

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

`https://en.wikipedia.org/wiki/ISO_4217#Active_codes`

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.

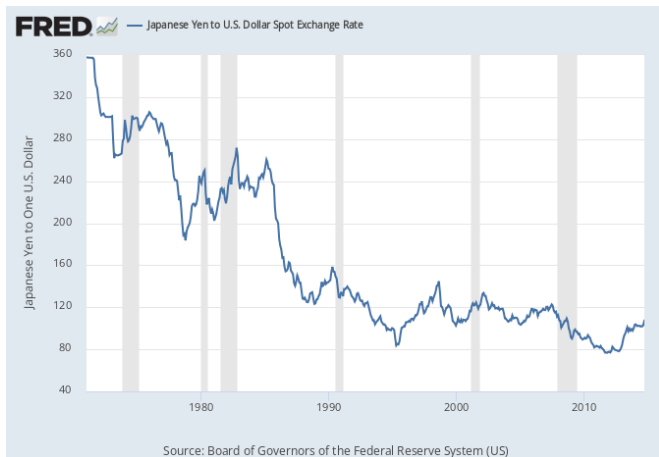
<http://finance.yahoo.com/currency-investing>

Indirect and Direct Rates

Currency	1 USD	in USD
Euro	0.824221	1.213267
British_Pound	0.729140	1.371479
Indian_Rupee	72.911642	0.013715
Australian_Dollar	1.307460	0.764842
Canadian_Dollar	1.280011	0.781243
Singapore_Dollar	1.328666	0.752635
Swiss_Franc	0.890538	1.122917
Malaysian_Ringgit	4.042002	0.247402
Japanese_Yen	104.713163	0.009550
Chinese_YuanRenminbi	6.427633	0.155578

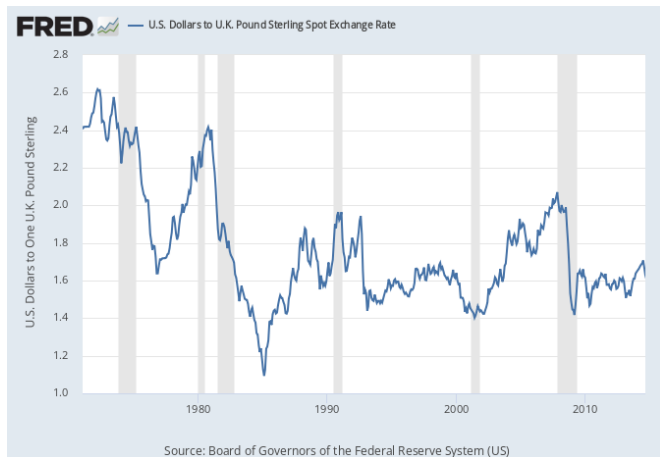
Source: <http://www.x-rates.com/d/USD/table.html>
on 2021-01-29

USD-JPY



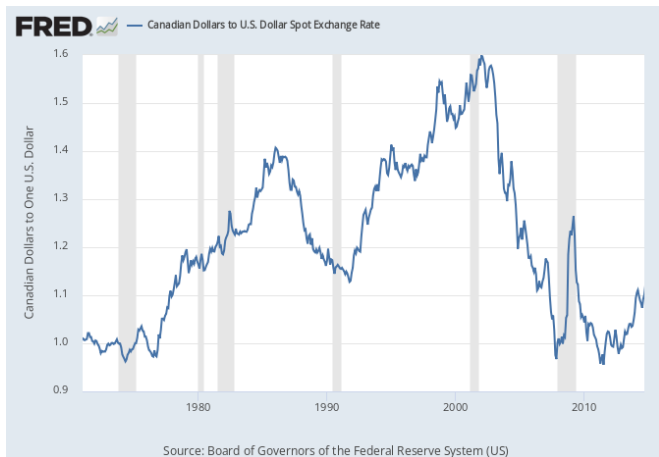
Source: <http://research.stlouisfed.org/fred2/series/EXJPUS?cid=95>

