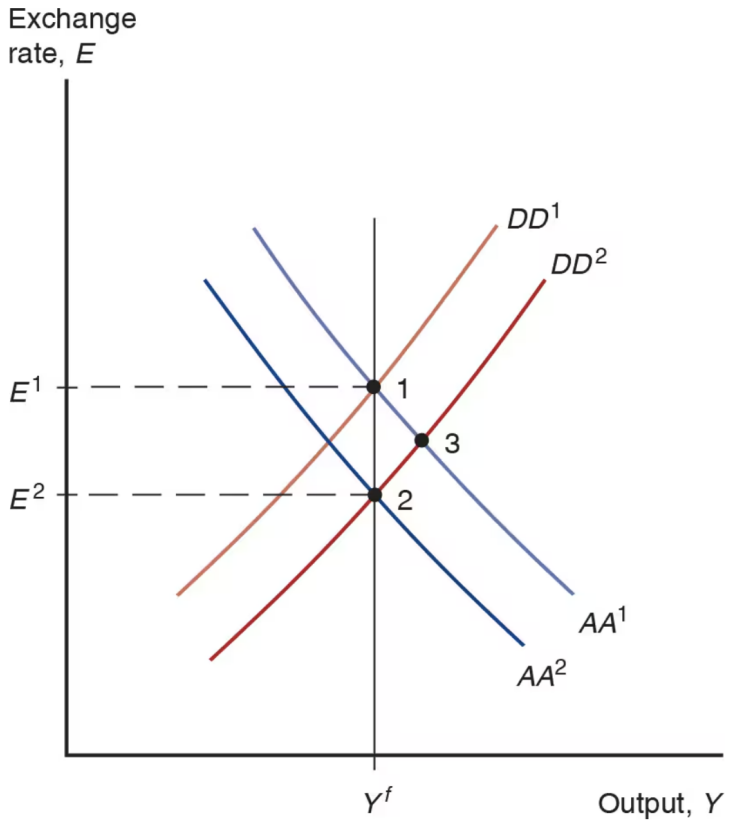
$$\text{AA Schedule:} \quad \frac{M^s}{P} = \text{L}\left(R^* + \frac{E^e}{E} - 1, Y\right)$$

$$\text{Phillips Curve:} \quad \pi = \pi^e + \alpha(Y - Y^f)$$

$$\text{Definition of inflation:} \quad \pi_t = \frac{P_t}{P_{t-1}} - 1$$

$$\text{Definition of expected inflation:} \quad \pi_t^e = \frac{P_{t+1}^e}{P_t} - 1$$

