

# Introduction to Foreign Exchange Markets

## Slides for International Economics: Finance

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# Preview

- ▶ Basic exchange rate concepts
- ▶ Exchange rates and the cost of foreign goods
- ▶ The foreign exchange markets
- ▶ The demand for currency deposits and other assets
- ▶ A model of exchange rate determination
  - ▶ effect of interest rates
  - ▶ effect of expectations

# What Is An Exchange Rate?

## Exchange Rate:

- ▶ The price of one currency in terms of another currency
- ▶ The number of units of the *quote currency* that it takes to buy one unit of the *base currency*
  - ▶ *quote* currency synonyms: *terms* currency or *counter* currency
  - ▶ *base* currency synonyms: *quoted* currency or *underlying* currency

# Textbook notation vs financial market notation

Textbooks usually write the quote currency first.

Financial markets typically state the base currency first.

## 3-Letter ISO Codes

Know the following: EUR, CAD, JPY, CNY, GBP

Find more [currency codes on Wikipedia](#)

# Exchange Rate Example

## **USD-EUR 0.7**

- ▶ USD is base currency; EUR is quote currency
- ▶ quote is in euros per dollar (“European terms”)
- ▶ textbooks typically write 0.7 EUR/USD

## **EUR-USD 1.43**

- ▶ EUR is base currency; USD is quote currency
- ▶ quote is in dollars per euro terms (“dollar terms” or “American terms”)
- ▶ textbooks typically write 1.43 USD/EUR

# Direct Rate vs. Indirect Rate

**Direct rate:** domestic currency per unit of foreign currency.

- ▶ in US, 1.4 USD per EUR
- ▶ in US, EUR-USD 1.4

**Indirect rate:** foreign currency per unit of domestic currency

- ▶ in US, 0.7 EUR per USD
- ▶ in US, USD-EUR 0.7

In class we will use the direct rate, but markets use both.

<http://finance.yahoo.com/currency-investing>

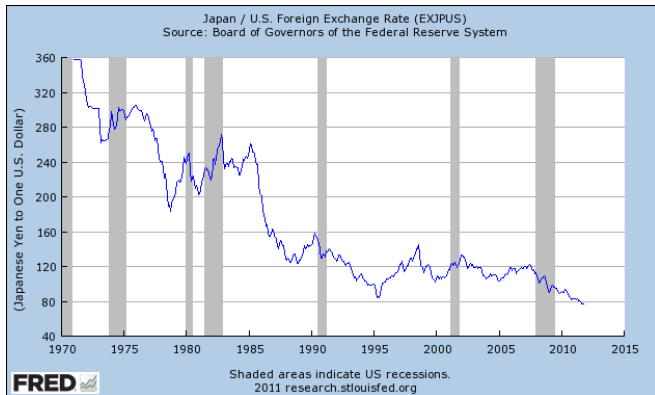
## Indirect and Direct Rates

Currency	1 USD	in USD
Euro	0.959636	1.042062
British Pound	0.803391	1.244724
Indian Rupee	86.589005	0.011549
Australian Dollar	1.604998	0.623054
Canadian Dollar	1.441102	0.693914
Singapore Dollar	1.350085	0.740694
Swiss Franc	0.908937	1.100186
Malaysian Ringgit	4.390012	0.227790
Japanese Yen	154.380933	0.006477
Chinese Yuan Ren-minbi	7.250100	0.137929

Source: <http://www.x-rates.com/d/USD/table.html>  
on 2025-01-30

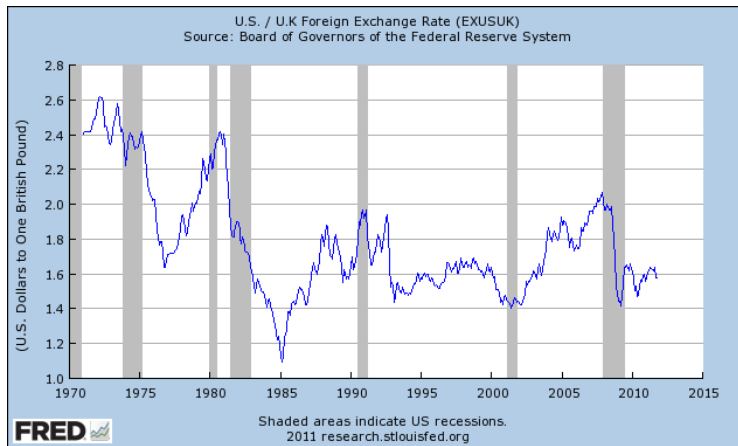


# USD-JPY



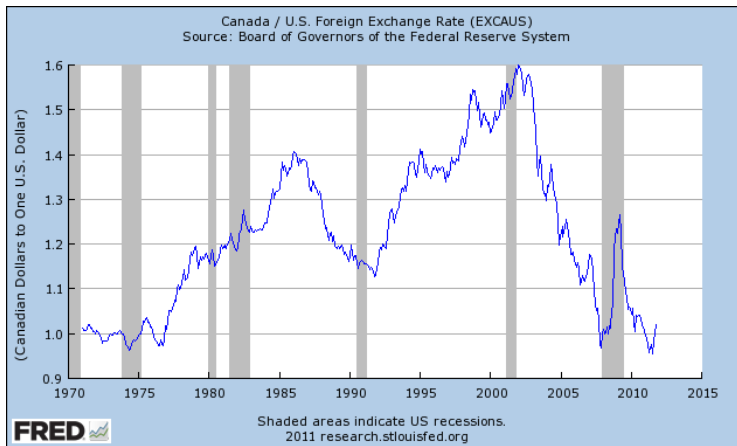
Source: <http://research.stlouisfed.org/fred2/series/EXJPUS?cid=95>

