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3. Exchange rate theory

Ch. 3: Exchange rate theory

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Exchange rate determination

For the moment, we will focus on **flexible exchange rates**.

In this system, the determination of exchange rates is left to the market.

We will investigate **two questions:**

- How is the exchange rate determined?
- What are the main drivers?

Treating forein money just like any other good

First, we will use a simple **demand-supply diagramme** - just like the one we would use to analyse the market for chocolate or tooth paste.

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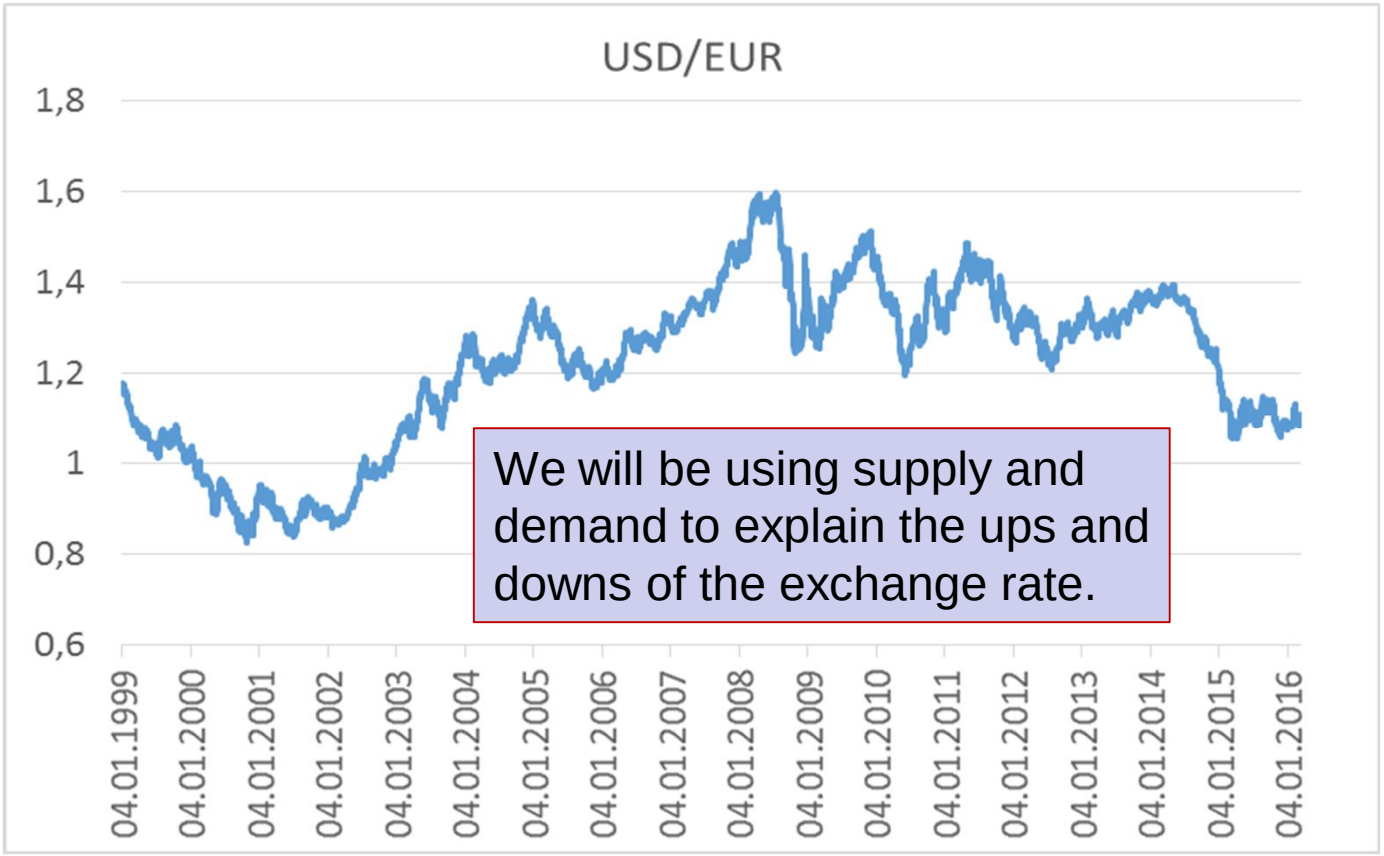
Exchange rates can be volatile

(I think, we mentioned that already.)