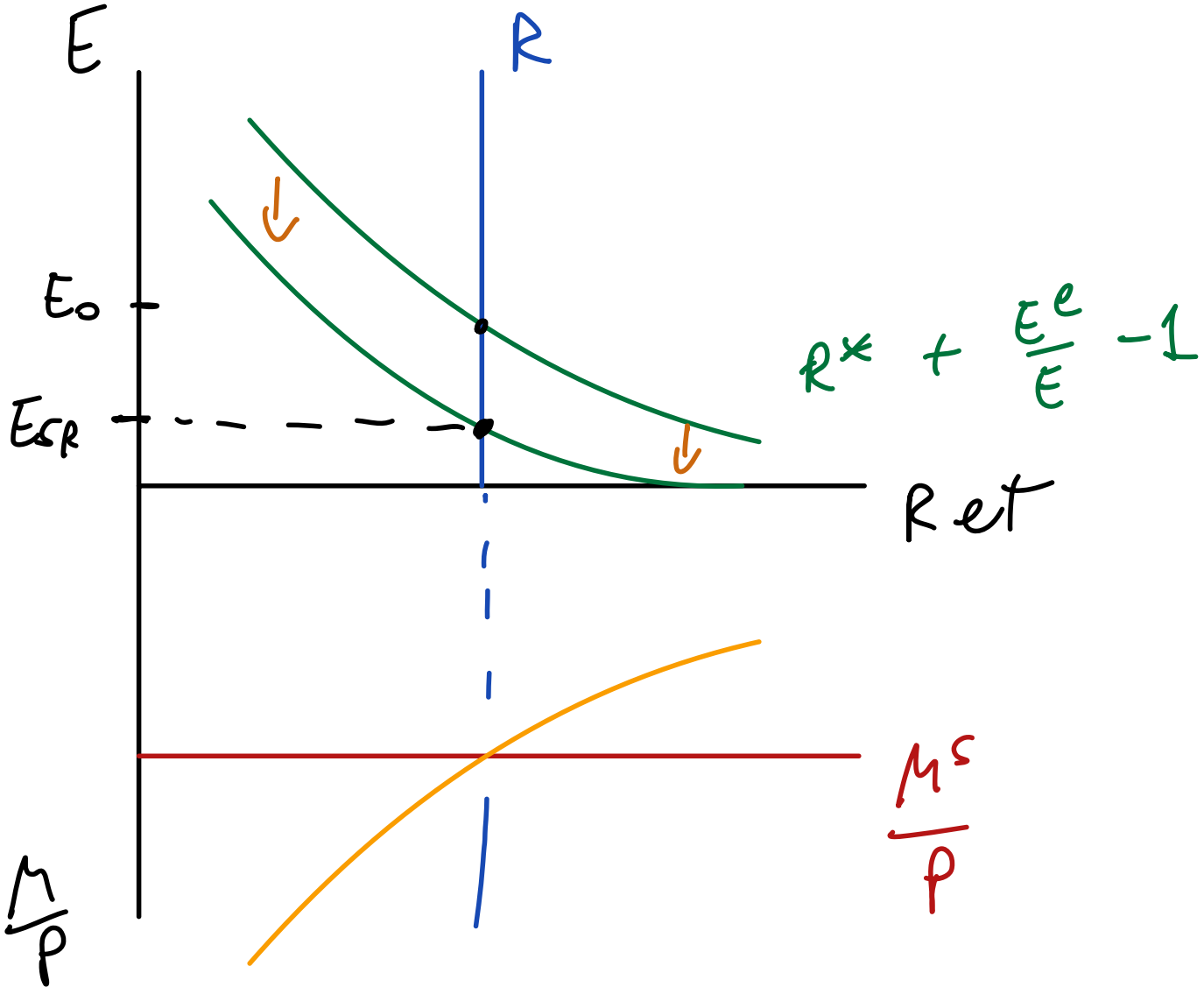
Permanent Shifts in Fiscal Policy



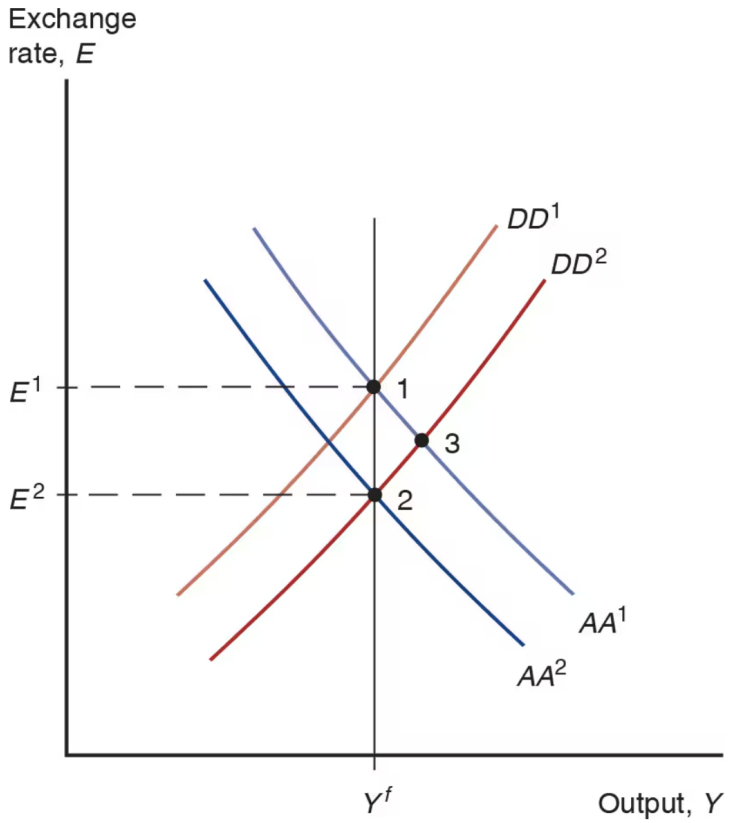
G↑ PERMANENTLY

=> D↑ => Y↑ => DD SHIFTS TO THE RIGHT

$$(AA): \frac{M^S}{P} = L\left(R^* + \frac{E^e - E}{E}, Y\right)$$

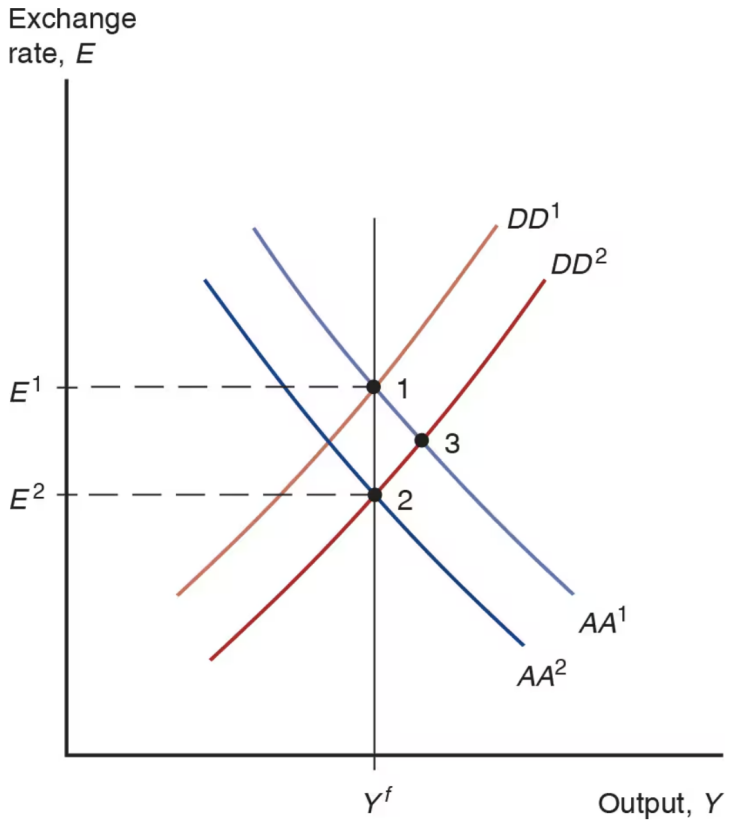

E
R
E_0
E_{cR}
$R^* + \frac{E^e}{E} - 1$
R et
$\frac{M^s}{P}$
$\frac{M}{P}$

Permanent Shifts in Fiscal Policy



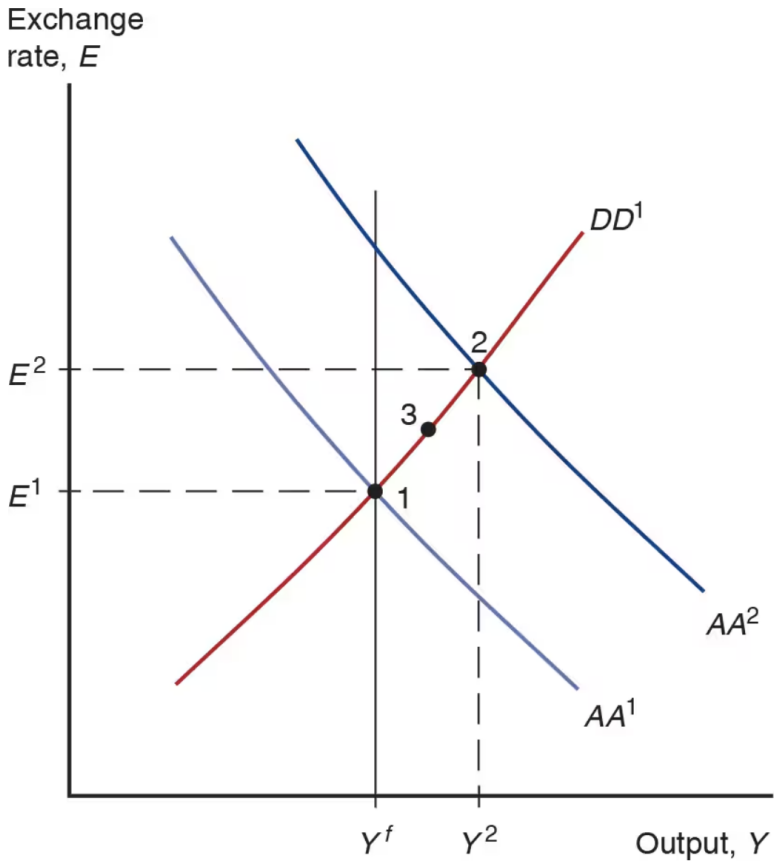
- Start in a medium run equilibrium at point 1 with $R_0 = R^*$ and $E_0^e = E^1$
- Increase in G shifts DD to the right
- At point 3, exchange rate is lower than E_1
- Since the shift in DD is permanent, appreciation at point 3 is also expected to be permanent
- E^e must also go down
- Lower E^e shifts AA down
- But how much?

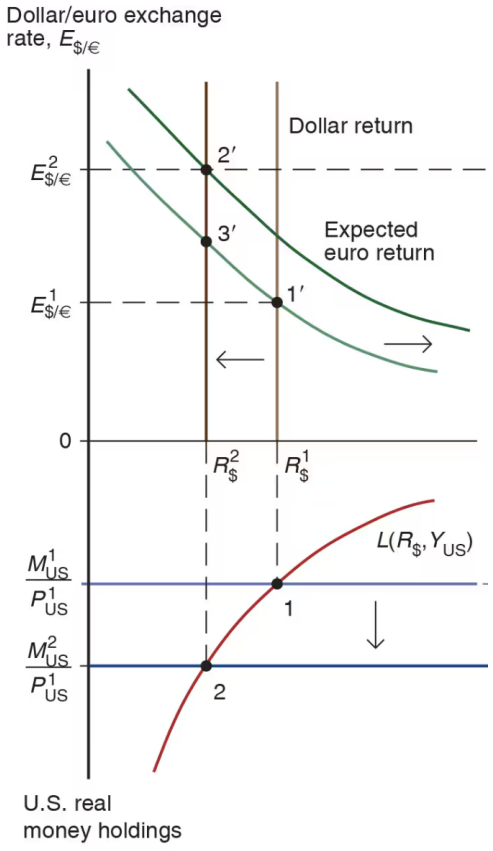
Permanent Shifts in Fiscal Policy



- There are no more shifts expected to occur, E^e remains constant
- Real money supply is constant
- Long run real money demand must stay unchanged
- Then P never changes
- MS=MD implies R does not change
- UIP implies E does not change either
- If Y must be equal to its original level Y^f, AA^1 must shift to AA^2