# GBP-USD



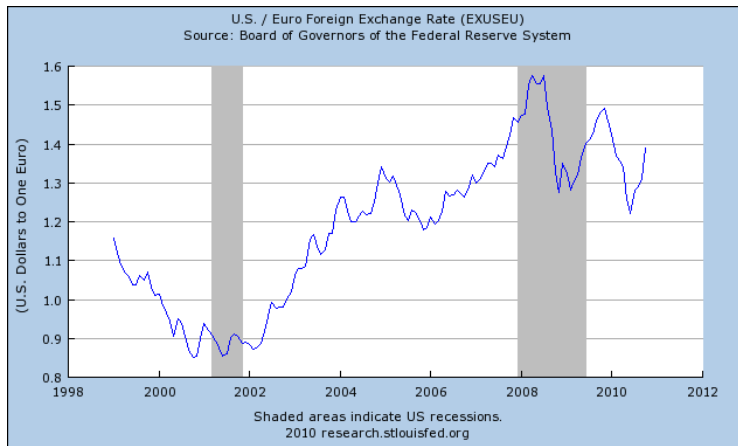
Source: <http://research.stlouisfed.org/fred2/series/EXUSUK?cid=95>

# USD-CAD



Source: <http://research.stlouisfed.org/fred2/series/EXCAUS?cid=95>

# EUR-USD



Source: <http://research.stlouisfed.org/fred2/series/EXUSEU?cid=95>

# Cost of Foreign Goods

Exchange rates allow us to

- ▶ express prices in a common currency
- ▶ make easier cost comparisons

Example: In 2025, the Mercedes-Benz G 500 AMG cost about EUR 194k. What is the implied dollar cost?

- ▶ Exchange rate (dollar terms): EUR-USD 1.04
- ▶ Foreign price: EUR 194K
- ▶ expected dollar price:
  - ▶ (exchange rate)  $\times$  (foreign price) = (domestic price)
  - ▶  $E \times P^* = P$
  - ▶ (USD 1.04/EUR)  $\times$  EUR 150k = USD 202k

# Depreciation and Appreciation

**Depreciation** a *fall* in the *exchange value* of a currency.

E *rises* (direct rate!)

raises the price of foreign goods relative to the price of our goods  
(cet. par.).

**Appreciation** a *rise* in the *exchange value* of a currency.

E *falls* (direct rate!)

lowers the price of foreign goods relative to the price of our goods  
(cet. par.).

# Depreciation Example

A depreciated currency buys a smaller amount of foreign currency.

**Example: EUR-USD 1.0 → EUR-USD 1.50**

- ▶ the dollar has depreciated relative to the euro. The dollar is now less valuable.
- ▶ Equivalently, the euro has appreciated relative to the dollar: the euro is now more valuable.

Given prices, a dollar buys fewer foreign goods after depreciating.

**Example:** Suppose a box of Neuhaus chocolate costs €100

- ▶  $€100 \times \$1/€1 = \$100$
- ▶  $€100k \times \$1.5/€1 = \$150$

Dollar depreciation → imports into US become more expensive.

Domestically produced goods, including our exports, are *relatively* less expensive.

## Appreciation Example

An appreciated currency buys a larger amount of foreign currency.

**Example:** JPY-USD 0.0125  $\rightarrow$  JPY-USD 0.0100

- ▶ here the dollar has appreciated relative to the yen; the dollar is more valuable.
- ▶ Equivalently, the yen has depreciated relative to the dollar; the yen is now less valuable.

Given prices, a dollar buys more foreign goods after appreciating.

**Example:** suppose a Honda accord costs ¥3.7M

- ▶  $¥3.7M \times \$0.0125/¥1 = \$46,250$
- ▶  $¥3.7M \times \$0.0100/¥1 = \$37,000$

Dollar appreciation  $\rightarrow$  imports into US become less expensive.

Domestically produced goods, including our exports, are *relatively* more expensive.



# Foreign Exchange Markets

- ▶ The set of markets where foreign currencies and other assets are exchanged for domestic ones
  - ▶ Institutions buy and sell deposits of currencies or other assets for investment purposes.
- ▶ The **daily** volume of foreign exchange transactions was \$7.5T in 2022, almost twice the \$4T in 2010.
  - ▶ About 80% of transactions involved the USD
  - ▶ USD-EUR transactions are almost 1/4 of the total

Source: BIS <<http://www.bis.org/publ/rpfx22.htm>>

# Currency Composition

Currency pair	2010		2013		2016		2019*		2022	
	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%
USD/EUR	1,099	27.7	1,292	24.1	1,172	23.1	1,581	24.0	1,706	22.7
USD/JPY	567	14.3	980	18.3	901	17.8	871	13.2	1,014	13.5
USD/GBP	360	9.1	473	8.8	470	9.3	630	9.6	714	9.5
USD/CNY	31	0.8	113	2.1	192	3.8	270	4.1	495	6.6
USD/CAD	182	4.6	200	3.7	218	4.3	287	4.4	410	5.5
USD/AUD	248	6.3	364	6.8	262	5.2	359	5.4	381	5.1
USD/CHF	166	4.2	184	3.4	180	3.6	227	3.4	293	3.9

Source: [BIS Triennial Survey](#)

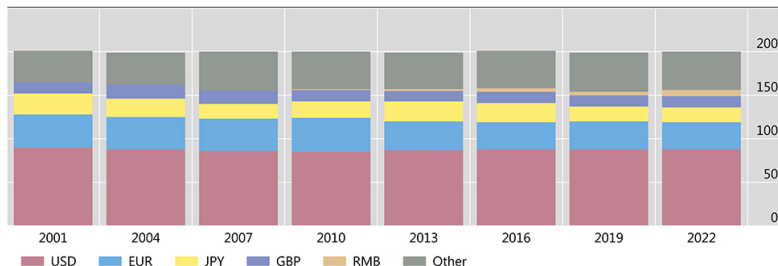
No real evidence of de-dollarization since 2010.

# Currency Composition of Foreign Exchange Turnover

## Foreign exchange turnover by currency<sup>1</sup>

In per cent

Graph A1



<sup>1</sup> As two currencies are involved in each transaction, the sum of shares in individual currencies will total 200%. Adjusted for local and cross-border inter-dealer double-counting, ie "net-net" basis; daily averages in April.