Source: Deutsche Bundesbank

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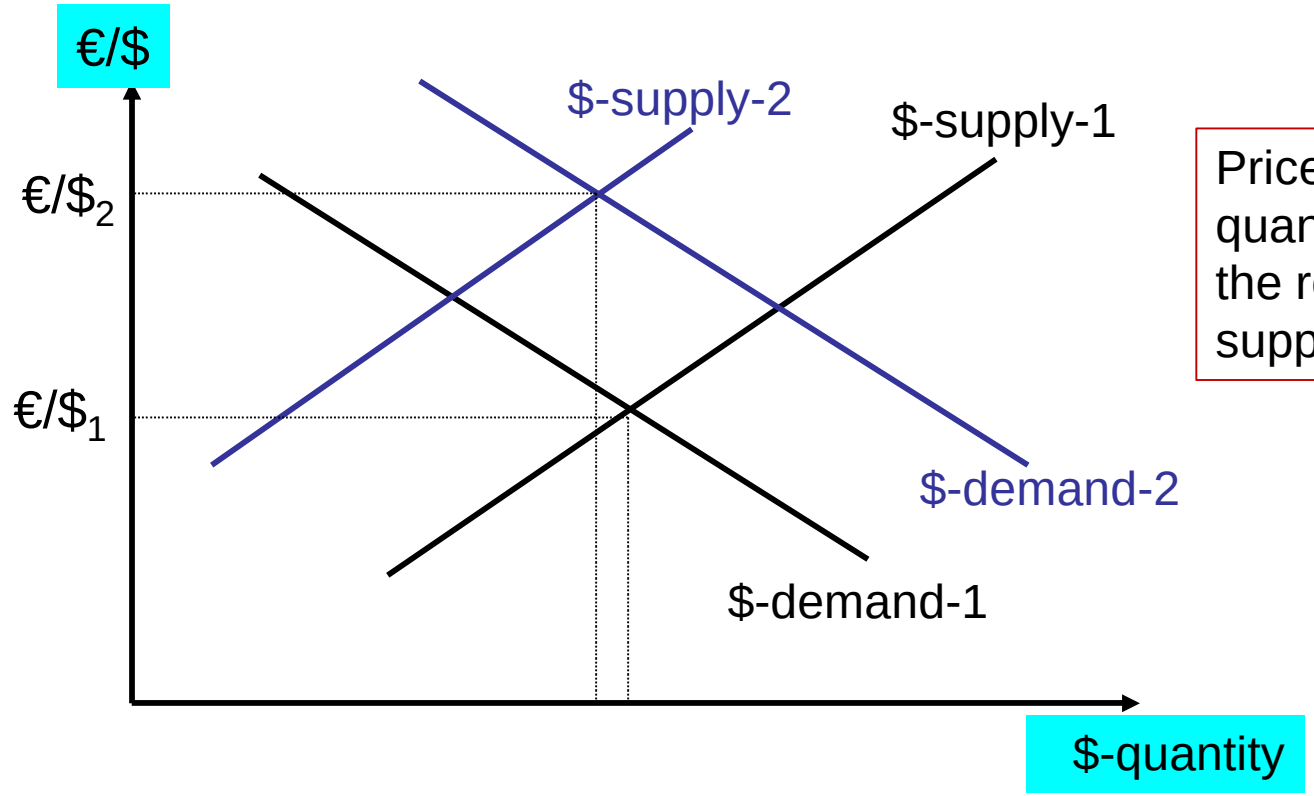
Supply and demand in the fx-market

The US$ is treated like a commodity just like any other good.