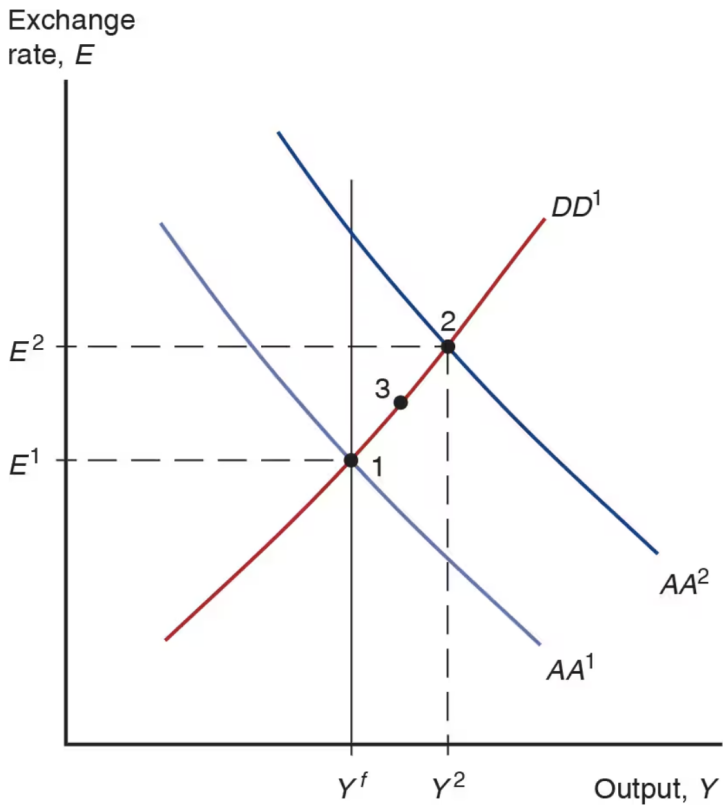
Permanent Shifts in Monetary Policy

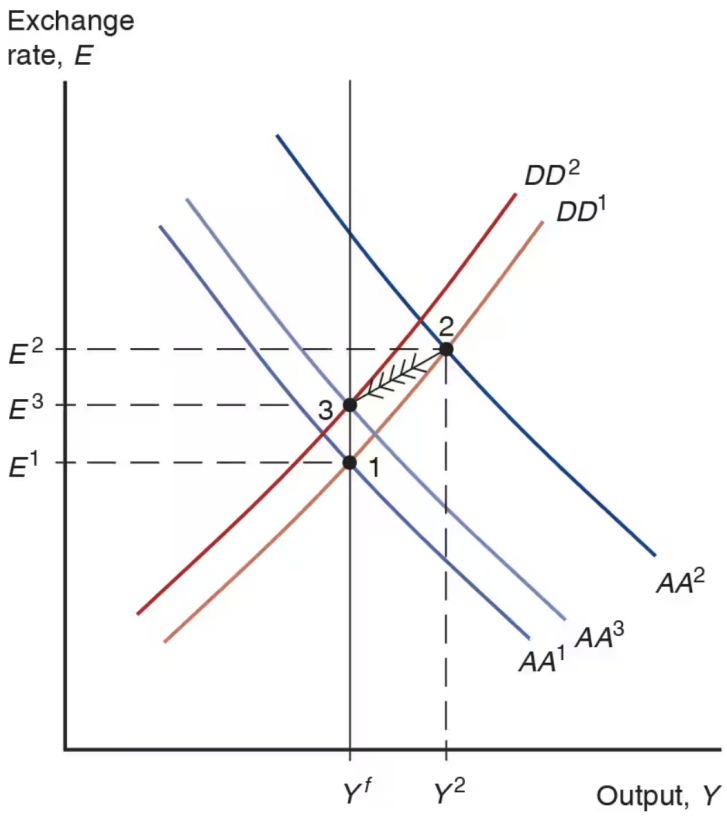




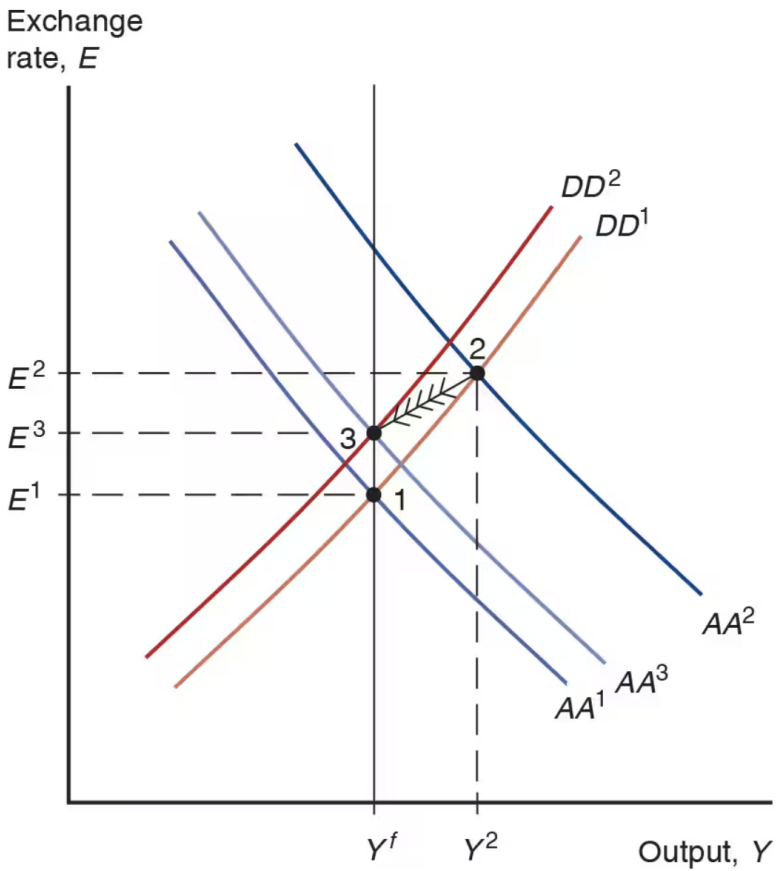
(a) Short-run effects

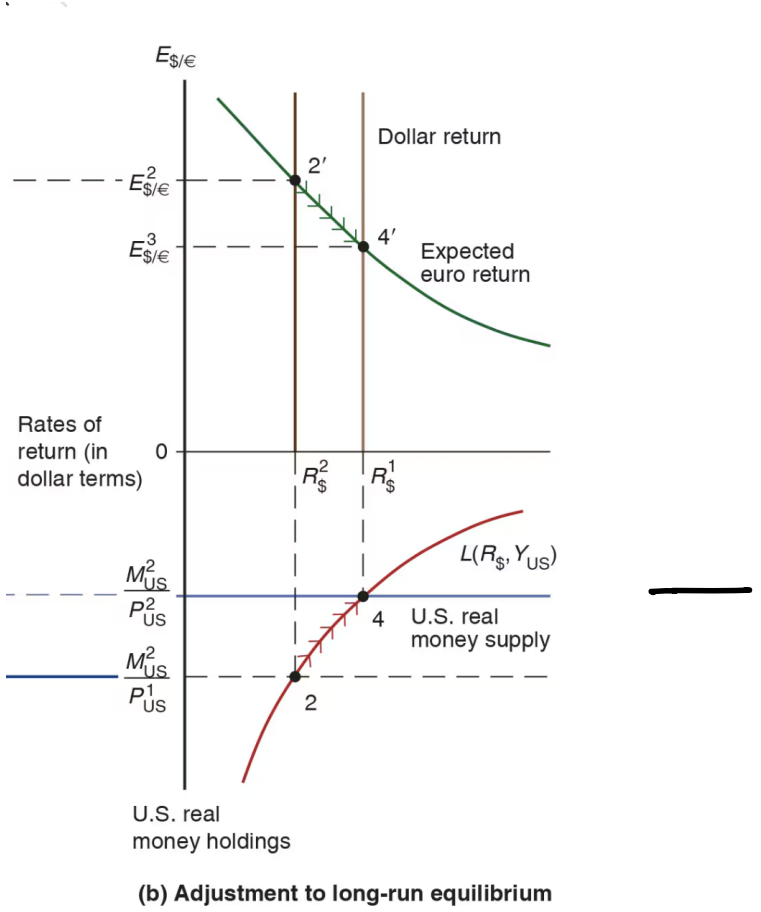
Permanent Shifts in Monetary Policy





Permanent Shifts in Monetary Policy





(b) Adjustment to long-run equilibrium

DD Schedule with Tariffs

IMPORT TARIFFS - "AD VALOREM" → PROPORTIONAL

$$IM = q \times VOLUME$$

- IM: UNITS OF DOM GOOD
- q: CHANGE OF UNITS
- $VOLUME$: IN UNITS OF FOREIGN GOOD

$$IM(q, Y-T)$$
$$(-) \quad (+)$$

$$= q \times VOLUME(q, Y-T)$$
$$(-) \quad (+)$$

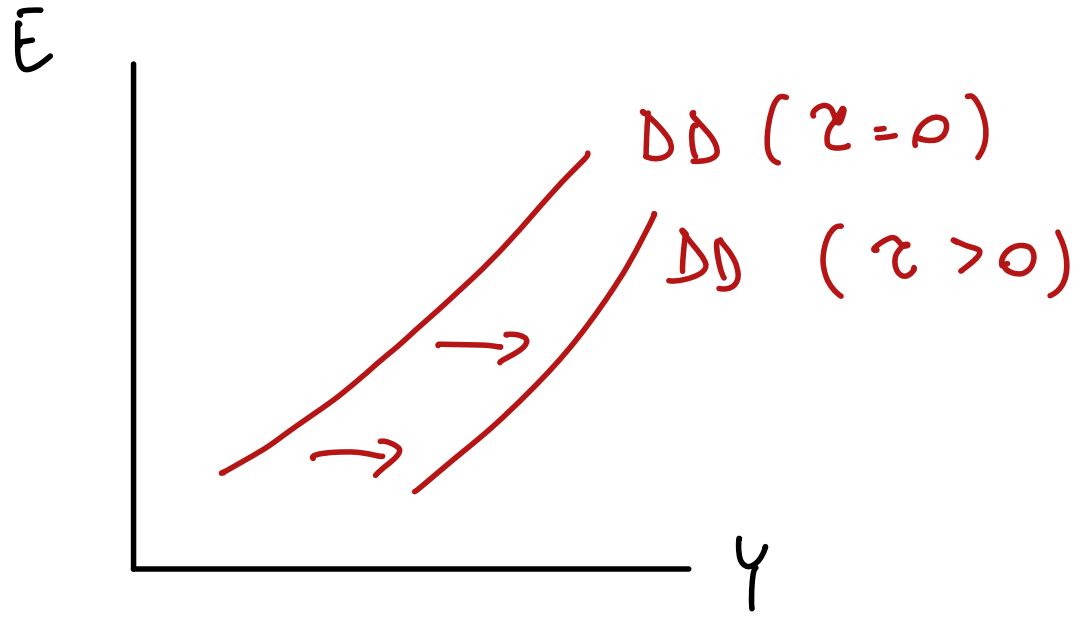
$$= q \, VOLUME\left(\frac{EP^*}{P}, Y-T\right)$$

$$IM = q \times VOLUME\left(\frac{EP^{*}(1+\tau)}{P}, Y - T\right)$$

AD VALOREM TARIFF

$$IM = IM\underset{(-)}{(}q\underset{(-)}{,}\ Y-T\underset{(+)}{,}\ \tau\underset{(-)}{)}$$

$$Y = C + I + G + EX - IM\underset{(-)}{(}\tau)$$

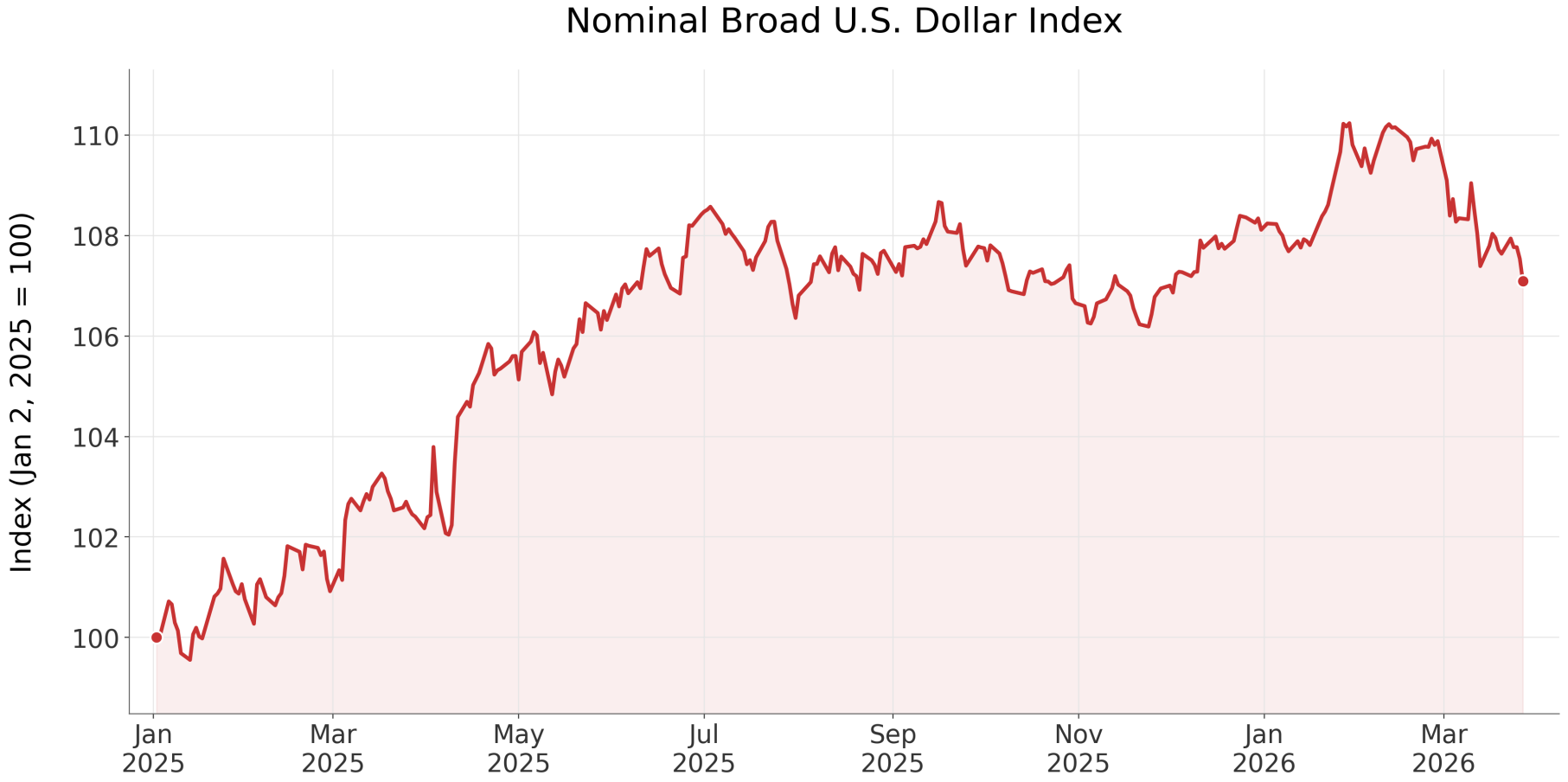


DD SHIFTS TO THE RIGHT WHEN τ GOES UP

ECON 1550 International Finance

A Tour of the World

Tariff Wars



Sources: Reuters tariff timeline; White House fact sheet (Feb. 20, 2026); data: FRED DTWEXBGS (Mar. 20, 2026).

Tariff authorities for executive branch

- **International Emergency Economic Powers Act, IEEPA (1977)** During declared national emergency
- **Section 232, Trade Expansion Act (1962)** For threats to national security
- **Section 301, Trade Act (1974)** To address unfair trade practices
- **Section 122, Trade Act (1974)** During balance-of-payments emergency