Source: BIS Triennial Central Bank Survey.

© Bank for International Settlements

# Foreign Exchange Market Participants

**Commercial banks and other depository institutions:** transactions involve buying/selling of deposits in different currencies for investment purposes.

**Non-bank financial institutions:** mutual funds, hedge funds, proprietary trading firms (PTFs), securities firms, insurance companies, and pension funds may buy/sell foreign assets for investment.

**Non-financial businesses:** conduct foreign currency transactions to buy/sell goods, services and assets.

**Central banks:** conduct official international reserves transactions.

# Foreign Exchange Market Participants (cont)

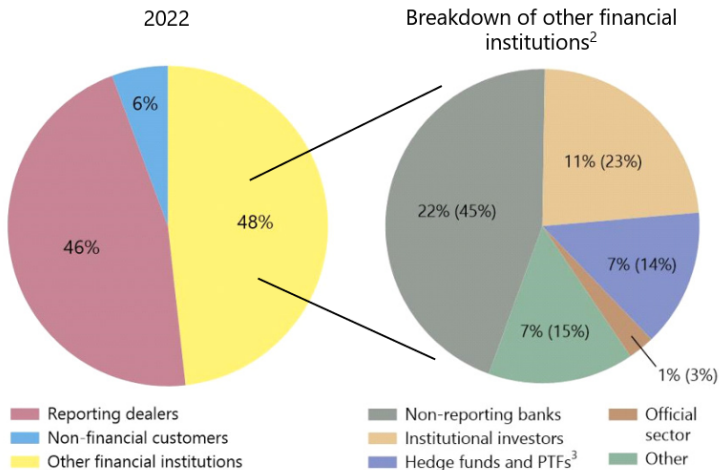


Image Source: [BIS Triennial Survey](#)

## Foreign Exchange Markets (cont.)

Buying and selling in the foreign exchange market are dominated by commercial and investment banks.

- ▶ Inter-bank transactions of deposits in foreign currencies occur in amounts \$1 million or more per transaction.
- ▶ Central banks sometimes intervene, but the direct effects of their transactions are small and transitory in many countries.

# Geographical distribution of turnover

Foreign exchange market activity is concentrated in a few of global financial centres:

Global FX trading in 2022, main players:

- ▶ the United Kingdom (38.1%)
- ▶ the United States (19.4%)
- ▶ Singapore (9.4%)
- ▶ Hong Kong SAR (7.1%).
- ▶ Japan (4.4%)
- ▶ Switzerland (3.6%)

Source: [BIS Triennial Survey](#) table 6

# Arbitrage in Foreign Exchange Markets

**Arbitrage** buying at a low price and selling at a high price for a profit.

When other factors are the same, people will buy assets where they are cheapest. If HKD are cheaper in New York, people will start buying them in New York and stop buying them in Hong Kong. As a result, the price of HKD in New York rises and the price in Hong Kong falls, until they are equal in the two markets.

- ▶ Computer and telecommunications technology transmit information rapidly and have integrated markets.
- ▶ The integration of markets implies that there are no significant arbitrage opportunities between markets.



# Triangular Arbitrage

Suppose geographical arbitrage equates bilateral exchange rates in all centers

Q: Are any arbitrage opportunities left?

A: Possibly a synthetic cross rate differs.

An **imaginary** opportunity.

	↓ buys →	USD	CAD	JPY
USA	USD	1	1.25	100
Canada	CAD	0.8	1	100
Japan	JPY	0.01	0.01	1

# Spot Rates and Forward Rates

**Spot rate** rate to exchange currencies “on the spot”

**Forward rate** exchange rate for currency exchanges that will occur at a future (“forward”) date.

# Spot Transaction

Exchange two currencies at a rate agreed on the date of the contract, for value or delivery (cash settlement) within two business days.

Note: the spot legs of swaps are never included among spot transactions.

# Outright Forward

Exchange two currencies at a rate agreed on the date of the contract for value or delivery (cash settlement) more than two business days later.

- ▶ typically 30, 90, 180, or 360 days in the future.

Outright forwards are generally not traded on organised exchanges, and their contractual terms are not standardised.

This category also includes non-deliverable forwards (NDFs) and their ilk. (See below.)

# Example Forward Rates

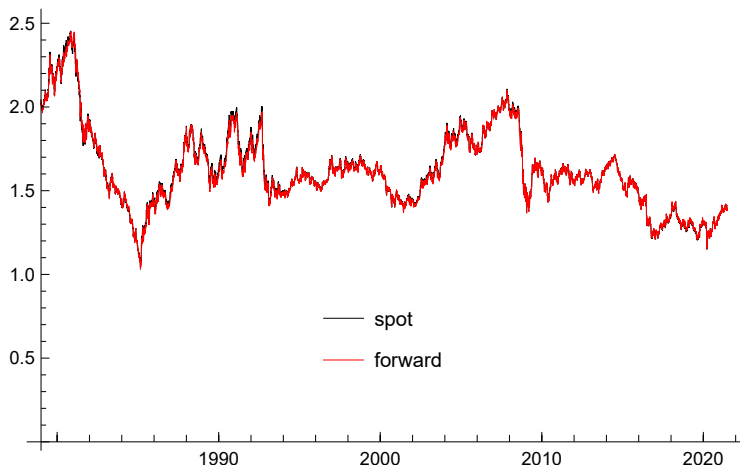
[https://www.fxempire.com/currencies/usd-cad/  
forward-rates](https://www.fxempire.com/currencies/usd-cad/forward-rates)

Forward points represent 1/10,000.

E.g., so forward points of +15.2 means add 0.00152 to a currency spot price.

# Spot and Forward Exchange Rates

GBP-USD (spot and 90 day forward)



Spot and 90-day forward exchange rates (end of month).

Data Source: Bank of England

Compare: KOMIE12 Figure 14-1

# Covered Interest Parity

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

Here  $E$  is the spot (direct) exchange rate,  $F$  is the forward exchange rate,  $R$  is the domestic interest rate, and  $R^*$  is the foreign interest rate.

