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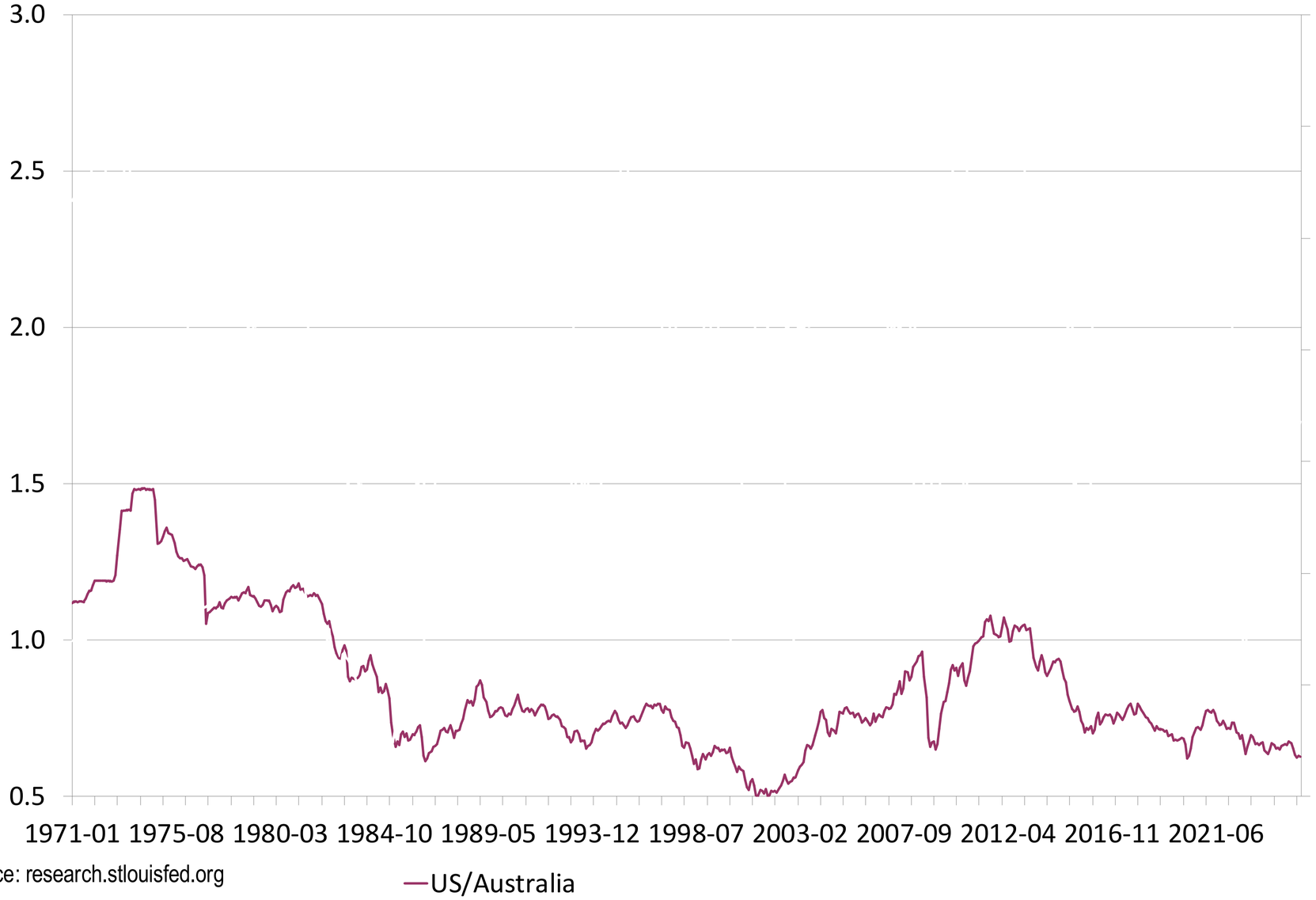
2. Exchange Rates

Global Business Environment

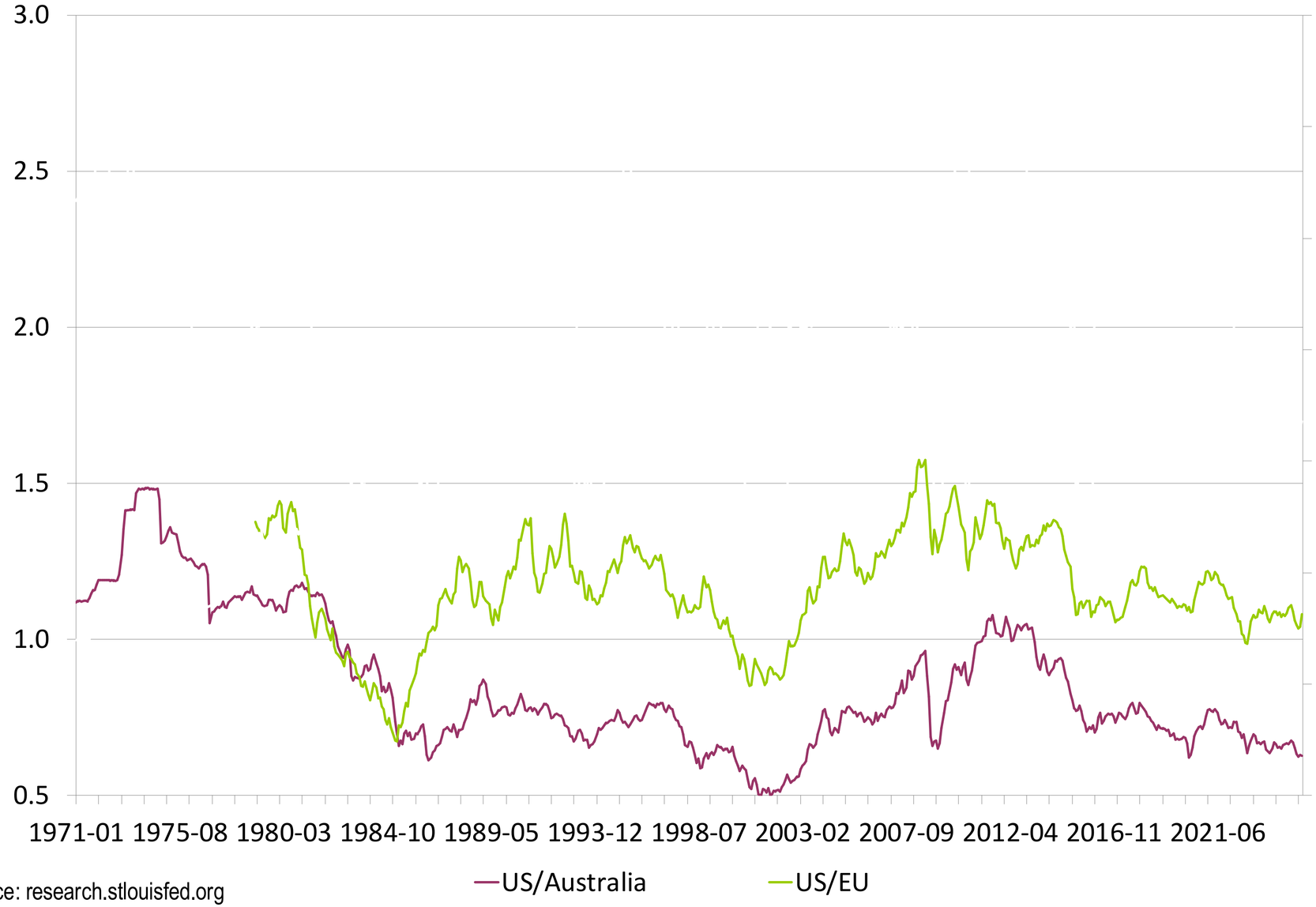
Luisa Lambertini

Exchange Rates (USD to one currency)



Source: research.stlouisfed.org

Exchange Rates (USD to one currency)