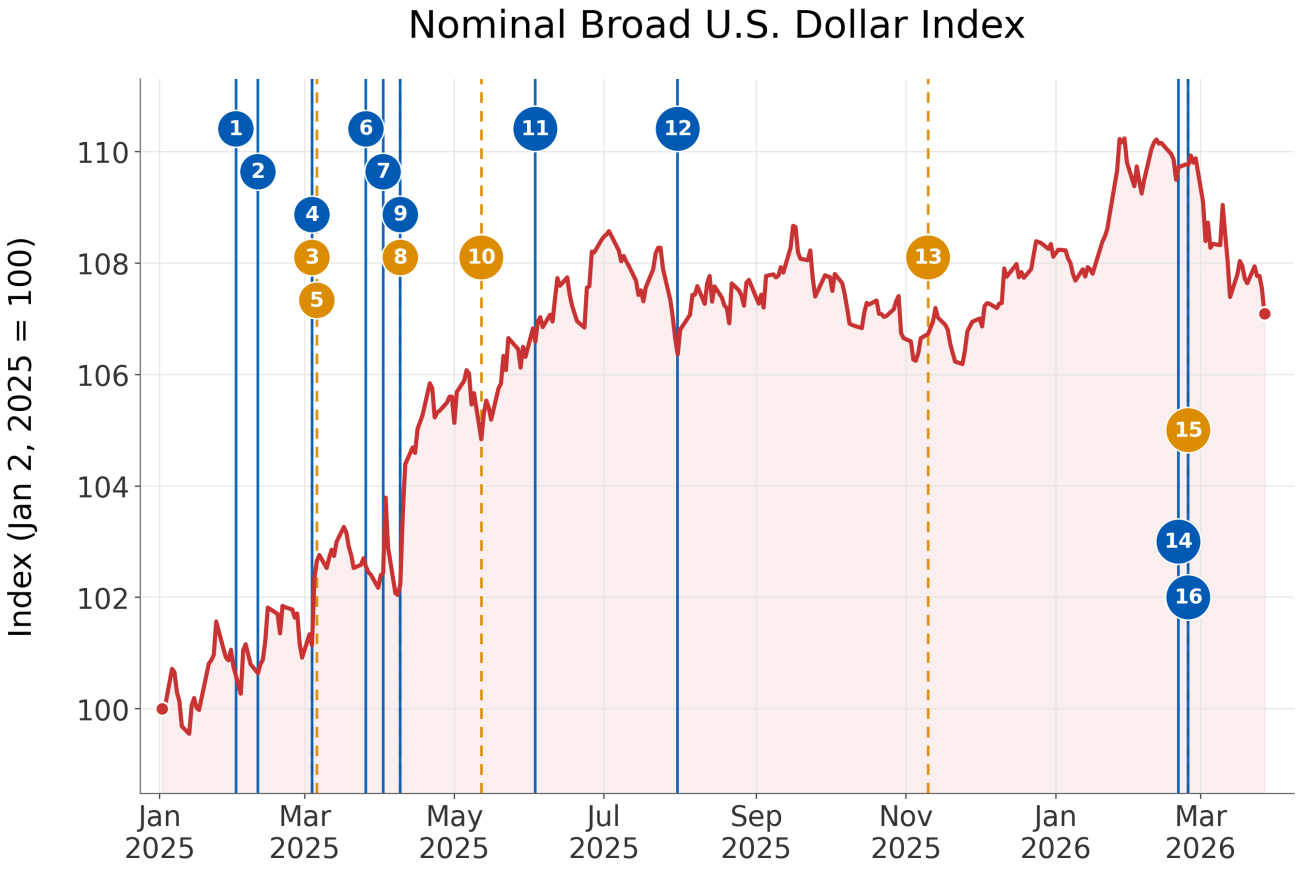
Declared emergencies for IEEPA tariffs

The failure of each country to…

- Canada — “take adequate steps to alleviate the illegal migration and illicit drug crises”
- Mexico — “arrest, seize, detain, or otherwise intercept Mexican drug trafficking organizations, other drug and human traffickers, criminals at large, and illicit drugs”
- China — “blunt the sustained influx of synthetic opioids”

Timeline of major tariff events

	Event	TACO
2025		
Feb 1	25% on Canada/Mexico; 10% on China (IEEPA)	Canada/Mexico delayed to Mar 4
Feb 10	Steel/aluminum to 25%, no exemptions (Sec. 232)	
Mar 4	Canada/Mexico take effect; China to 20%	Mar 6: USMCA-compliant exempt until Apr
Mar 26	25% on autos/parts (Sec. 232)	
Apr 2	“Liberation Day” 10% + country-specific	Apr 9: 10% paused ex China
Apr 9	China raised to 145%	May 12: 30% for 90 days; Nov: 1-yr deal
Jun 3	Steel/aluminum to 50% (Sec. 232); UK stays 25%	
Jul 31	Reciprocal tariffs on $\sim$60 partners (10–41%)	
2026		
Feb 20	Supreme Court strikes down IEEPA tariffs	All IEEPA tariffs terminated Feb 24
Feb 24	10% surcharge on most imports (Sec. 122)	Expires Jul 24, 2026

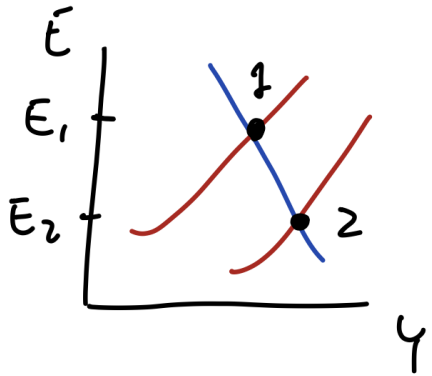


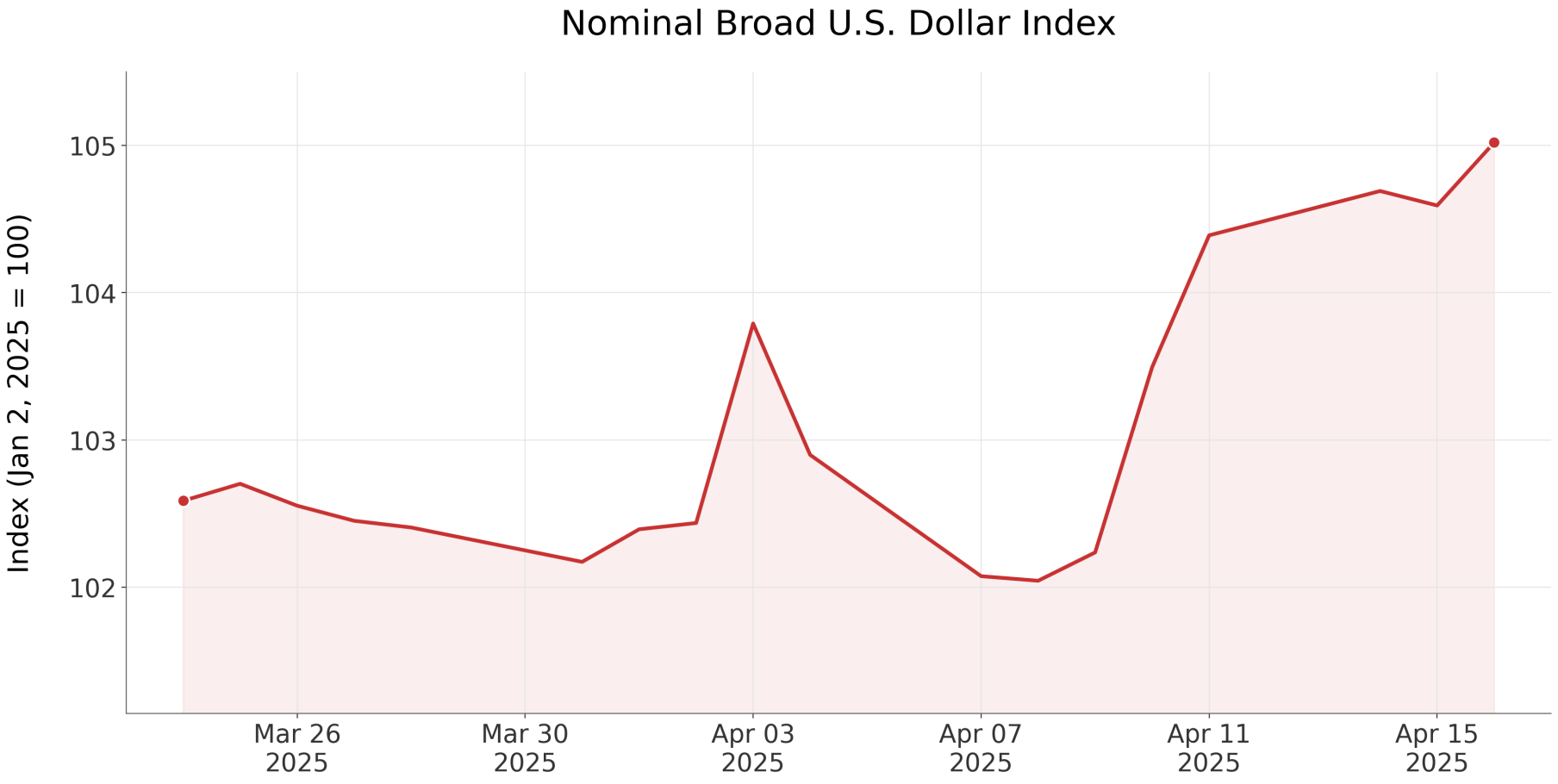
Event

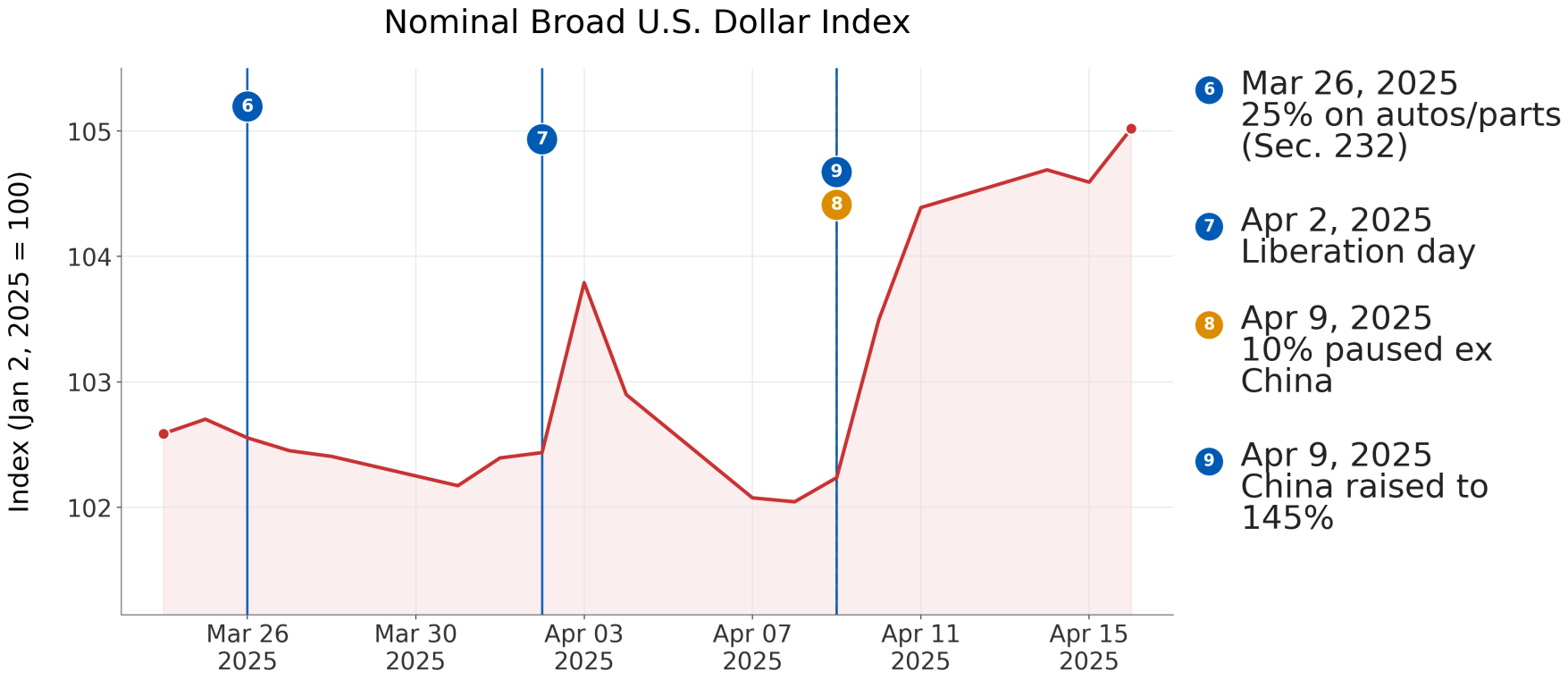
- 1 Feb 1, 2025
- 2 Feb 10, 2025
- 4 Mar 4, 2025
- 6 Mar 26, 2025
- 7 Apr 2, 2025
- 9 Apr 9, 2025
- 11 Jun 3, 2025
- 12 Jul 31, 2025
- 14 Feb 20, 2026
- 16 Feb 24, 2026