- ▶ Covered interest parity relates interest rates across countries and the rate of change between forward exchange rates and the spot exchange rate:
- ▶ It says that rates of return on dollar deposits and “covered” foreign currency deposits are the same.
  - ▶ How could you earn a risk-free return in the foreign exchange markets if covered interest parity did not hold?
  - ▶ Covered positions using the forward rate involve little risk.

# Uncovered Interest Parity

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



# Foreign-Exchange Swaps

**Spot-forward swap:** combines of a spot sale with a forward repurchase.

**Forward-forward swap:** combines two forward transactions (e.g., a forward sale with a later forward repurchase).

Swap contracts often result in lower fees or transactions costs because they combine two transactions.

Swaps allow parties to meet each others needs for a temporary amount of time.

# Other Methods of Currency Exchange (Futures)

**Futures contracts:** a contract designed by a third party for a standard amount of foreign currency delivered/received on a standard date.

Futures contracts can be bought and sold on exchanges, and only the current owner is obliged to fulfill the contract.

# Other Methods of Currency Exchange (Options)

**Options contract:** option (but not obligation) to receive or deliver foreign exchange at a stated price on a future date

- ▶ Gives the owner the option, but not obligation, of buying or selling currency if the need arises.
- ▶ Includes *swaption* contracts: option to enter into a swap.

Standardized options contracts can be bought and sold on exchanges, but OTC remains most common.

# Daily Global Foreign Exchange Turnover

"Net-net" basis, 1 daily averages in April in billions of US dollars

Table 1

Instrument	2010	2013	2016	2019*	2022
Foreign exchange instruments	3,973	5,357	5,066	6,581	7,508
Spot transactions	1,489	2,047	1,652	1,979	2,107
Outright forwards	475	679	700	998	1,163
Foreign exchange swaps	1,759	2,240	2,378	3,198	3,810
Currency swaps	43	54	82	108	124
Options and other products <sup>2</sup>	207	337	254	298	304

Source: [BIS Triennial Survey](#)

# Daily Global Foreign Exchange Turnover

Net-net basis, daily averages in April

Graph 1

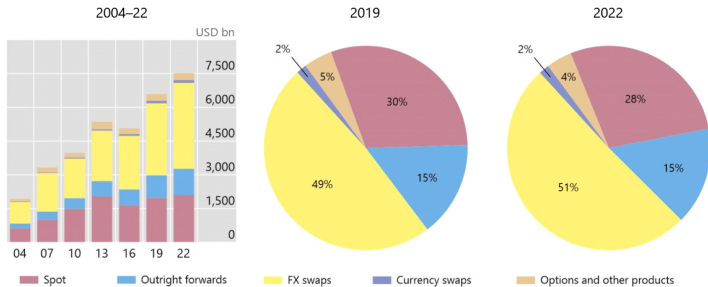


Image Source: [BIS Triennial Survey](#)

# Rate of Return

**Rate of return** the percentage change in value that an asset produces during a time period.

**Real rate of return** inflation-adjusted rate of return (approximately:  
interest rate - inflation rate)  
the addition to purchasing power (control over goods & services)

**Example: \$1000 saving deposit,  $R=2\%/yr$ , inflation =  $1\%/yr$**

- ▶ After 1 year the deposit is worth  
 $\$1000 \times 1.02 = \$1020$
- ▶ So its rate of return is  
 $(\$1020 - \$1000)/\$1000 = 2\%/yr$
- ▶ The real rate of return is (approximately):  
 $2\% - 1.0\% = 1.0\%$

# Ignoring Inflation in the Short Run

A rise in  $P$  reduces the goods and services controlled by a given nominal wealth.

- ▶ Suppose the inflation rate is 0%. Then prices are fixed, and nominal rates of return = real rates of return.
- ▶ Because trading of deposits in different currencies occurs on a daily basis, we often assume that prices do not change from day to day.
  - ▶ A reasonable assumption to make for the short run.

# Other Influences on Currency-Deposit Demand

**Risk:** The volatility of real wealth

**Liquidity:** the ease with which one can turn the asset into goods and services

We will assume that the risk and liquidity of currency deposits does not depend on currency denomination.

Assume: risk and liquidity are of secondary importance to individuals deciding to buy or sell currency deposits.

Implication: investors in currency deposits are primarily concerned about the rates of return.



# Rate of Return on Currency Deposits

The rate of return that an investor expects to earn on an interest bearing assets is determined by

- ▶ interest rate
- ▶ expected exchange rate movements

**Domestic currency assets:** expected return is just  $R$

**Foreign currency assets:** expected return is  $R^* + (E^e - E)/E$   
interest + expected depreciation of the domestic currency

# Summary: Demand for Currency Deposits

## Influences on the demand for deposits

- ▶ Risk
- ▶ Liquidity
- ▶ Expected rate of return
  - ▶ we will emphasize this for now

## Deposits

- ▶ bear interest (at annual rate)
- ▶ denominated in domestic or foreign currency
- ▶ Foreign currency deposits additionally have capital gains or losses
  - ▶ Exchange-rate risk