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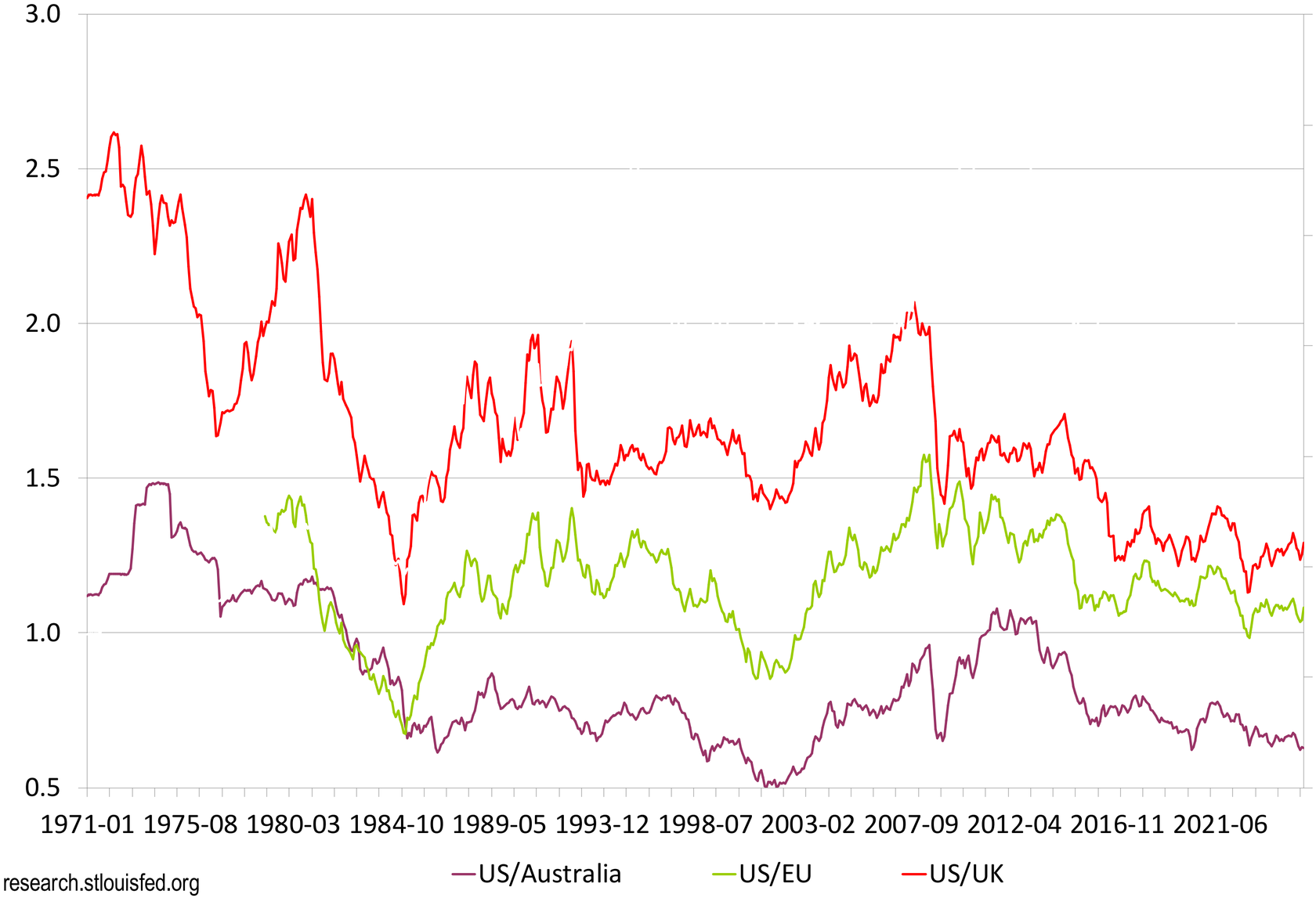
Exchange Rates (USD to one currency)



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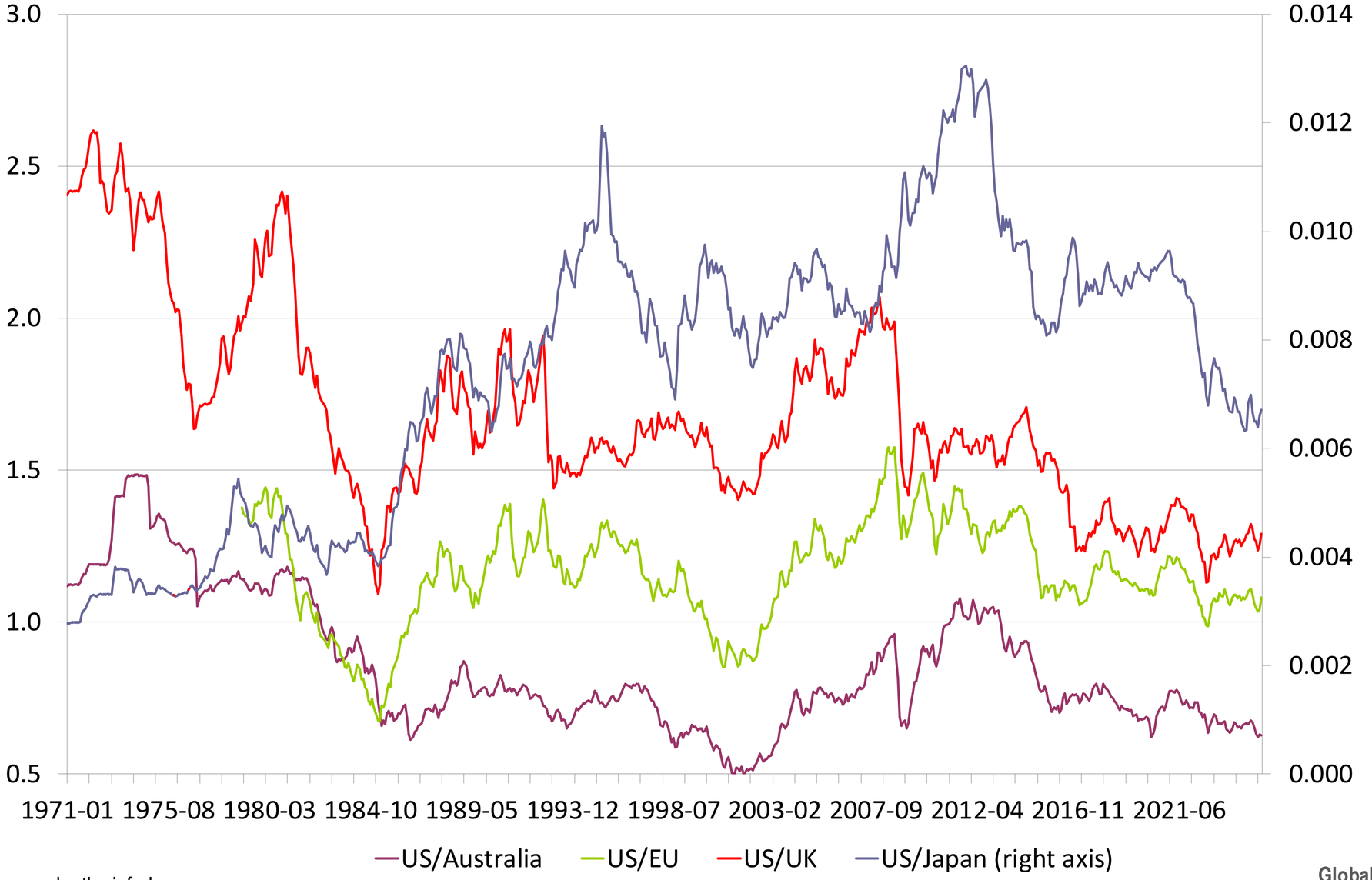
Exchange Rates (USD to one currency)



Source: research.stlouisfed.org

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2.1 Exchange Rates and Relative Prices