GBP-USD



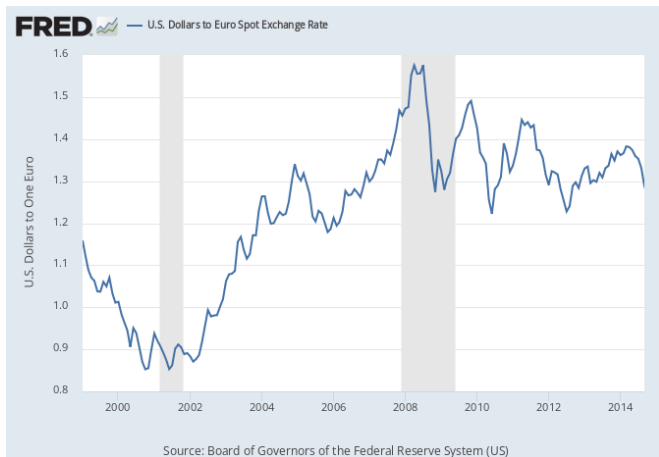
Source: <http://research.stlouisfed.org/fred2/series/EXUSUK?cid=95>

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 2010, the Mercedes-Benz SLS AMG cost about EUR 150k. What was the dollar cost?

- ▶ Exchange rate (dollar terms): EUR-USD 1.3
- ▶ Foreign price: EUR 150K
- ▶ Domestic price:
 - ▶ (exchange rate) x (foreign price)
 - ▶ (USD 1.3/EUR) x EUR 150k = USD 195k

Depreciation and Appreciation

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

S *rises* (direct rate!)

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

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

S *falls* (direct rate!)

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

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 an AMG costs €150k

- ▶ $€150k \times \$1/€1 = \$150k$
- ▶ $€150k \times \$1.5/€1 = \$225k$

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 → JPY-USD 0.0100

- ▶ 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 ¥1.5M

- ▶ $¥1,500,000 \times \$0.0125/¥1 = \$18,750$
- ▶ $¥1,500,000 \times \$0.0100/¥1 = \$15,000$

Dollar appreciation → 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 \$6.6T in 2019, \$5.1T in 2016, \$5.4T in 2013, \$4T in 2010, and \$3.2T in 2007.
 - ▶ About 85% of transactions involved the USD
 - ▶ USD-EUR transactions are just over 1/4 of the total

Source: <http://www.bis.org/publ/rpfx10.htm>

Currency Composition

OTC foreign exchange turnover by currency pair

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

Table 3

Currency pair	2004		2007		2010		2013		2016		2019	
	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%
USD / EUR	541	28.0	892	26.8	1,099	27.7	1,292	24.1	1,172	23.1	1,584	24.0
USD / JPY	328	17.0	438	13.2	567	14.3	980	18.3	901	17.8	871	13.2
USD / GBP	259	13.4	384	11.6	360	9.1	473	8.8	470	9.3	630	9.6
USD / AUD	107	5.5	185	5.6	248	6.3	364	6.8	262	5.2	358	5.4
USD / CAD	77	4.0	126	3.8	182	4.6	200	3.7	218	4.3	287	4.4
USD / CNY	...	...	...	...	31	0.8	113	2.1	192	3.8	269	4.1
USD / CHF	83	4.3	151	4.5	166	4.2	184	3.4	180	3.6	228	3.5

Source: BIS

(https://www.bis.org/statistics/rpfx19_fx.htm)

Foreign Exchange Market Participants

1. Commercial banks and other depository institutions: transactions involve buying/selling of deposits in different currencies for investment purposes.
2. Non-bank financial institutions (mutual funds, hedge funds, securities firms, insurance companies, pension funds) may buy/sell foreign assets for investment.
3. Non-financial businesses conduct foreign currency transactions to buy/sell goods, services and assets.
4. Central banks: conduct official international reserves transactions.

Daily Global Foreign Exchange Turnover

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

Table 1

Instrument	2004	2007	2010	2013	2016	2019
Foreign exchange instruments	1,934	3,324	3,973	5,357	5,066	6,590
Spot transactions	631	1,005	1,489	2,047	1,652	1,987
Outright forwards	209	362	475	679	700	999
Foreign exchange swaps	954	1,714	1,759	2,240	2,378	3,202
Currency swaps	21	31	43	54	82	108
Options and other products ²	119	212	207	337	254	294

Source: BIS

(https://www.bis.org/statistics/rpfx19_fx.htm)

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 2019, main players:

- ▶ the United Kingdom (43.1%)
- ▶ the United States (16.5%)
- ▶ Singapore (7.6%)
- ▶ Hong Kong SAR (7.6%).
- ▶ Japan (4.5%)