# Dollar and Yen Interest Rates (3 month rates, annualized)

Interest Rates on Dollar and Yen Deposits, 1978–2020

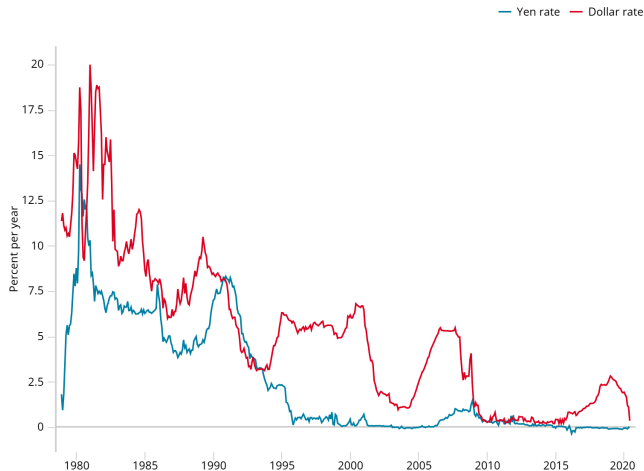
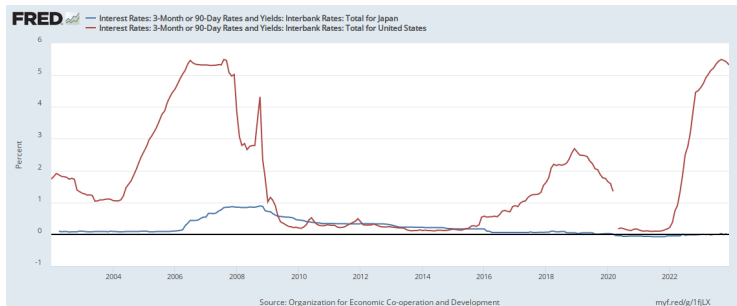


Image Source: KOMIE12 Fig 14-2 (Data Source: Data Stream)

# Dollar and Yen Interest Rates (3 month rates, annualized)



Source: **FRED Interbank Rates**

## The Demand for Currency Deposits (cont.)

Suppose  $R = 1\%/yr$  and  $R^* = 2\%/yr$ .

Does a euro deposit yield a higher expected rate of return?

To answer this, we must consider the expected change in the value of a euro.

Suppose today the exchange rate is EUR-USD 1.5, and the expected rate one year in the future is EUR-USD 1.3.

- ▶ USD 150 can be exchanged today for EUR 100.
- ▶ These EUR 100 will yield EUR 102 after one year.
- ▶ These EUR 102 are expected to be worth  $(1.3 \text{ USD/EUR}) \times \text{EUR } 102 = \text{USD } 132.60$  in one year.

Clearly USD 151.50 from investing at home is better than USD 132.60 from investing abroad.

The return is higher on domestic assets, despite the higher interest rate abroad.

# The Demand for Currency Deposits (cont.)

## Recap

$$R = 1.0\%$$

$$R^* = 2.0\%$$

$$E = 1.50$$

$$E^e = 1.30$$

The rate of return from investing domestically is simply the interest rate,  $R=0.01=1\%$ .

The expected rate of return from investing abroad

$$\frac{132.60 - 150}{150} = -0.116 = -11.6\%$$

The euro deposit has higher interest rate but a lower expected rate of return.

All investors should hold dollar deposits; none should hold euro deposits.

# The Demand for Currency Deposits (cont.)

**Approximate analysis:** the dollar rate of return on euro deposits approximately equals:

- ▶ the interest rate on euro deposits (2%)
- ▶ plus the expected rate of appreciation of euro deposits (-13.3%)
- ▶  $2\% + -13.3\% = -11.3\%$  (which approximately equals our exact -11.6%)

Approximate expected return on foreign currency deposits:

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

## The Demand for Currency Deposits (cont.)

Recap: our (approximate) expected rate of return on euro deposits is

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

- ▶ interest rate on euro deposits, plus
- ▶ expected rate of depreciation of the dollar
  - ▶ expected exchange rate
  - ▶ current exchange rate



# Model of Foreign Exchange Markets

*Given* the expected future exchange rate, how do changes in the *current* exchange rate affect the expected rate of return of foreign currency deposits?

## Model of Foreign Exchange Markets (cont.)

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

*Given* the expected future exchange rate:

- ▶ Depreciation of the domestic currency today lowers the expected rate of return on foreign currency deposits. Why?
  - ▶ When the domestic currency depreciates, the initial cost of investing in foreign currency deposits increases, thereby lowering the expected rate of return of foreign currency deposits.
- ▶ Appreciation of the domestic currency today raises the expected return of deposits on foreign currency deposits. Why?
  - ▶ When the domestic currency appreciates, the initial cost of investing in foreign currency deposits decreases, thereby raising the expected rate of return of foreign currency deposits.

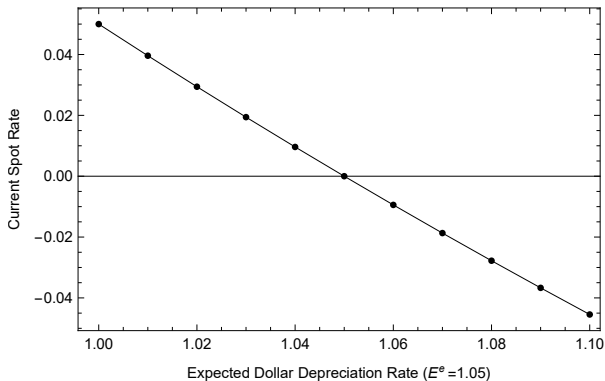
# Exchange Rate and Asset Return

cost of foreign exchange	expected dollar depreciation	expected dollar return
1.00	5.00%	8.00%
1.01	3.96%	6.96%
1.02	2.94%	5.94%
1.03	1.94%	4.94%
1.04	0.96%	3.96%
1.05	0.00%	3.00%
1.06	-0.94%	2.06%
1.07	-1.87%	1.13%
1.08	-2.78%	0.22%
1.09	-3.67%	-0.67%
1.10	-4.55%	-1.55%

Constants:  $R^{EU}=0.03$ ,  $E^e=1.05$

Note: compare KOMIE12 Tbl. 14-4

# Expected Domestic Rate of Depreciation



Note: compare KOMIE12 Fig. 14-3

# Equilibrium in the FX Market

Equilibrium in the market for foreign exchange requires equal desirability of competing assets.