Global Business Environment

Luisa Lambertini

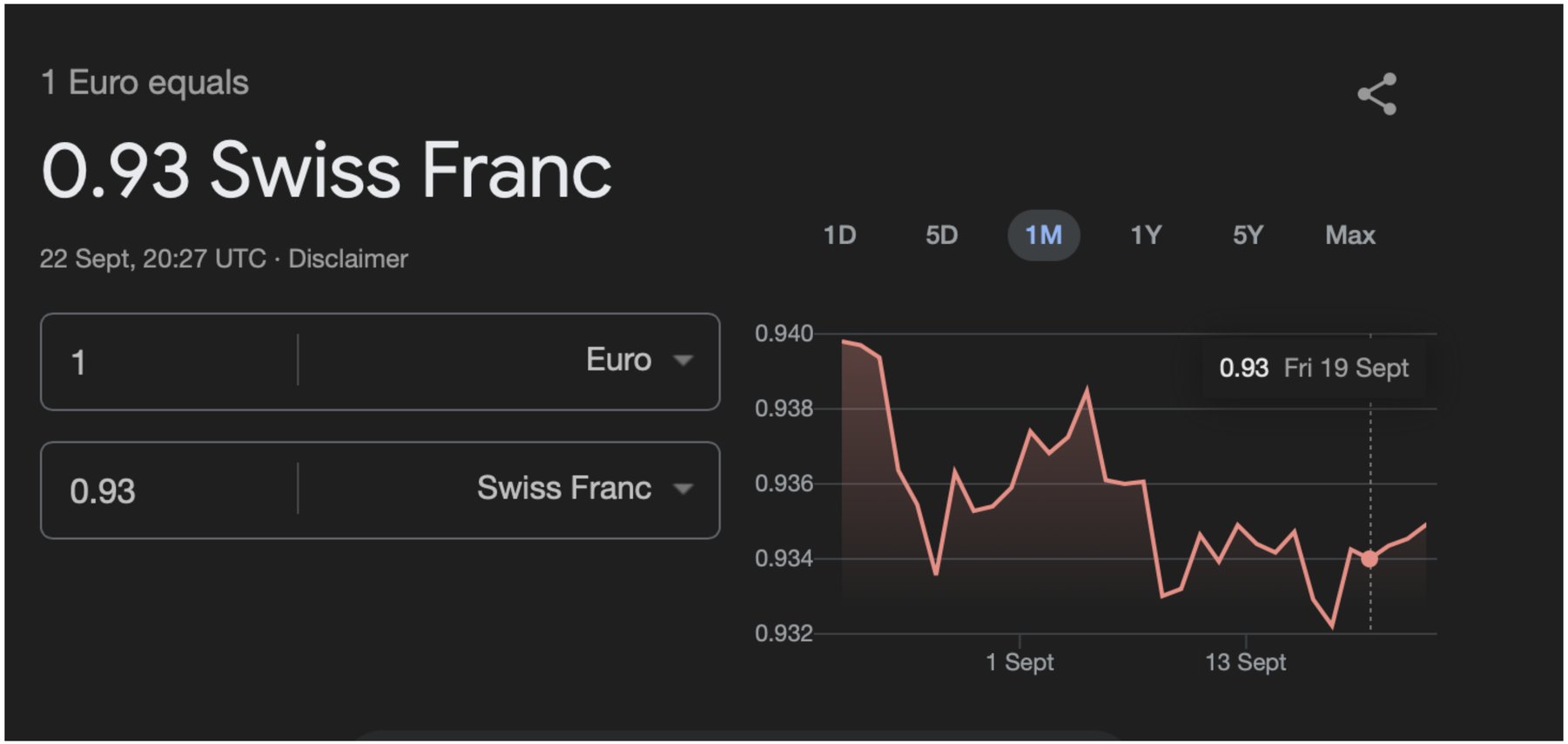
Exchange Rates and Relative Prices

- Exchange rate: it is the price of one currency in terms of another
- A bottle of French champagne costs EUR 30 in France
- The exchange rate between the Swiss Franc and the Euro is $E_{CHF/EUR}$ = 0.9353 (CHF 0.9353 = EUR 1)
- The bottle of French champagne costs CHF 28.1 in Switzerland
- $E_{CHF/EUR}$ = 1.2 → CHF 36; $E_{CHF/EUR}$ = 0.8 → CHF 24

Depreciation and Appreciation

- Depreciation of the Swiss Franc: $E_{CHF/EUR} \uparrow$
- Appreciation of the Swiss Franc: $E_{CHF/EUR} \downarrow$

The Swiss Franc / Euro Exchange Rate $E_{CHF/EUR}$

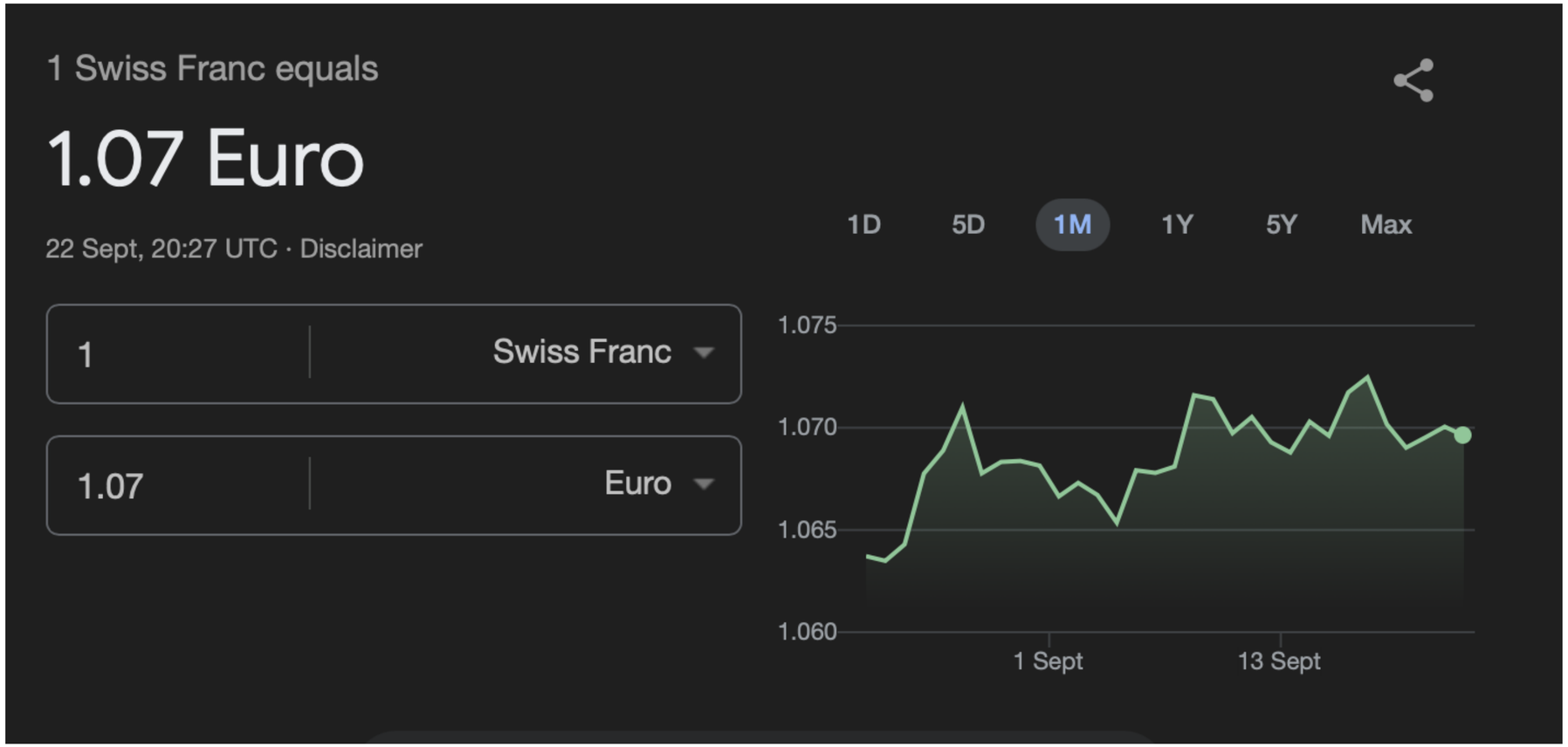


CHF/EUR

How many CHF do we need to buy one Euro?

Source: ECB

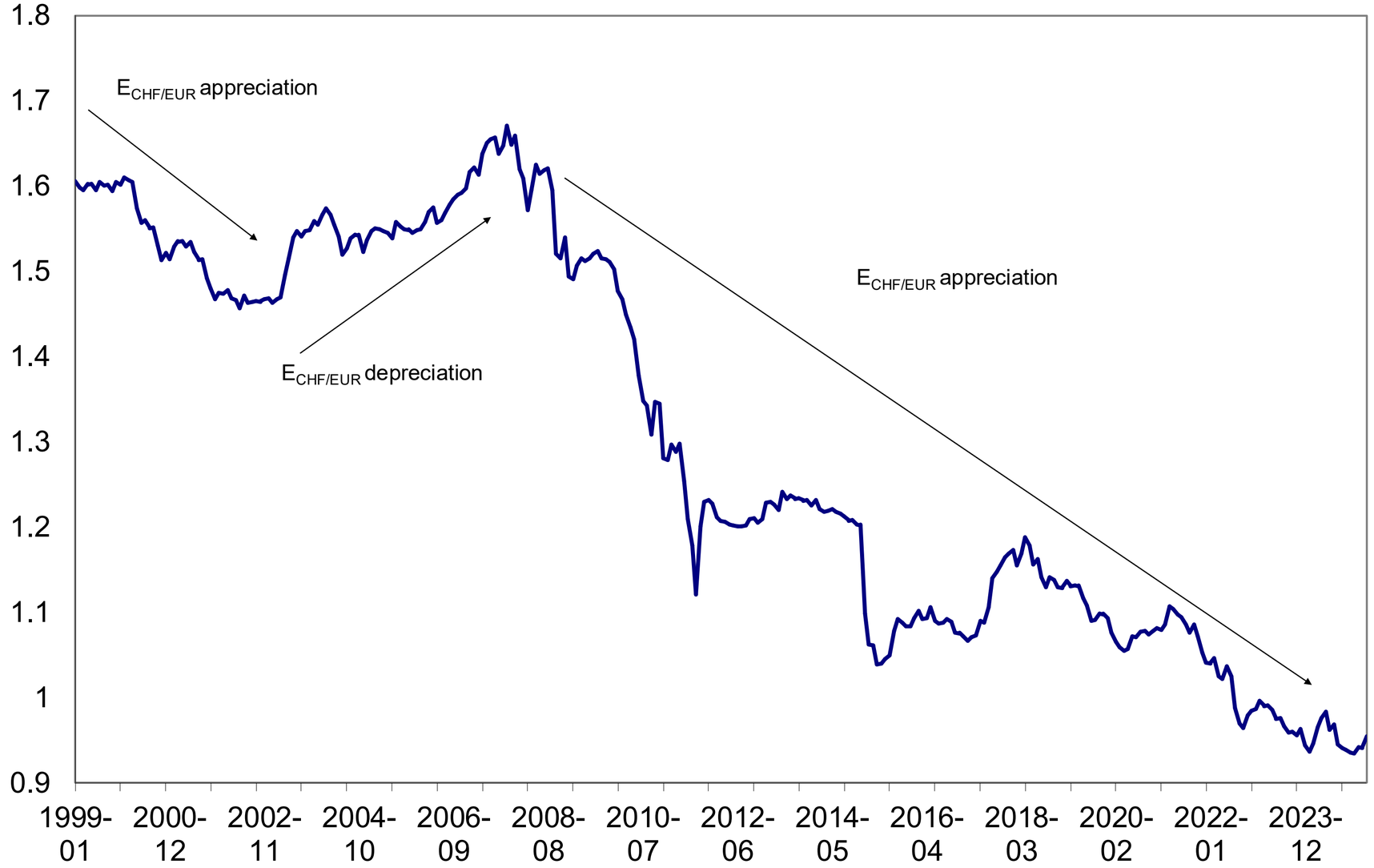
The Euro / Swiss Franc Exchange Rate $E_{EUR/CHF}$