Source: BIS (2019, 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

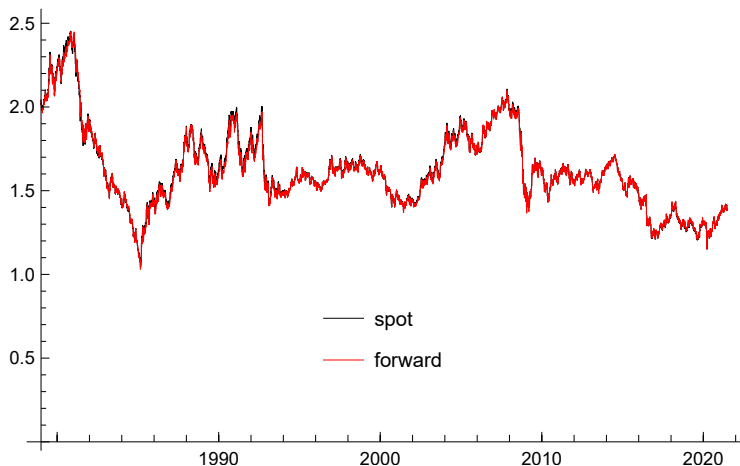
`https://www.fxempire.com/currencies/usd-cad/
forward-rates`

Forward points represent 1/10,000.

S.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: KOM Figure 3-1 (14-1)

Covered Interest Parity

$$R = R^* + (F - S)/S$$

Here S 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

$$R = R^* + (S^e - S)/S$$

Foreign-Exchange Swaps

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

Forward-forward swap: combines of a forward sale with a later forward repurchase.

Swaps often result in lower fees or transactions costs because they combine two transactions, and they allow parties to meet each others needs for a temporary amount of time.

Other Methods of Currency Exchange

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 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.

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 $R^* + (S^e - S)/S$
interest + expected depreciation of the domestic currency

Summary: Demand for Currency Deposits

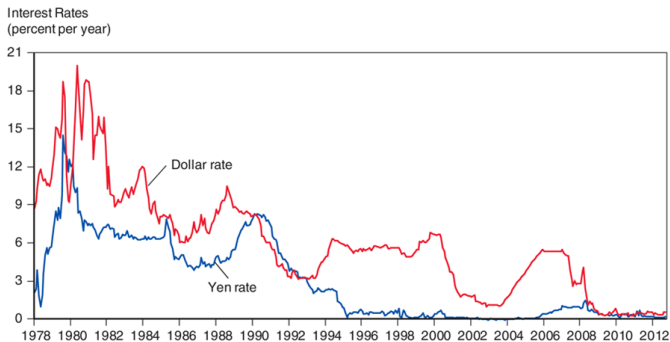
Influences on the demand for deposits

- ▶ 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)



Source: *Datastream*. Three-month interest rates are shown.

Source: KOM Fig 3-2 (14-2) (Original Data Source: Data Stream)

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

$$R = 1.0\%$$

$$R^* = 2.0\%$$

$$S = 1.50$$

$$S^e = 1.30$$

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:

$$R^* + (S^e - S)/S$$

The Demand for Currency Deposits (cont.)

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

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

- ▶ 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.)

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

Given the expected future exchange rate:

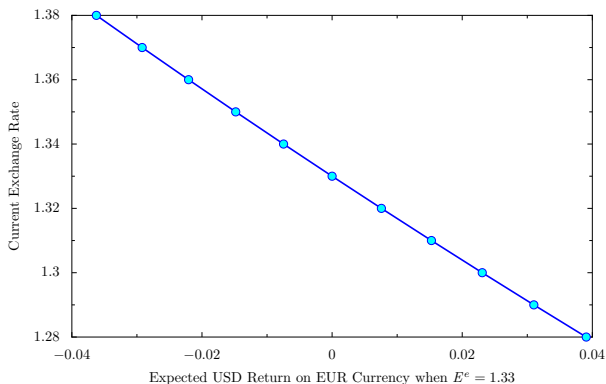
- ▶ Depreciation of the domestic currency today lowers the expected rate of return on foreign currency deposits. **Why?**
 - ▶ When the domestic currency depreciates, the initial cost of investing in foreign currency deposits increases, thereby lowering the expected rate of return of foreign currency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

Case	S	$\frac{S^e - S}{S}$	$R^* + \frac{S^e - S}{S}$
1	1.39	-4.0%	-3.0%
2	1.36	-2.0%	-1.0%
3	1.33	0.0%	1.0%
4	1.30	2.0%	3.0%
5	1.28	4.0%	5.0%

Constants: $R^* = 1.0\%$, $S^e = 1.33$

The Relation Between the Current Dollar/Euro Exchange Rate and the Expected Dollar Return on Euro Deposits



Note: compare KOM 11 Fig. 3-3 (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

$$R = R^* + (S^e - S)/S$$

- ▶ 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 ($R^* + (S^e - S)/S$)