TACO

- 3 Mar 4, 2025
- 5 Mar 6, 2025
- 8 Apr 9, 2025
- 10 May 12, 2025
- 13 Nov 10, 2025
- 15 Feb 24, 2026




Nominal Broad U.S. Dollar Index
Index (Jan 2, 2025 = 100)
105
104
103
102
Mar 26
2025
Mar 30
2025
Apr 03
2025
Apr 07
2025
Apr 11
2025
Apr 15
2025


Nominal Broad U.S. Dollar Index
Index (Jan 2, 2025 = 100)
105
104
103
102
Mar 26
2025
Mar 30
2025
Apr 03
2025
Apr 07
2025
Apr 11
2025
Apr 15
2025
6
7
9
8
6 Mar 26, 2025
25% on autos/parts
(Sec. 232)
7 Apr 2, 2025
Liberation day
8 Apr 9, 2025
10% paused ex
China
9 Apr 9, 2025
China raised to
145%

The dollar fell despite rising tariffs

- Nominal broad dollar index: 129.46 on Jan 2, 2025 $\rightarrow$ 120.28 on Mar 20, 2026—roughly a 7% depreciation over about 15 months.
- AA-DD model says tariffs should make the dollar *appreciate*
- Yet the dollar weakened through most of the tariff escalation.

Why might tariffs weaken the dollar?

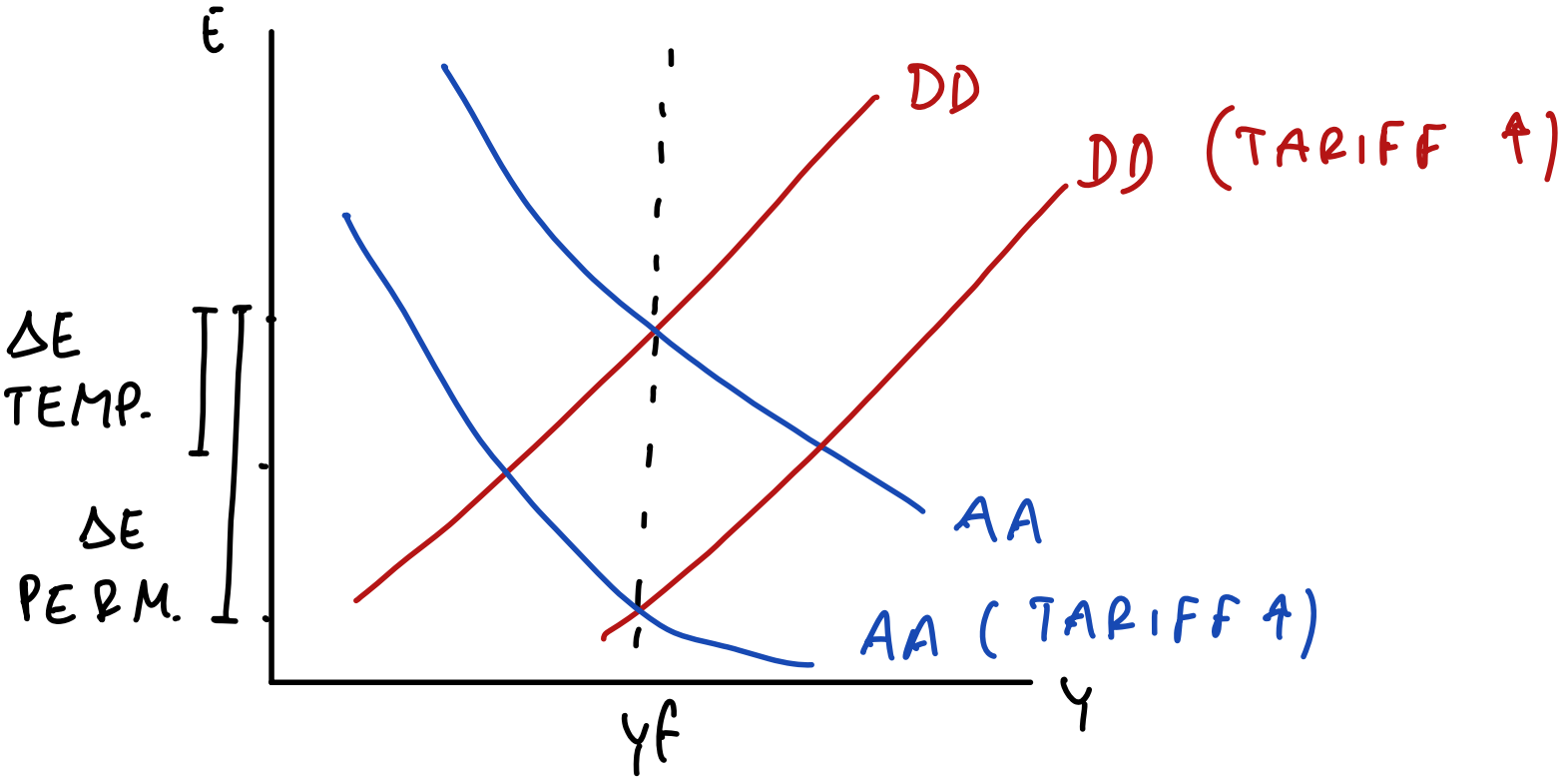
- Retaliation: trading partners imposed their own tariffs
- Duration of tariffs: the IEEPA legal challenge raised questions about tariffs being permanent or temporary
- Uncertainty: frequent reversals, volatile policies
- The overall behavior combines all effects

Retaliation: Not huge

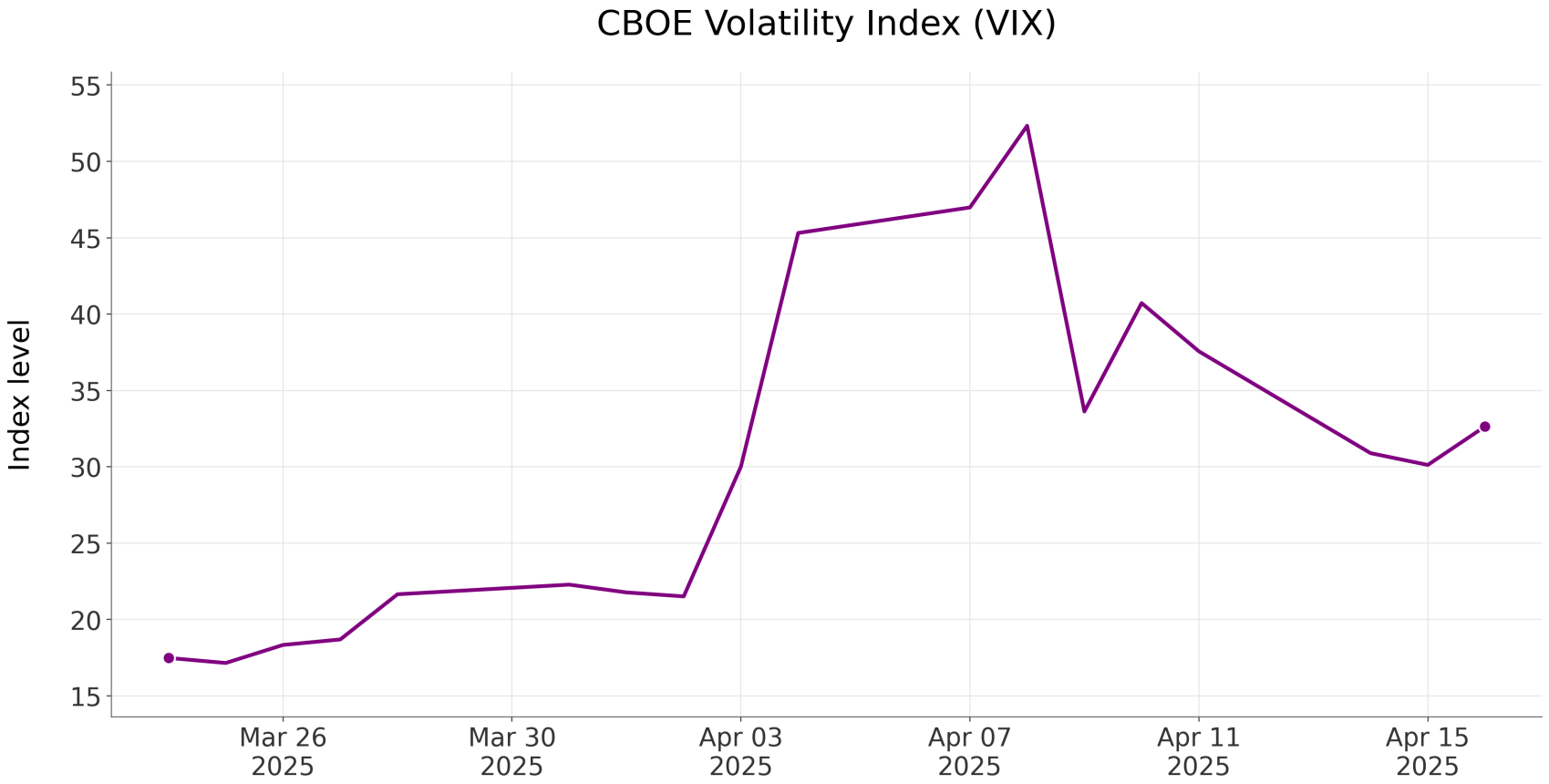
	Before (Jan 2025)	**Now** (Mar 2026)	**Peak** (Apr 2025)
On foreign goods entering the U.S.	2.2%	**10%**	**28%**
On U.S. goods entering other countries	1.9%	**3.2%**	—

Sources: Yale Budget Lab (peak); Tax Foundation; WTO tariff profiles; U.S. Census Bureau export data (2024). All figures are trade-weighted averages.