EUR/CHF

How many EUR do we need to buy one CHF?

The Swiss Franc / Euro Exchange Rate $E_{CHF/EUR}$



Source: Swiss National Bank

Exchange Rates and Relative Prices - Summary

- Exchange rate
- Depreciation and appreciation

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2.2 Exchange Rates and Asset Returns

Global Business Environment

Luisa Lambertini

Exchange Rate as an Asset Price

- Asset: Deposit in a specific currency
- Rate of return of the asset: percentage increase in value over a certain time period
- Expected CHF rate of return on a EUR deposit:

$$(1 + R_{EUR}) \frac{E^{e}_{CHF/EUR}}{E_{CHF/EUR}} - 1$$

R_{EUR} the interest rate offered by the deposit

$E^{e}_{CHF/EUR}$ is the expected spot exchange rate at the end of the investment

Nominal and Real Rate of Return

- This is an *expected nominal* rate of return
- Expected *real* rate of return: expected nominal rate of return – expected inflation
- Example: 3-month EUR deposit
  - $R_{EUR,3m}$ = 3.9% interest rate on a 3-month EUR deposit
  - $R_{CHF,3m}$ = 1.6% interest rate on a 3-month CHF deposit
  - $E_{CHF/EUR}$ = 0.936 exchange rate
  - $E^e_{CHF/EUR}$ = 0.93 expected exchange rate in 3 months
  - Expected inflation = 0.08% over the next 3 months – expected annual inflation over the next 3 months (0.33%) divided by 4

$$\frac{1}{0.936} \times \left(1 + \frac{0.039}{4}\right) \times 0.93 - 1 = 0.0033 \text{(quarterly level, 0.0132 annualized)}$$

This is the expected nominal CHF return; expected real CHF return = 0.33%-0.08%=0.25%

A Simple Rule

- A simple rule to approximate the CHF rate of return on a EUR deposit

$$R_{EUR} + \frac{E^{e}_{CHF/EUR} - E_{CHF/EUR}}{E_{CHF/EUR}}$$

- Previous example: $R_{EUR,3m} = 3.9\%$; $E_{CHF/EUR} = 0.936$; $E^{e}_{CHF/EUR} = 0.93$
- Expected nominal CHF return = 0.33% (1.33% annualized) same as with the other calculation

Equilibrium in the Foreign Exchange Market

- Deposits of all currencies offer the same expected rate of return
- Interest parity condition (IPC):

$$R_{CHF} = R_{EUR} + \frac{E^{e}_{CHF/EUR} - E_{CHF/EUR}}{E_{CHF/EUR}}$$

- Let's check with our numerical example

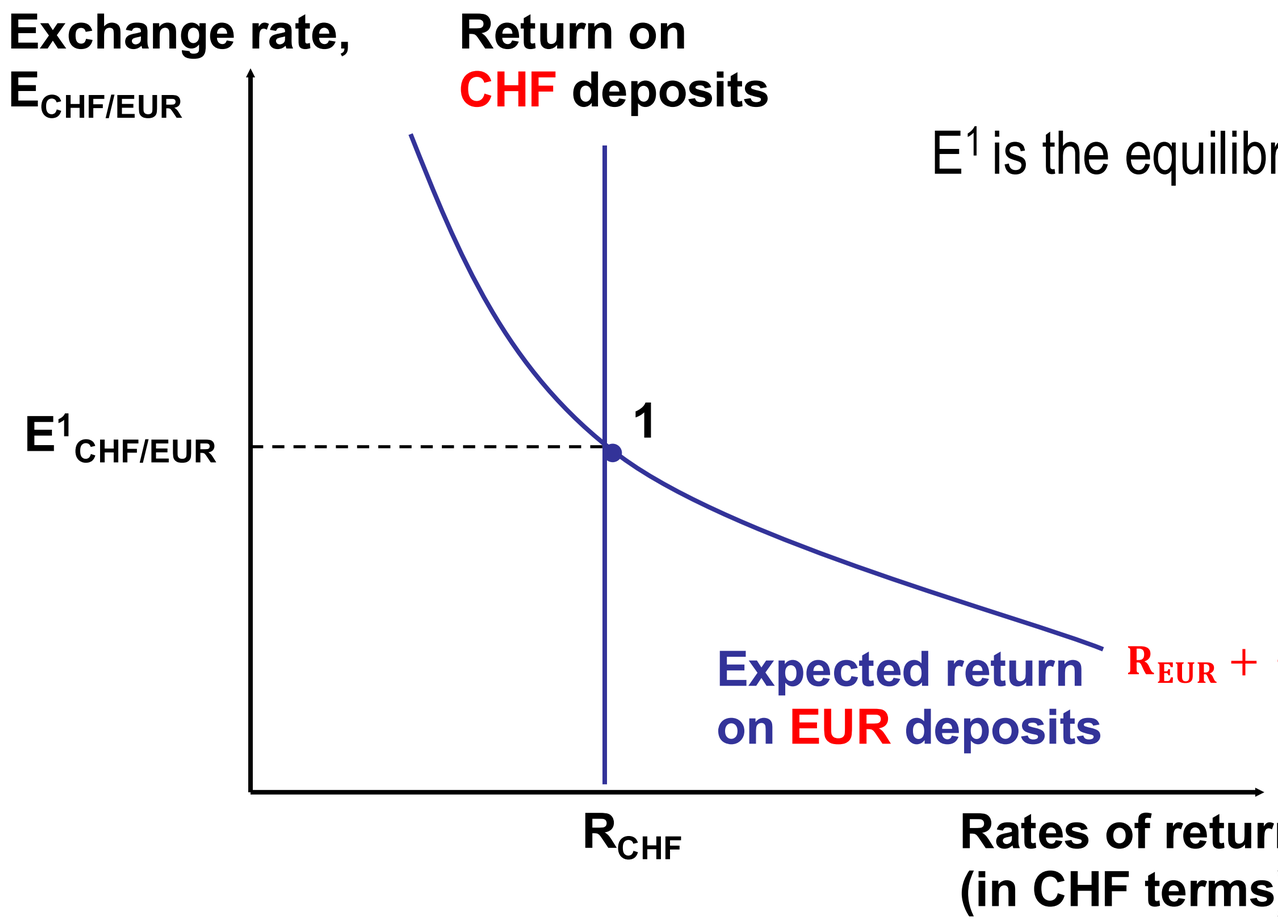
$$\frac{0.016}{4} \approx \frac{0.039}{4} + \frac{0.93 - 0.936}{0.936}$$