## Interest parity

- ▶ comparable assets must bear comparable expected rates of return

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

- ▶ implies that deposits in various currencies are equally desirable.
- ▶ is the basic component of our first model of foreign exchange markets.
- ▶ expected return on dollar denominated deposits ( $R$ ) must equal expected return on foreign currency denominated deposits  $(R^* + (E^e - E)/E)$

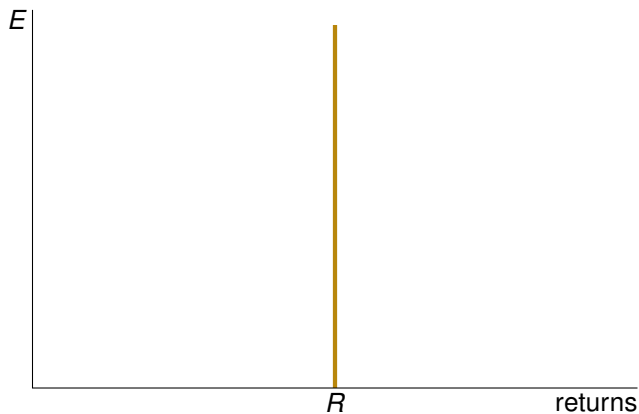
# Model of Foreign Exchange Markets (cont.)

Interest parity says:

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

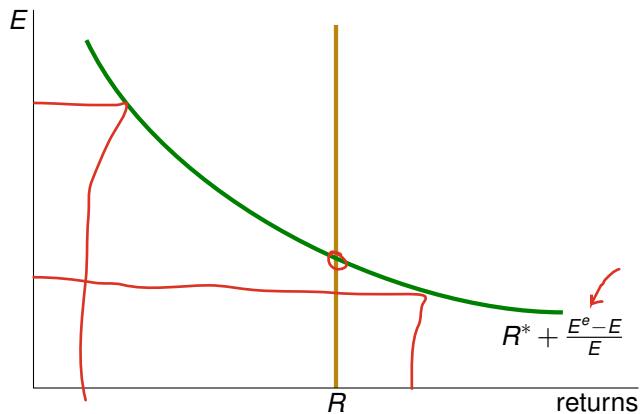
- ▶ Why should this condition hold? Suppose it didn't.
  - ▶ Suppose  $R > R^* + (E^e - E)/E$
  - ▶ Then no investor would want to hold euro deposits, driving down the demand and price of euros.
  - ▶ Then all investors would want to hold dollar deposits, driving up the demand and price of dollars.
  - ▶ The dollar would appreciate and the euro would depreciate, increasing the right side until equality was achieved:

# Domestic Interest Rate in the FX Market



Note: compare KOMIE12 Fig 14-4

# DRED Curve in the FX Market



Note: compare KOMIE12 Fig 14-4

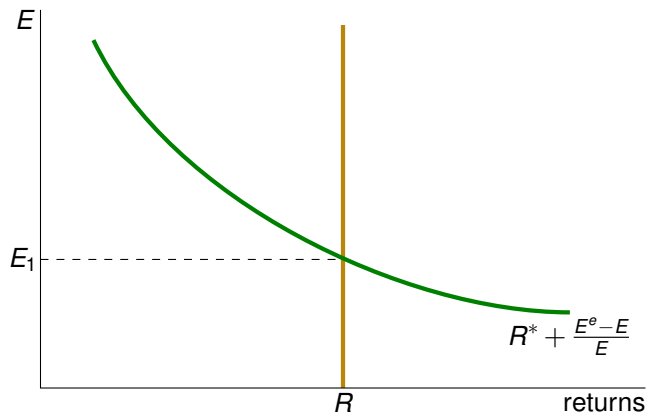


# Exogenous vs Endogenous Variables

**Exogenous variable:** value determined *outside* the model

**Endogenous variable:** value determined *by* the model

# Static Equilibrium in the FX Market



Note: compare KOM 12 Fig 14-4 (3-4)

# Comparative Statics

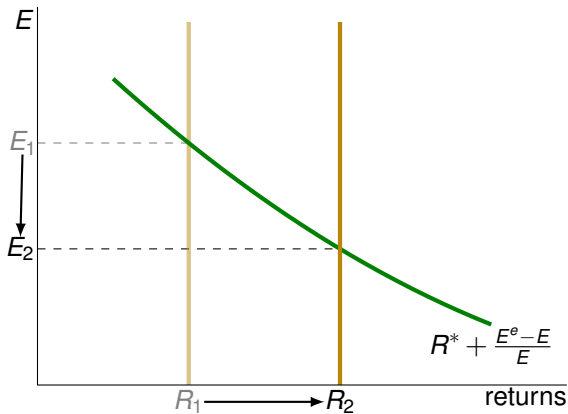
**Static equilibrium model:** exogenous variables determine the static equilibrium

**Comparative statics experiment:** change an exogenous variable and determine the change in the static equilibrium

## Effect of changing $R$ :

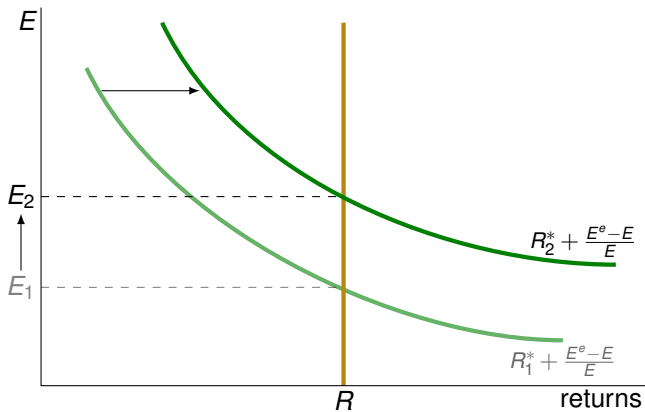
- ▶ an increase in the interest rate paid on deposits denominated in a particular currency will increase the rate of return on those deposits.
- ▶ This leads to an appreciation of the currency.
- ▶ Higher interest rates on dollar-denominated assets causes the dollar to appreciate.
- ▶ Higher interest rates on euro-denominated assets causes the dollar to depreciate

$\uparrow R \rightarrow \downarrow E$



Note: compare KOM 12 Fig 14-5 (3-5)