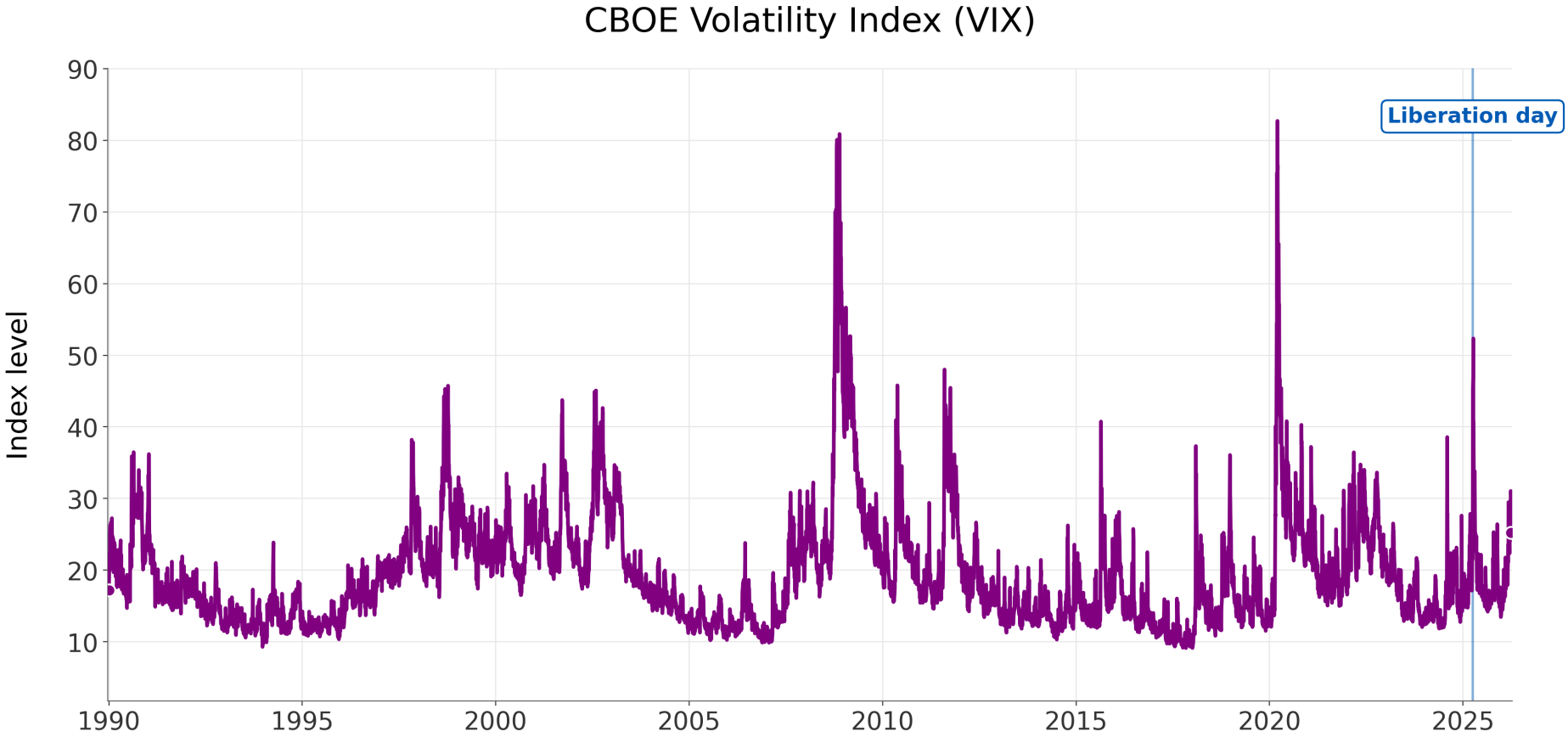
Duration of tariffs: changes size of appreciation only, not direction



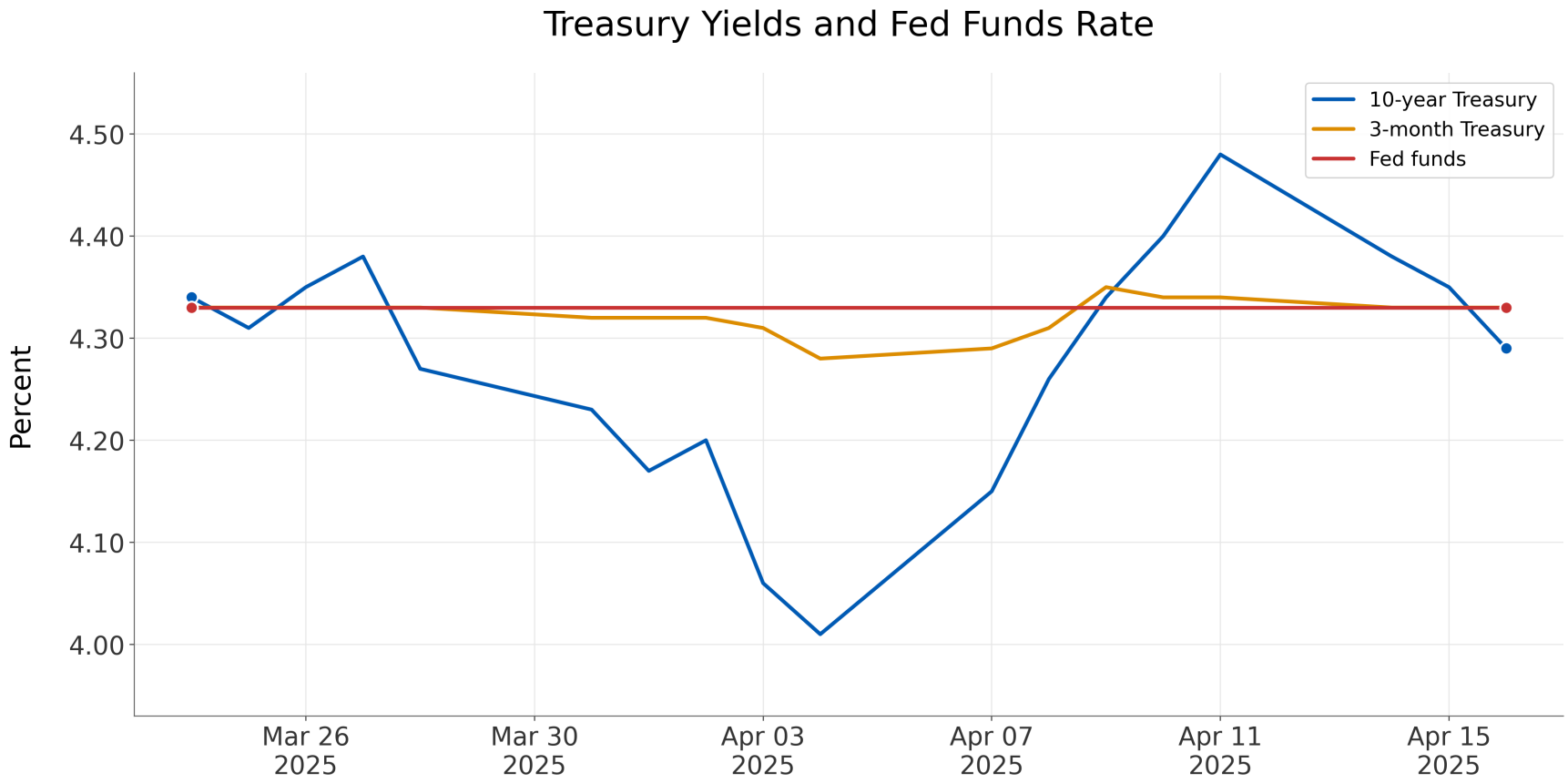
Uncertainty: Increase in risk premium



Source: FRED VIXCLS.


CBOE Volatility Index (VIX)
Index level
90
80
70
60
50
40
30
20
10
1990
1995
2000
2005
2010
2015
2020
2025
Liberation day

U.S. rates in the VIX window

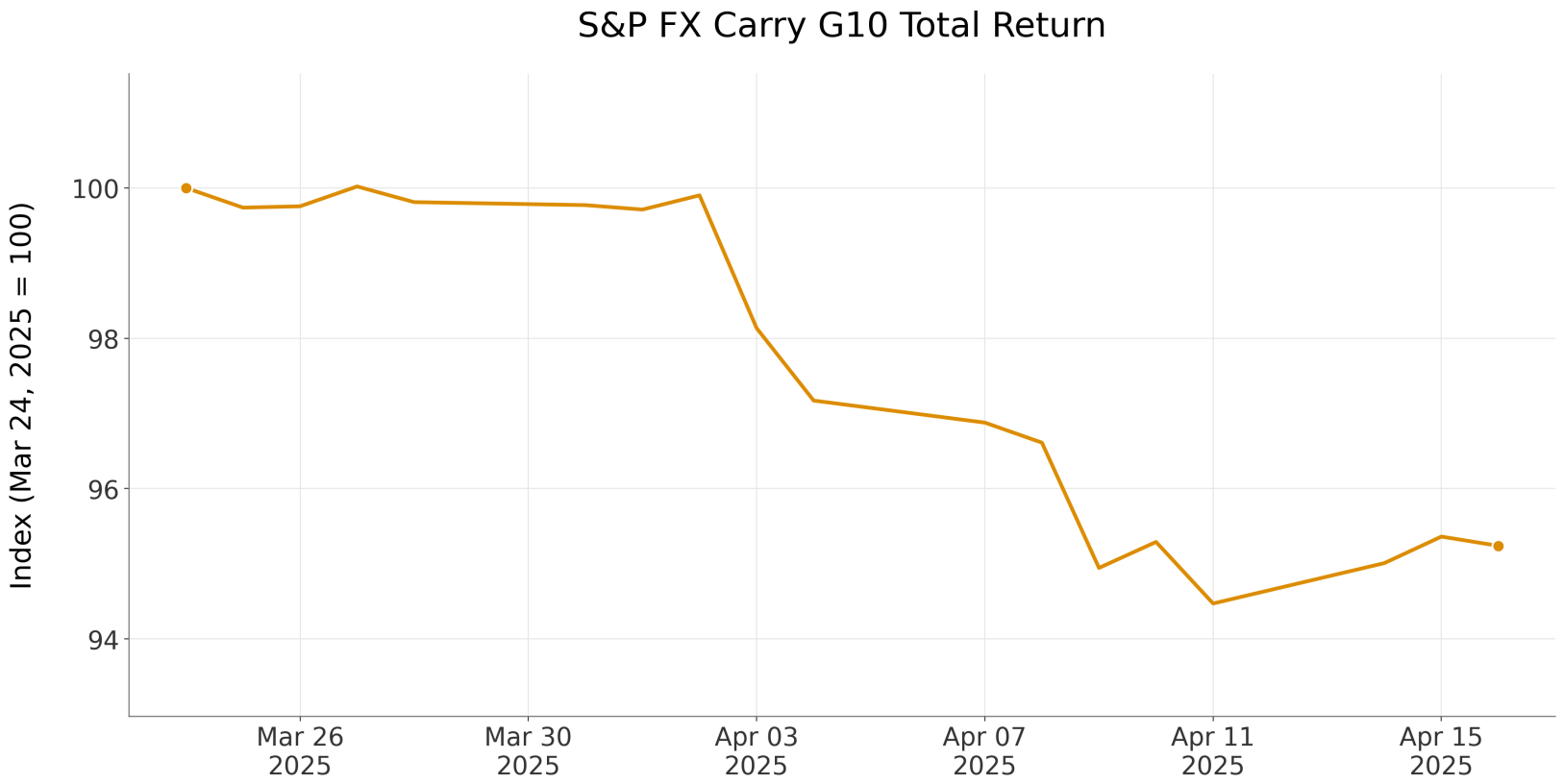


Source: FRED DGS10, FRED DGS3MO, and FRED DFF.