Equilibrium in the Foreign Exchange Market

$$R_{CHF} = R_{EUR} + \frac{E^{e}_{CHF/EUR} - E_{CHF/EUR}}{E_{CHF/EUR}}$$

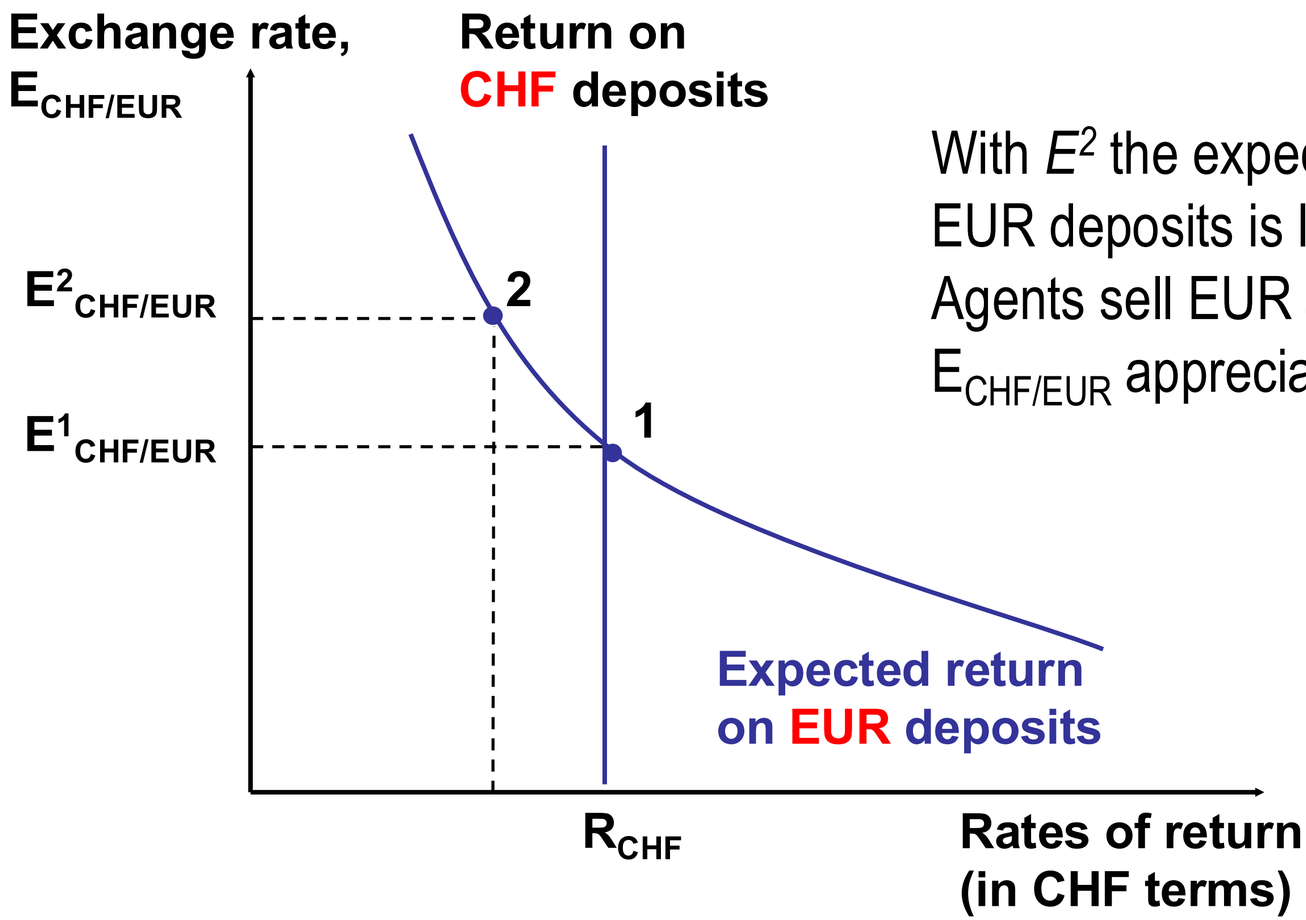
- If $E_{CHF/EUR}$ depreciates ↑,the expected CHF return on EUR deposits falls
- Given R_{CHF}, R_{EUR} and $E^{e}_{CHF/EUR}$, the spot exchange rate adjusts to equalize expected returns