$\uparrow R^* \rightarrow \uparrow E$

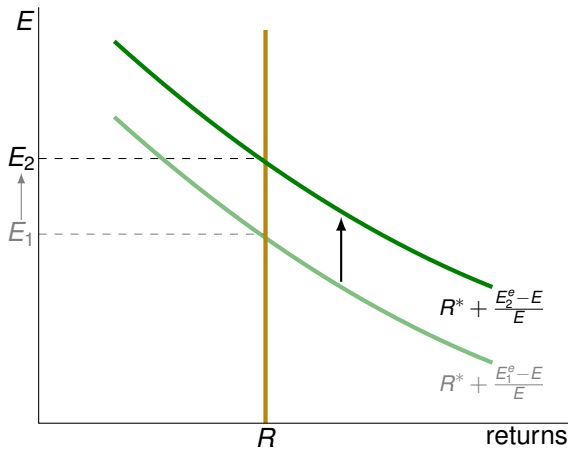


Note:  $R_2^* > R_1^*$ ; compare KOM 12 Fig 14-6 (3-6).

# Appreciation of the Expected Euro

- ▶ If people expect the euro to appreciate in the future, then euro-denominated assets will pay in valuable euros, so that these future euros will be able to buy many dollars and many dollar-denominated goods.
  - ▶ The expected rate of return on euros therefore increases.
  - ▶ An expected appreciation of a currency leads to an actual appreciation (a self-fulfilling prophecy).
  - ▶ An expected depreciation of a currency leads to an actual depreciation (a self-fulfilling prophecy).

$\uparrow Ee \rightarrow \uparrow E$



Note:  $E_2^e > E_1^e$ .



# Summary

**exchange rate (direct rate)** the domestic-currency price of foreign exchange.

**foreign exchange** interest-bearing deposits foreign currencies. (for the most part)

**spot exchange rate** a contracted rate at which foreign exchange will be bought on sold “on the spot”.

**forward exchange rate** a contracted rate at which foreign exchange will be bought on sold on a *future* date.

By “foreign exchange” we primarily mean interest-bearing deposits foreign currencies.

## Summary (cont)

**Depreciation (of the domestic currency)** E (direct rate) rises; the currency becomes less valuable.

Goods priced in it (e.g., our exports) become relatively less expensive. Imports become relatively expensive.

A depreciation hurts consumers (who buy imports) but helps exporters.

**Appreciation (of the domestic currency)** E (direct rate) falls; the currency becomes more valuable.

Goods priced in it (e.g., our exports) become relatively expensive. Imports become relatively cheap.

An appreciation helps consumers (who buy imports) but hurts exporters.

## Summary (cont)

The primary players in the market for foreign exchange are commercial and investment banks. Their arbitrage activities ensure interest parity holds: comparable assets should bear comparable rates of return.

- ▶ This implies covered interest parity.
- ▶ Ignoring risk factors, this implies “uncovered” interest parity.

## Summary (cont)

### **Covered interest parity** $R = R^* + (F - E)/E$

the rate of return on domestic currency deposits must equal the rate of return on “covered” foreign currency deposits.

Foreign currency deposits can be “covered” with a forward exchange contract.

### **Uncovered interest parity** $R = R^* + (E^e - E)/E$

Expected rates of return on foreign and domestic currency deposits are equal

Expected rates of return on currency deposits and determined by interest rates and expected exchange rates.

## Summary (cont)

- ▶ An increase in the domestic interest rate (an increase in its expected rate of return) leads to an appreciation of the domestic currency.
- ▶ An increase in the expected future exchange rate lead to a depreciation of the domestic currency.

# Introduction to Carry

The carry of an asset is the return (benefit or cost) of holding it.  
Commodities often have a negative carry: the cost of storage.

# Introduction to the Currency Carry Trade

**Currency carry trade:** uncovered interest arbitrage; borrow in one currency to lend in another, uncovered

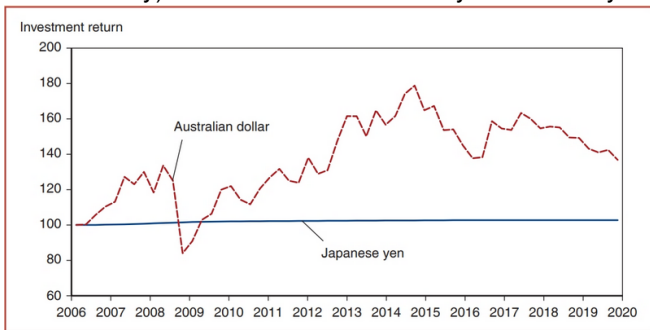
**Investment currency** lend at high interest

**Funding currency** borrow at low interest

Uncovered interest parity says the expected profits from this *carry trade* are zero. But ...

# Carry Trade vs. Interest Parity

A sustained profitable carry trade (JPY as funding currency, AUD as investment currency) was observed in the early 21st century.





# Possible Reconciliation: Uncertain Crash

AUD expected appreciation

- ▶ 90% chance of 1 percent per year
- ▶ 10% chance of -40 percent per year
- ▶ average =  $0.9 \times 1\% + 0.1 \times (-40\%) = -3.1\%$

Furthermore, *suppose* these expectations are correct. The probability of a crash in the next six years is less than half.

$$1 - 0.9^6 = 0.47$$

# Nondeliverable Forward Contracts

## **counterparties settle the *difference***

- ▶ "cash settled": only difference flows
- ▶ contracted price vs. "fixing" price
- ▶ usually: fixing price = realized spot rate (up to 2 days before settlement)

## **traded over-the-counter (OTC)**

- ▶ direct trade between two parties (vs. trading on an exchange)

## **offshore *nondeliverable* forward markets:**

- ▶ NY (esp for Latin America), London, Hong Kong, Singapore

# Nondeliverable Forward Exchange

NDF market became significant in early 1990s

- ▶ Initially mostly Latin American currencies

NDFs are often a response to capital controls

- ▶ E.g., China restricts foreign ownership of renminbi deposits
  - ▶ ISO: CNY; common: RMB; Latinized symbol: ¥
- ▶ China loosened CNY trade restrictions in 2010 (→ shrinking NDF mkt as pct of fwd transactions)

2013 BIS Triennial Survey reported \$127 billion in daily NDF turnover

# SAFE

Initially, China's State Administration for Foreign Exchange (SAFE) prohibited offshore conversion.