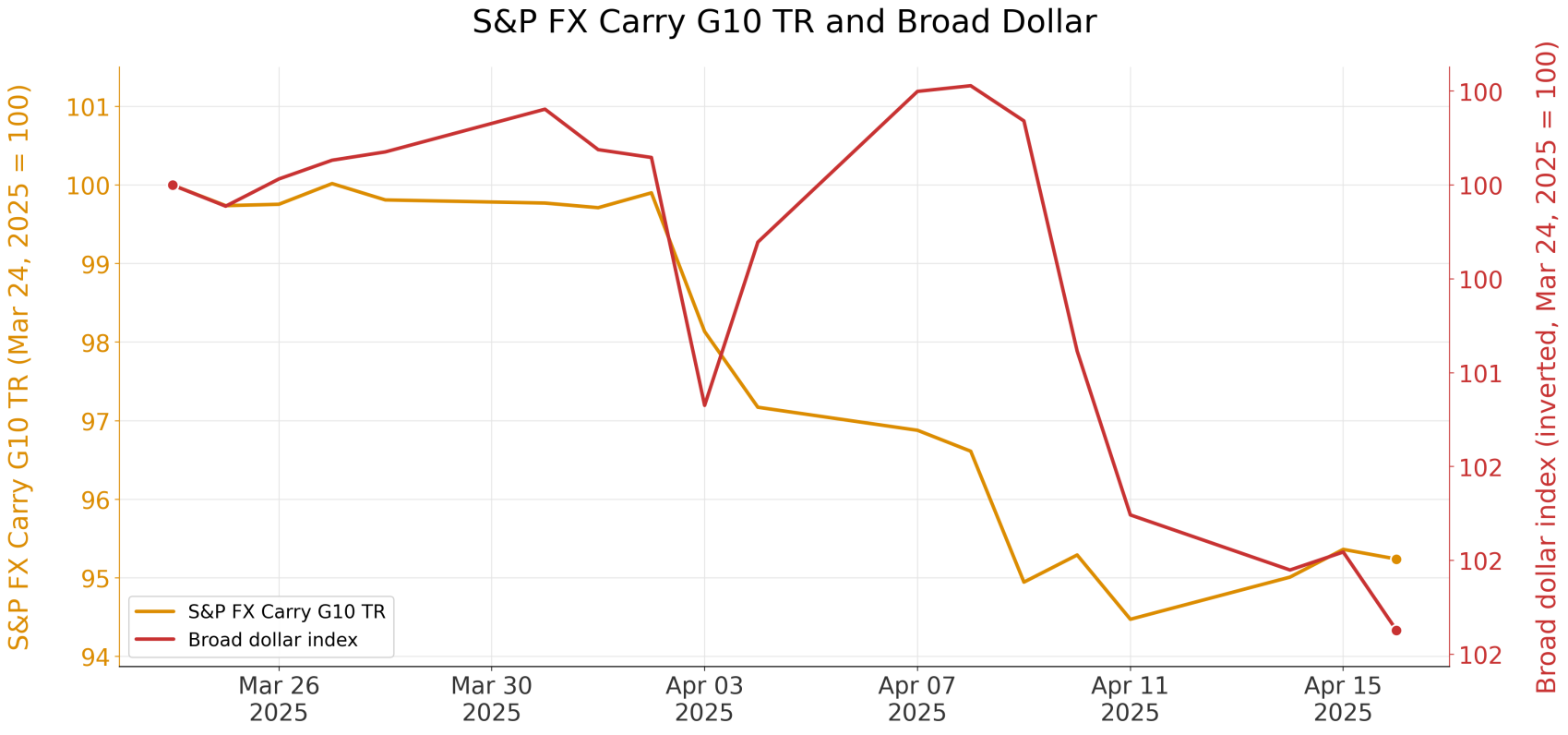
Carry Trade Index: S&P FX Carry G10 TR

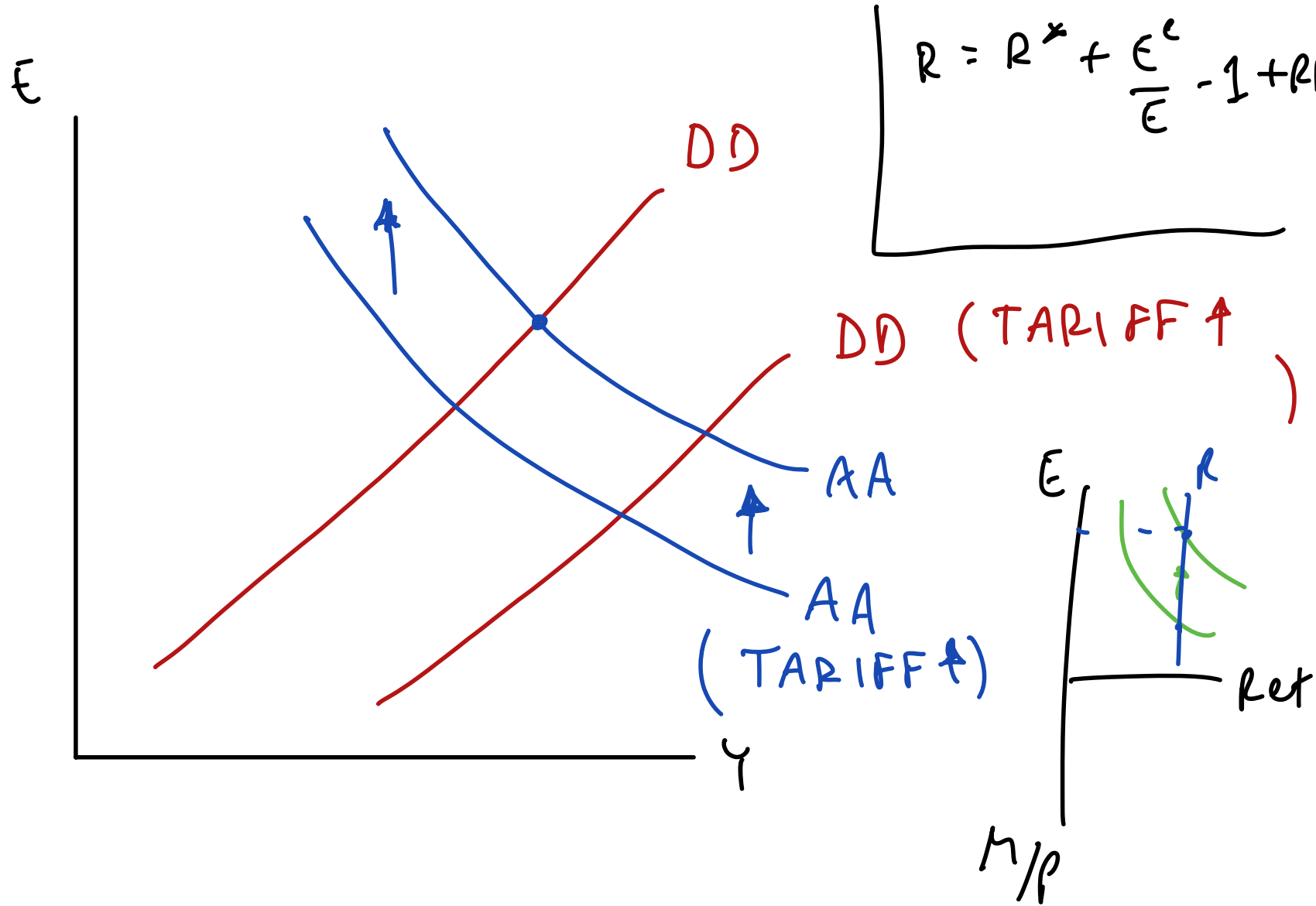
- Rank currencies by 3-month interest rate
- Lend in the 3 highest interest rate currencies; borrow in the lowest three
  - 3 highest NOK/GBP/AUD
  - 3 lowest CHF/JPY/SEK
- Rebalanced quarterly

Carry Trade Index: S&P FX Carry G10 TR



Source: S&P Dow Jones Indices daily total-return index levels for the S&P Risk Premia FX Carry G10 Index (USD) TR. Rebased to 100 on Mar. 24, 2025.


S&P FX Carry G10 TR and Broad Dollar
S&P FX Carry G10 TR (Mar 24, 2025 = 100)
Broad dollar index (inverted, Mar 24, 2025 = 100)
101
100
99
98
97
96
95
94
100
100
100
101
102
102
102
S&P FX Carry G10 TR
Broad dollar index
Mar 26
2025
Mar 30
2025
Apr 03
2025
Apr 07
2025
Apr 11
2025
Apr 15
2025

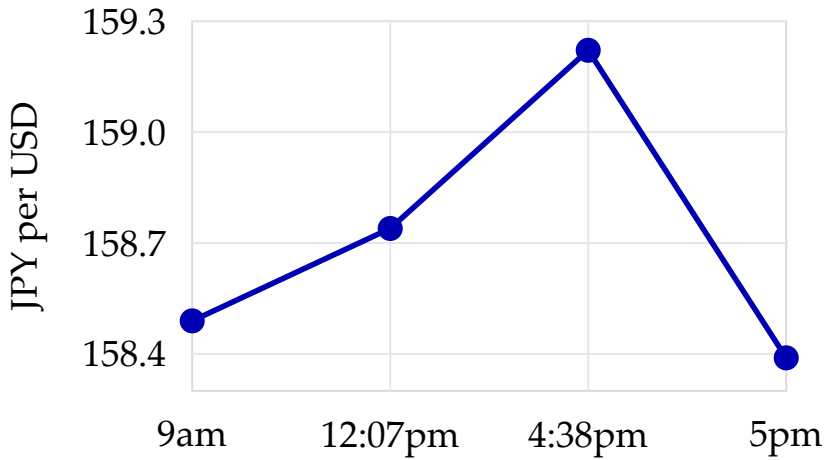

E
Y
DD
DD (TARIFF ↑)
AA
AA
(TARIFF ↑)
$R = R^* + \frac{E^e}{E} - 1 + RP$
E
R
Ret
M/P

The December 2025 yen episode

- On December 19, 2025, the BOJ raised its policy rate from 0.5% to 0.75%, but the yen weakened rather than strengthened
- The move had been widely telegraphed, so markets had largely priced it in
- Gov. Ueda's cautious, data-dependent guidance did not signal a clearly faster tightening path
- Investors judged the decision as not hawkish enough and pushed USD/JPY higher

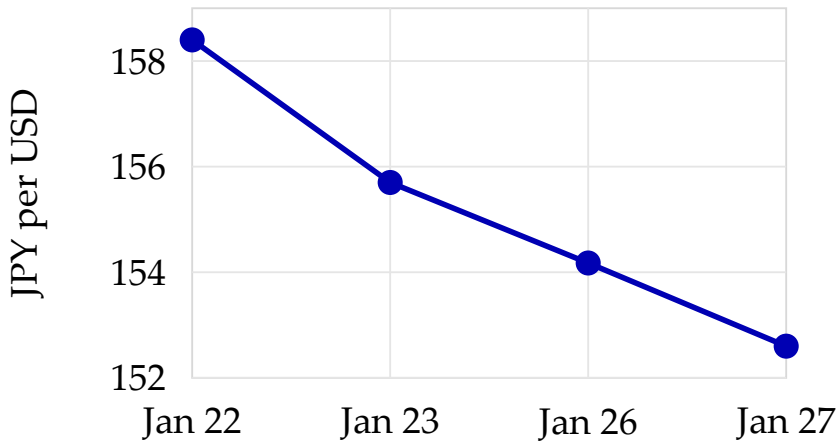
The January 2026 yen episode

Jan. 23 intraday



Yen weakened, then partially reversed

Daily



Yen strengthened sharply

Sources: BOJ Jan. 23 FX list; Minkabu intraday quotes; MTFX; Macrotrends.