The Equilibrium Exchange Rate



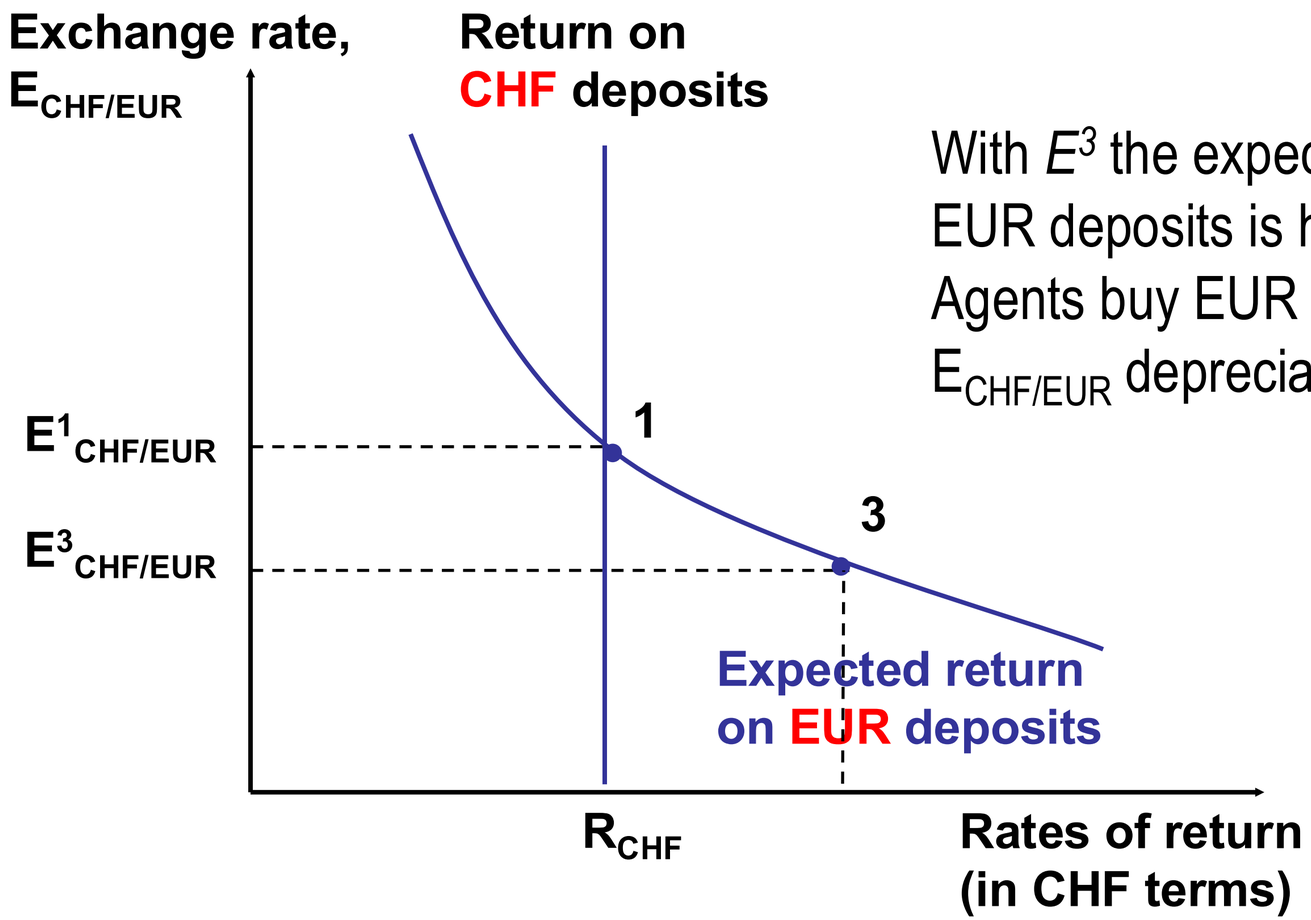
E^1 is the equilibrium exchange rate

The Equilibrium Exchange Rate



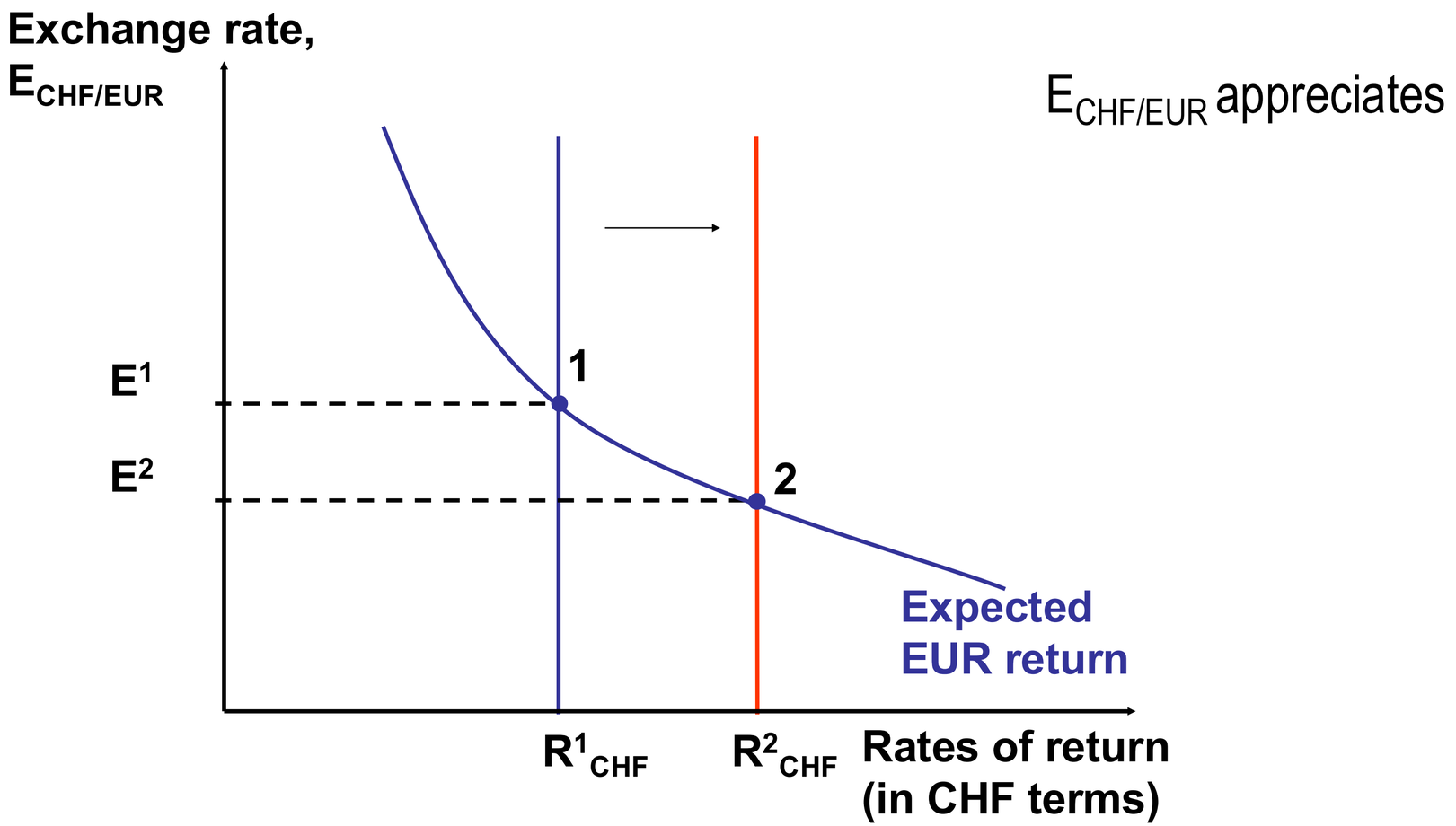
With E^2 the expected return from EUR deposits is lower than R_{CHF}. Agents sell EUR and buy CHF. $E_{CHF/EUR}$ appreciates to E^1

The Equilibrium Exchange Rate

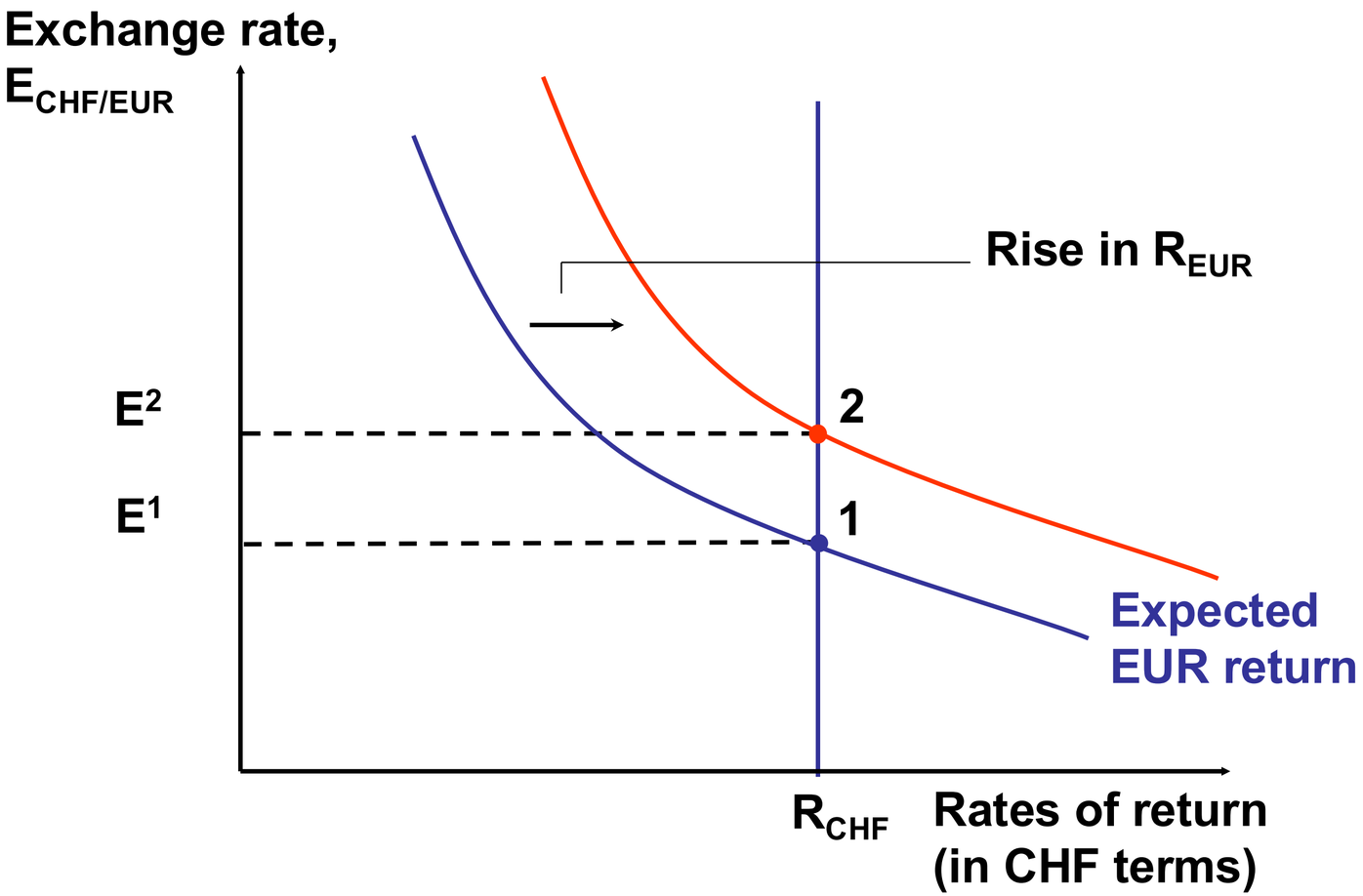


With E^3 the expected return from EUR deposits is higher than R_{CHF}. Agents buy EUR and sell CHF. $E_{CHF/EUR}$ depreciates to E^1