Result: offshore banks could not deliver CNY to fulfill forward contracts

One possibility: try to find a domestic (Chinese) bank that can offer forward delivery domestically. Not always possible.

Another possibility: NDFs (all flows are in another currency (e.g., USD))

Often called the RMB NDF market.

## NDF Example

Use NDF contracts to hedge future payments in Chinese yuan

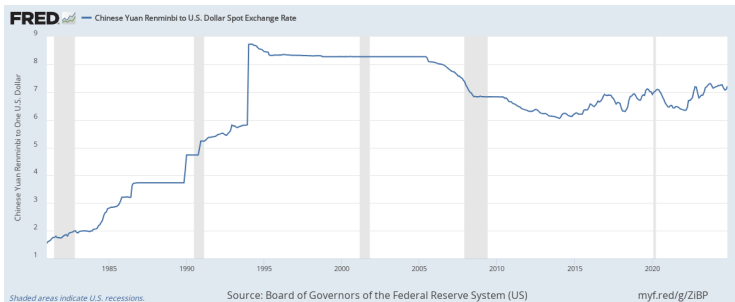
- ▶ You need to pay CNY 10M in six months for equipment purchases.  
This exposes you to currency risk.
- ▶ Possible hedge: buy CNY six months forward at the NDF rate of CNY 6.7200 per U.S. dollar from an offshore bank.  
This bank cannot deliver CNY!
- ▶ Six months later, make a net settlement in dollars for the NDF contract.  
If fixing rate ( $E_f$ ) is at par, there are no cash flows.  
If  $E_f > 6.72$ , the CNY is cheap. You fulfill your NDF contract by paying the bank  $\text{USD}(10\text{M}/6.72 - 10\text{M}/E_f)$   
If  $E_f < 6.72$ , the CNY is expensive. The bank fulfills your NDF contract by paying you  $\text{USD}(10\text{M}/E_f - 10\text{M}/6.72)$
- ▶ Because of your NDF hedge, your total cost is a certain USD 10M/6.72.

# Changing Role of CNY

July 2010: Hong Kong banks allowed to settle in Renminbi.

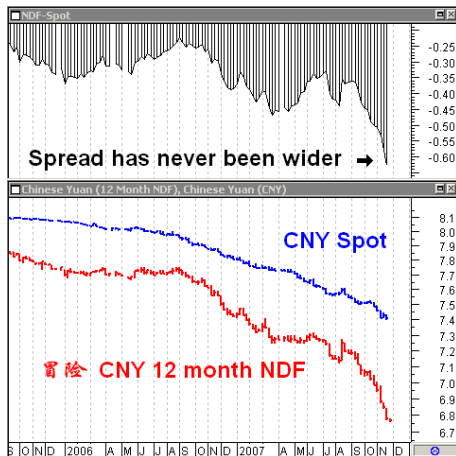
- ▶ called the CNH market
- ▶ diminishes (relatively) NDF demand
- ▶ capital restrictions mean CNH price and CNY price can differ

# USD-CNY: Recent History



Source: <https://fred.stlouisfed.org/graph/fredgraph.png?g=AEEZ>

# CNY Nondeliverable Forwards





# Example: CNY NDF

8 Sep 2009

## **USD-CNY 6.83 (spot)**

- ▶ Daily reference rate
- ▶ 20% appreciation since July 2005  
(when fixed rate scrapped)

## **USD-CNY 6.7415 (12 month NDF)**

- ▶ implies  $(6.7415 - 6.83) / 6.83 = -1.3\%$  “expected” change

## Example: CNY NDF

**10 Sep 2010** PBoC fixes “mid-point” at USD-CNY 6.7625

13 Sep 2010

**USD-CNY 6.7625 (spot)** vs. 6.7415 “predicted” by the NDF market a year before

**USD-CNY 6.6449 (12 month NDF)** 12-month implied yuan appreciation: 1.74%

$$(6.6449 - 6.7625) / 6.7625 = -1.74\%$$

<http://www.bloomberg.com/apps/quote?ticker=CCN%2B12M:IND#chart>

## Example: CNY NDF

13 Sep 2011

**USD-CNY 6.40 (spot)** vs. 6.449 “predicted” by the NDF market a year before

23 Sep 2011

**USD-CNY 6.4125 (12 month NDF)** 12-month implied yuan depreciation: 0.2%

$$(6.4125 - 6.40)/6.40 = 0.2\%$$

## Example: CNY NDF

13 Sep 2011

**USD-CNY 6.40 (spot)** vs. 6.449 “predicted” by the NDF market a year before

23 Sep 2011

**USD-CNY 6.4125 (12 month NDF)** 12-month implied yuan depreciation: 0.2%

$$(6.4125 - 6.40)/6.40 = 0.2\%$$

**China Foreign Exchange Trade System (CFETS)** also known as  
the National Interbank Funding Center (the Center)  
a sub-institution of the People's Bank of China (PBC)  
provides systems for foreign exchange (FX) trading, RMB lending  
and bond trading  
handles settlement and clearing of FX trading  
head office in Shanghai, with subcenters throughout China  
website: <http://www.chinamoney.com.cn>

# Offshore Trading in CNY

Before 2004, the yuan was restricted to China.

In 2004, Hong Kong began to offer renminbi personal accounts.

Since then, China has continually relaxed the rules on international transactions in renminbi. Current account transactions are liberalized.

Capital account transactions are slowly liberalizing.

In September 2011, China agreed that the City of London would become an offshore trading center for the renminbi.

By the end of 2014, London accounted for more than 40% of all offshore CNY trading, catching up with Hong Kong.