Timeline of the turn

When	What happened	USD/JPY
Jan. 22	BOJ meeting opens.	158.43
Jan. 23, 12:07 pm	Statement: no hawkish surprise. USD/JPY edges up.	158.74
Jan. 23, 3:30–4:38 pm	Ueda press conference: no tightening	159.22
Jan. 23, late U.S.	Expectations of government intervention to prevent yen depreciation	155.72
Jan. 27	Higher interest rates expected	152.21

Sources: BOJ statement; Ueda press conference summary (NRI); Reuters rate-check report; MTFX; Macrotrends.

Why the direction changed

First: why did JPY weaken?

- The BOJ statement and Ueda's press conference signaled lower future interest rates than expected
- Despite no actual change in the interest rate, expected lower interest rate led to depreciation

Then: why did JPY strengthen?

- A NY Fed survey revealed market expects FX intervention to prevent JPY from falling
- Markets now concerned about JPY depreciation
- Depreciation $\rightarrow$ higher inflation $\rightarrow$ higher expected interest rates $\rightarrow$ appreciation

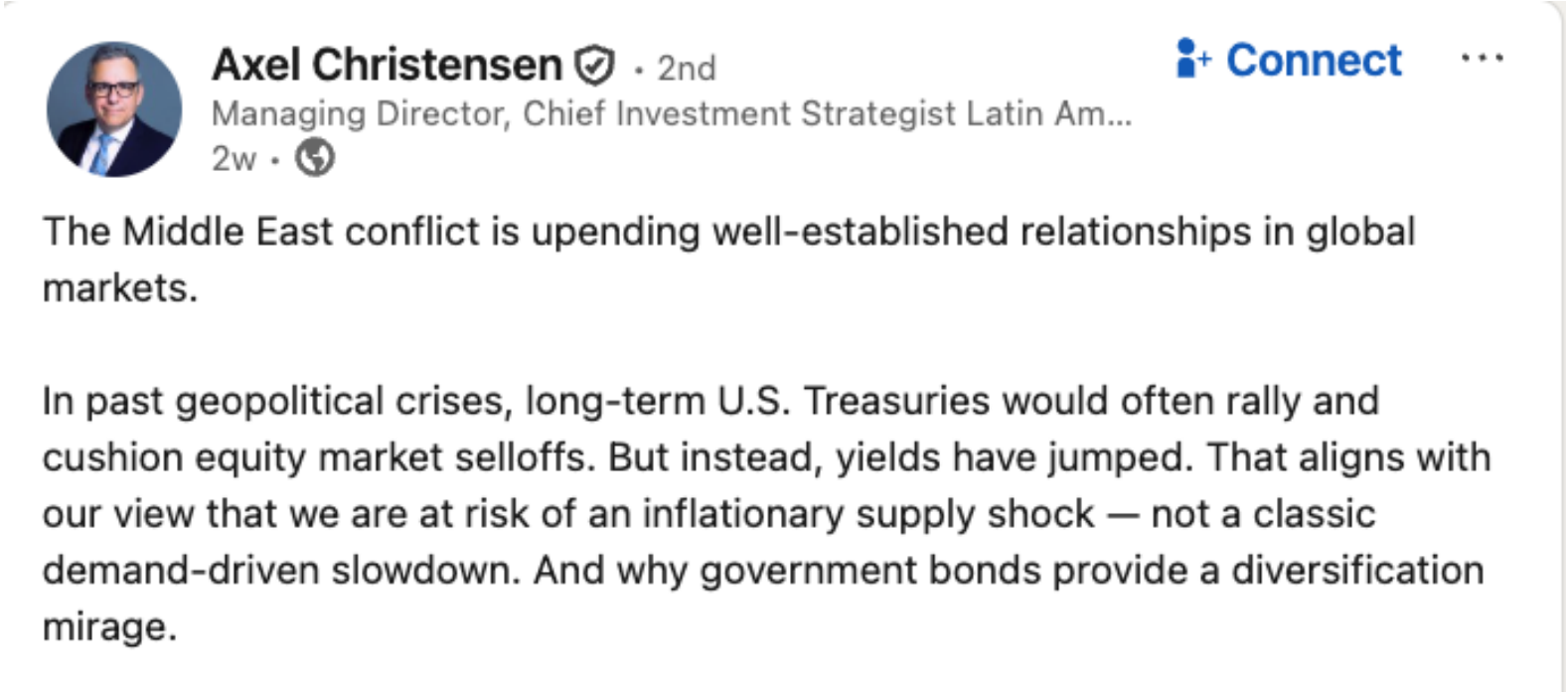
Sources: BOJ statement; Summary of Opinions; Reuters; Ueda press conference summary (NRI).

ECON 1550 International Finance

A Tour of the World

When Safe Havens Stop Working

Are Treasuries still a safe haven?



Axel Christensen · 2nd
Managing Director, Chief Investment Strategist Latin Am...
2w ·

Connect ···

The Middle East conflict is upending well-established relationships in global markets.

In past geopolitical crises, long-term U.S. Treasuries would often rally and cushion equity market selloffs. But instead, yields have jumped. That aligns with our view that we are at risk of an inflationary supply shock — not a classic demand-driven slowdown. And why government bonds provide a diversification mirage.

Full AA-DD Model

DD Schedule: $$Y = \mathrm{C}(Y - T) + I + G + \mathrm{CA}(EP^*/P, Y - T, Y^*)$$

AA Schedule: $$\frac{M^s}{P} = \mathrm{L}\left(R^* + \frac{E^e}{E} - 1, Y\right)$$

Phillips Curve: $$\pi = \pi^e + \alpha(Y - Y^f)$$

Definition of inflation: $$\pi_t = \frac{P_t}{P_{t-1}} - 1$$

Definition of expected inflation: $$\pi_t^e = \frac{P_{t+1}^e}{P_t} - 1$$

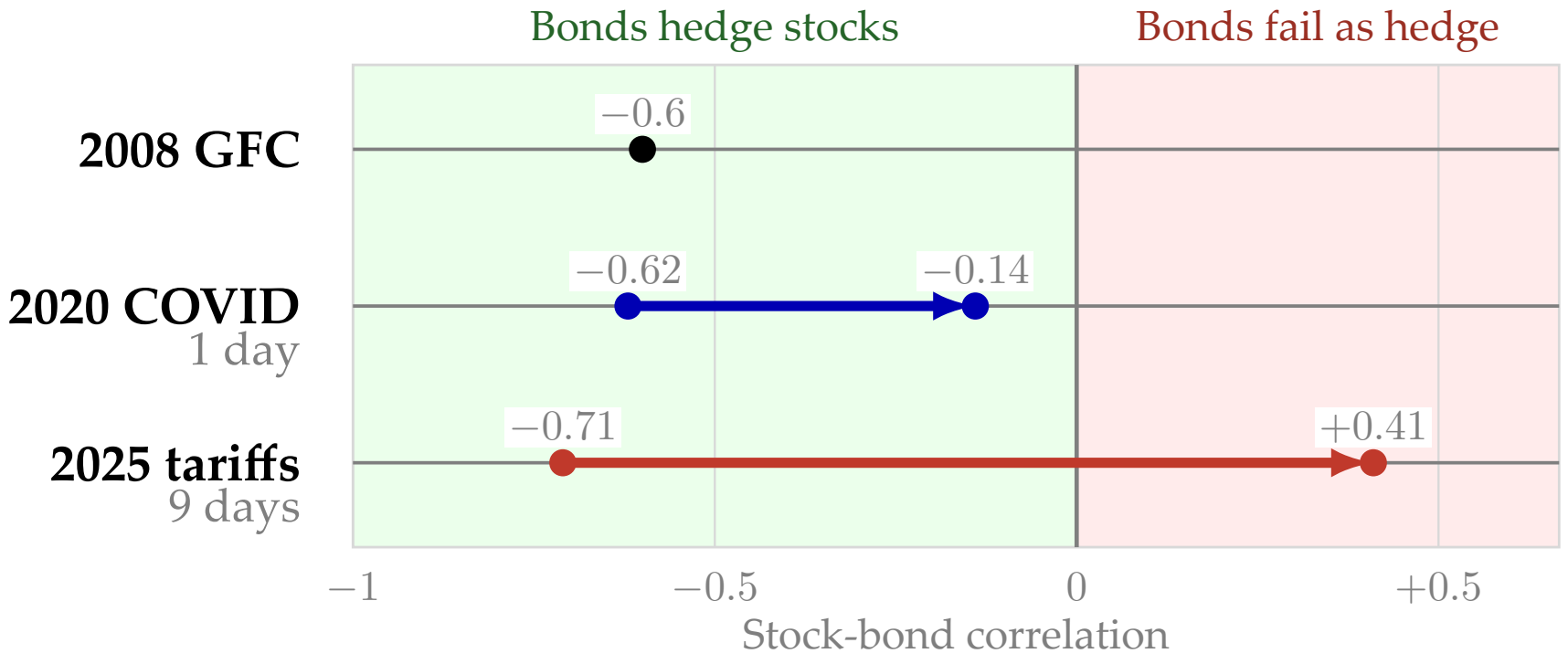
Supply shock vs demand shock

Same shock, different outcome

	Why	Stocks	Treasuries	Dollar	
2008 GFC	More demand for safety	↓	↑	↑	classic hedge
2020 COVID	Scramble for cash	↓	↓	↑	mixed
2025 tariffs	Investors cut U.S. exposure	↓	↓	↓	both failed

Sources: Hu, Jin, & Pan (2025); ECB Financial Stability Review, Nov. 2025; BIS Working Paper 966; Acharya & Laarits (NBER); Fed IFDP 1427.

The stock-bond correlation flip



Sources: Hu, Jin, & Pan (2025) stock-bond correlation series; BIS Working Paper 966 on March 2020 Treasury stress.