A rise in the interest rate on CHF deposits

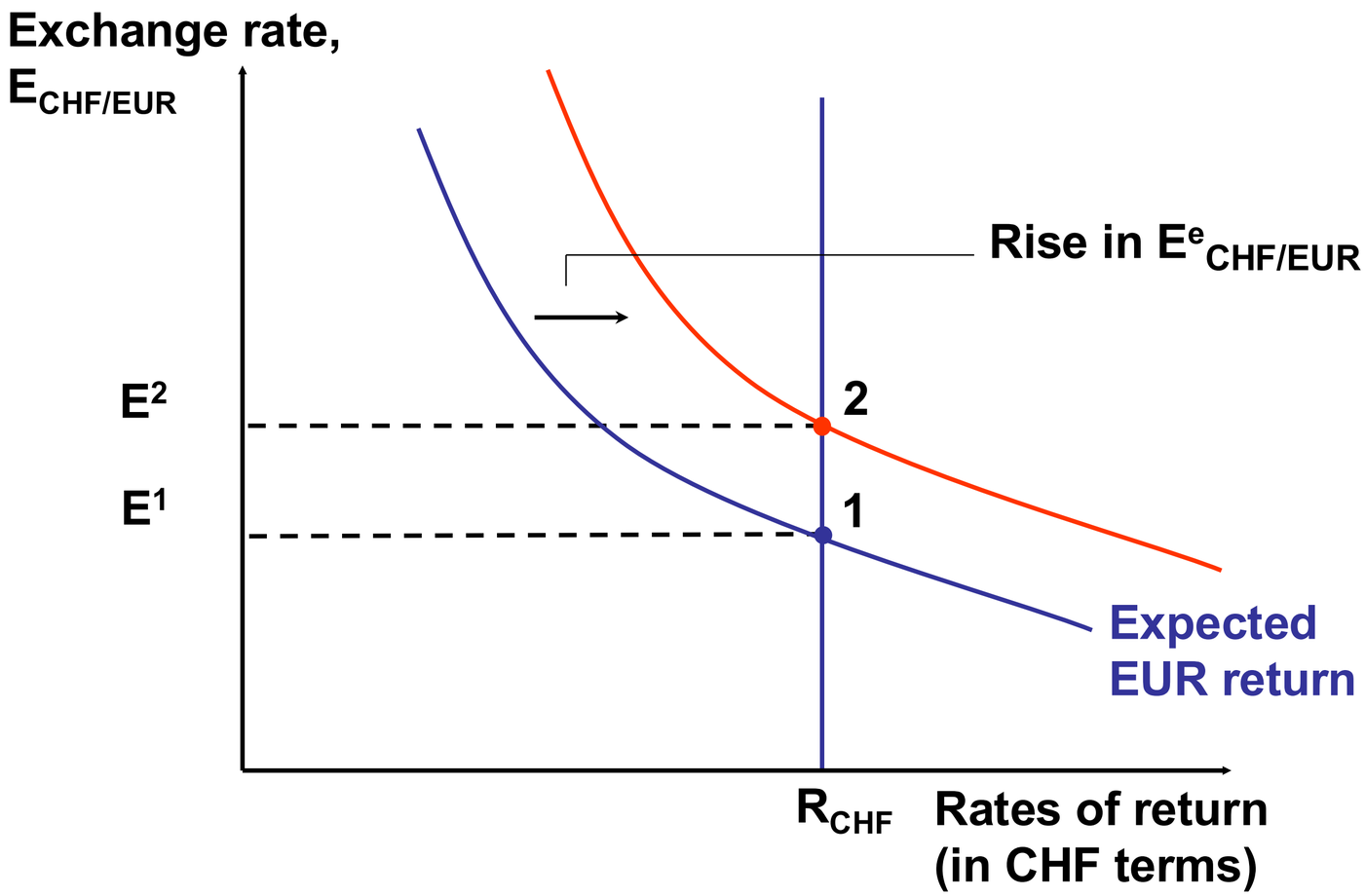


A rise in the interest rate on EUR deposits



$E_{CHF/EUR}$ depreciates

A rise in the expected CHF/EUR exchange rate



$E_{CHF/EUR}$ depreciates

Which announcement may lead to $E^e_{CHF/EUR}$ ↑?

$E_{CHF/EUR}$ moves even if interest rates have not changed yet!

Exchange Rates and Asset Returns - Summary

- Exchange rate as an asset price
- Rate of return of a deposit denominated in foreign currency
- Interest parity condition and the equilibrium exchange rate

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2.3 Foreign Exchange Market

Global Business Environment

Luisa Lambertini

The Foreign Exchange Market

- The foreign exchange market (or Forex or FX) is by far the largest market in terms of volume of trading (up to USD 7.5 trillion daily)
- It is a decentralized market
- The largest trading centers are London, New York, Tokyo, Frankfurt and Singapore
- The main participants are commercial banks, asset-management firms, pension funds, insurance companies, and central banks

Forward Exchange Rate

- Exchange rates that specify a date in the future (30, 90, 180 days or one year)
- $F_{CHF/EUR}$= forward exchange rate between CHF and EUR
- Forward premium:

$$\frac{F_{CHF/EUR} - E_{CHF/EUR}}{E_{CHF/EUR}}$$

- Let's take a look at some data on spot and forward rates

Spot and Forward Rates, Sept 22 2025

Euro/U.S. Dollar (^EURUSD)

1.17987 **+0.00525 (+0.45%)** 15:36 CT [FOREX]

1.17982 1.17991

FORWARD RATES for Mon, Sep 22nd, 2025 Notes Ale

Forward Rates

Name	Bid	Ask	Mid Price	Time	Links
EUR/USD Overnight Forward	0.70800	0.71800	0.71200	15:34 ET	
EUR/USD Tomorrow Forward	0.71800	0.72800	0.72300	12:16 ET	
EUR/USD Spot Forward	0.68900	0.75600	0.72250	15:30 ET	
EUR/USD 1-Week Forward	5.15300	5.33700	5.24500	15:30 ET	
EUR/USD 2-Week Forward	10.13600	10.41900	10.27600	15:35 ET	
EUR/USD 3-Week Forward	15.16300	15.46300	15.31000	15:35 ET	
EUR/USD 1-Month Forward	21.69700	21.89500	21.79250	15:35 ET	
EUR/USD 2-Month Forward	42.26400	42.66400	42.45850	15:35 ET	
EUR/USD 3-Month Forward	60.97300	61.57000	61.26400	15:35 ET	
EUR/USD 4-Month Forward	81.99700	83.20100	82.59000	15:35 ET	
EUR/USD 5-Month Forward	98.39400	99.85700	99.11800	15:35 ET	
EUR/USD 6-Month Forward	114.04200	115.74800	114.88900	15:35 ET	
EUR/USD 7-Month Forward	131.09200	133.05701	132.07201	15:35 ET	
EUR/USD 8-Month Forward	148.18800	150.41100	149.30249	15:35 ET	
EUR/USD 9-Month Forward	163.34900	165.79700	164.58400	15:35 ET	
EUR/USD 10-Month Forward	178.04700	180.71800	179.41350	15:35 ET	
EUR/USD 11-Month Forward	192.54401	195.43700	194.06800	15:35 ET	
EUR/USD 1-Year Forward	206.65100	209.75500	208.33100	15:35 ET	

$E_{USD/EUR} = 1.17987$ spot

I want to buy EUR 3m forward

1.17987 + 61.264 points

The forward rate is

1.17987+61.264/10000= 1.186

Covered interest parity condition

- Covered rate of return on a EUR deposit

$$(1 + R_{EUR}) \frac{F_{CHF/EUR}}{E_{CHF/EUR}} - 1$$

- This is approximately equal to

$$R_{EUR} + \frac{F_{CHF/EUR} - E_{CHF/EUR}}{E_{CHF/EUR}}$$

- Covered Interest Rate Parity Condition (CIPC):

$$R_{CHF} = R_{EUR} + \frac{F_{CHF/EUR} - E_{CHF/EUR}}{E_{CHF/EUR}}$$

Example

- You are given the following information (September 22, 2025)

$E_{USD/EUR}$ = 1.17987

$F^{3m}_{USD/EUR}$ = 1.186

$R^{3m}_{EUR} = 2\%$ (this is the 3 month euribor)

Find R^{3m}_{USD} that satisfies CIPC

Current Euribor and USD SOFR

FX Swaps

- FX swap: spot sale of a currency combined with forward repurchase (or vice versa)
- The amount of forward repurchase is fixed of the start of the contract
- Example: I have CHF but need EUR now; need CHF later. Buy EUR spot + sell EUR 3m forward; sell CHF spot and repurchase CHF forward
- Swaps make up a large portion of all Forex trading

Pricing a FX Swap

- A CHF/EUR swap is an exchange of two assets. For example
  - Deposit with initial value of 1 CHF with maturity 1 year and interest rate R_{CHF} (home leg)
  - Deposit with initial value of $E_{EUR/CHF}$ with maturity 1 year and interest rate R_{EUR} (foreign leg)

$$\underbrace{1}_{\text{PV home leg}} = \underbrace{E_{EUR/CHF}\frac{(1+R_{EUR})}{(1+R_{CHF})}F_{CHF/EUR}}_{\text{PV foreign leg}}$$

- They are equal by CIPC and the swap has zero net value

FX Futures

- Contract to buy or sell a specified amount of foreign currency at a predetermined price on a set date in the future – similar to forward contracts
- Futures contracts are standardized and traded on an exchange
- Forwards instead are traded over-the-counter

FX Options

- FX option gives its owner the right to buy or sell a specified amount of foreign currency at a specified price at any time up to a specific expiration date
- The option's seller (writer) is required to fulfill the agreement
- Put option (sell) and call option (buy)
- American option can be exercised at any time (up to the expiration date)
- European option can be exercised only at maturity

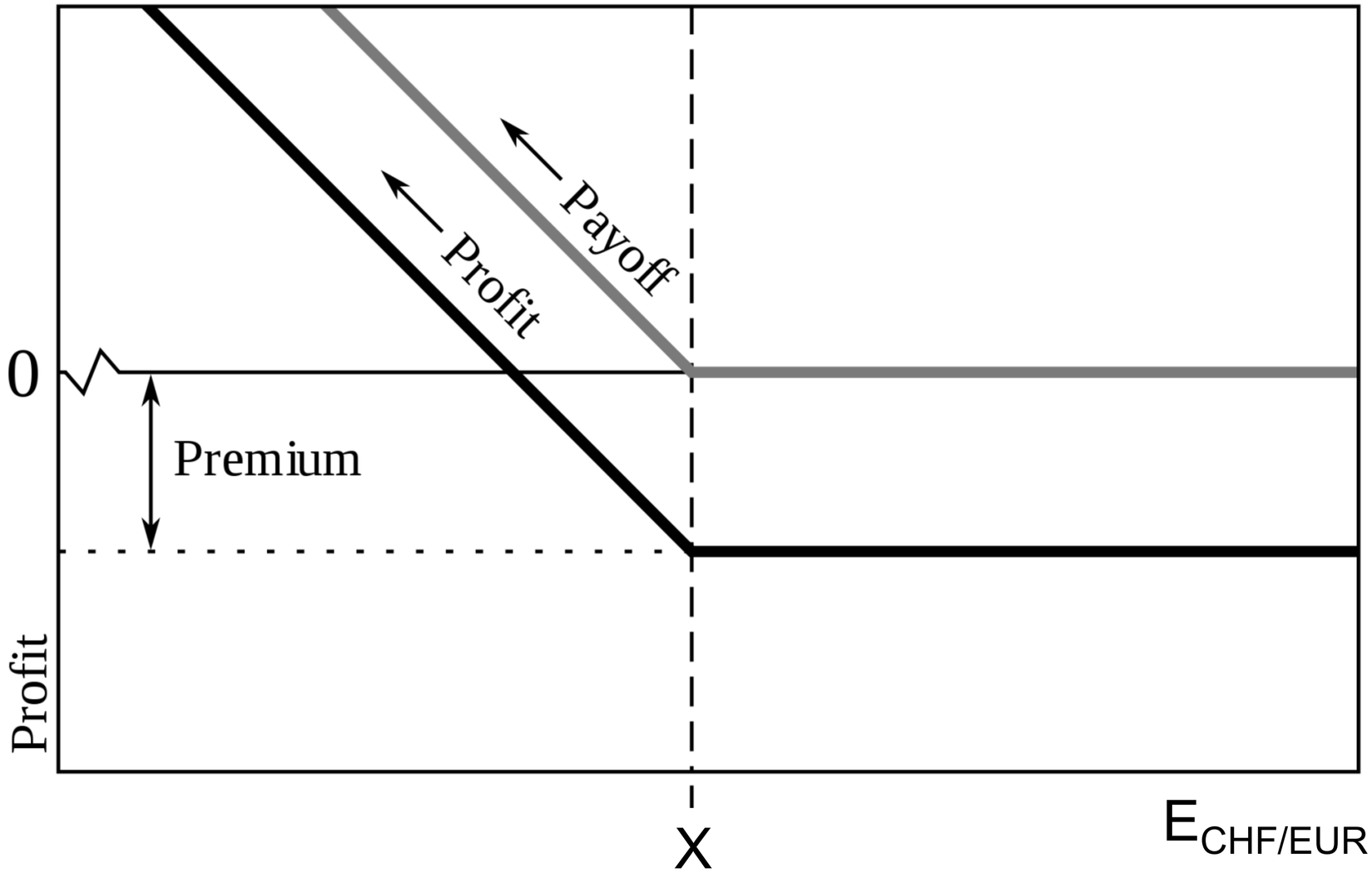
Put Option

- It gives the owner the right to sell a stated number of foreign currency at the strike price X
- The intrinsic value at $t \leq T$ of a CHF/EUR put option:

$$P_t = \text{Max}\,(X - E_{CHF/EUR,t}\,, 0)$$

- Put option is in-the-money if $P_t > 0$

Put Option



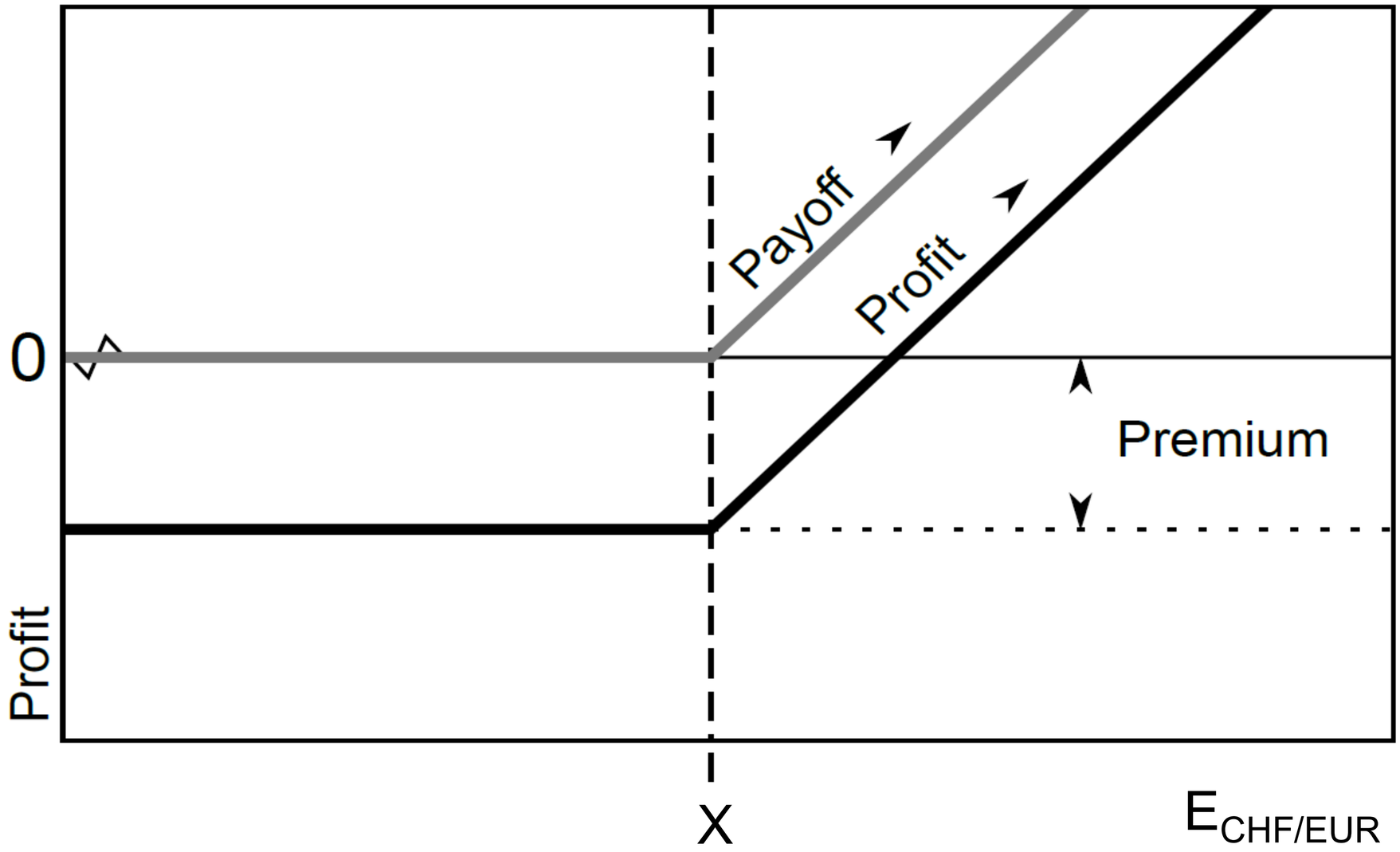
Call Option

- Owner has the right to buy a stated number of foreign currency at the strike price X
- The intrinsic value at $t \leq T$ of a EUR/CHF call option:

$$C_t = \text{Max}\,(E_{CHF/EUR,t} - X,\ 0)$$

- Call option is in-the-money if $C_t > 0$

Call Option



Example

- You have USD
- You want a call option to buy 10’000 EUR at 1.1689 in 1 month
- The cost of the option is USD 0.0175 x 10000=175 USD
- At which spot rate do you break even?
- If on 2025-10-23 the spot rate is 1.19, do you exercise the option? What is your profit (or loss)?

EUR/USD Options expiring 2025-10-23 (29 Days)

O/N | 1W | 2W | 1M | 2M | 3M | 6M | 12M

PUT OPTIONS			CALL OPTIONS		
Delta	*Price*	*Strike*	*Price*	*Delta*	*Imp Vol.*
-0.10	0.00102	1.1549	0.02928	0.90	6.51%
-0.25	0.00321	1.1689	0.01757	0.75	6.36%
-0.34	0.00498	1.1748	0.01346	0.66	6.36%
-0.49	0.00855	1.1830	0.00884	0.51	6.44%
-0.64	0.01381	1.1918	0.00538	0.36	6.62%
-0.74	0.01901	1.1989	0.00351	0.26	6.82%
-0.90	0.03391	1.2165	0.00119	0.10	7.42%

Foreign Exchange Market - Summary

- Foreign exchange market
- FX contracts: forward rates, swaps, futures, options
- Carry trade