Price changes and/or quantity changes are the results of shifts in supply and demand.

→ The exchange rate as a market price

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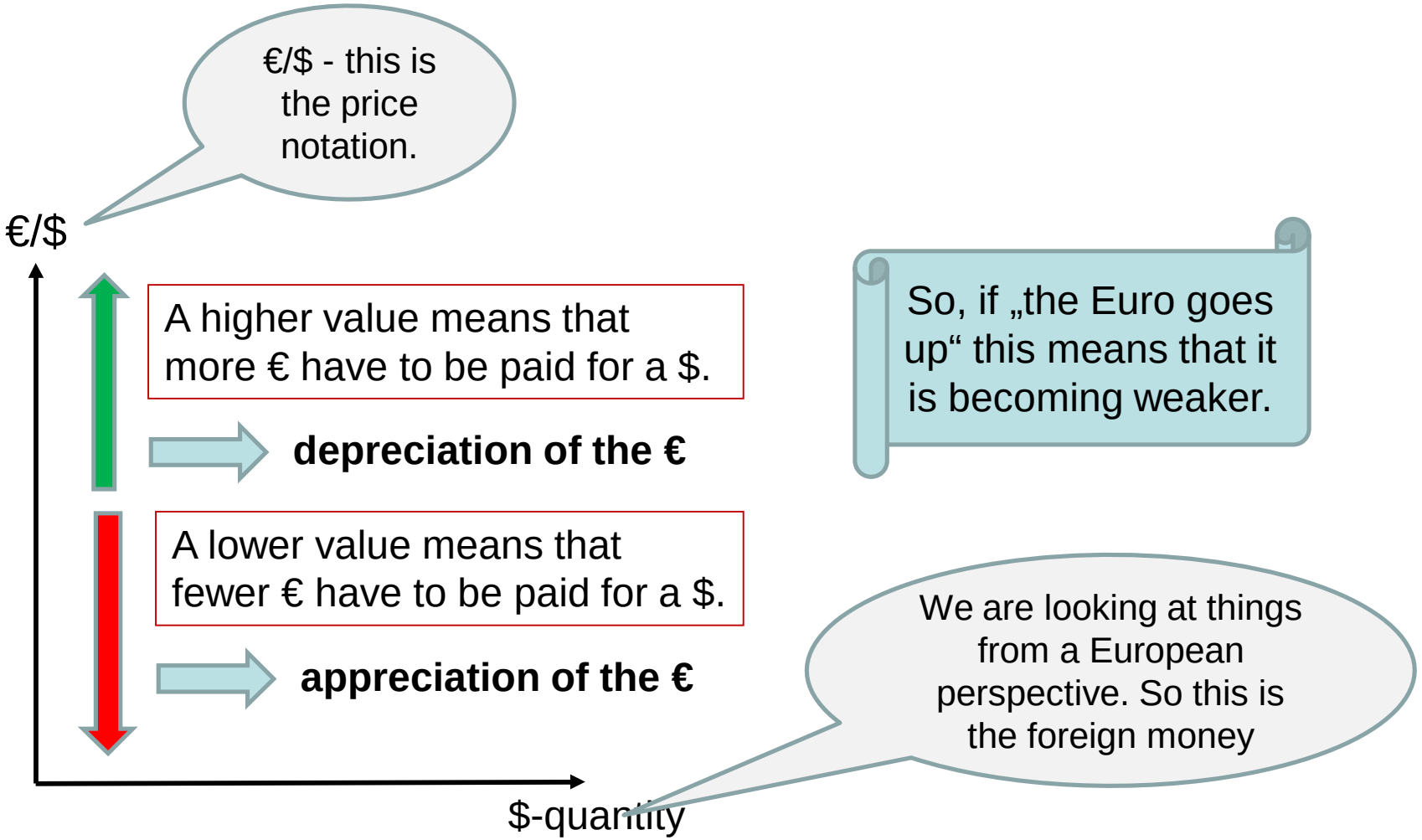
Just a quick refresher



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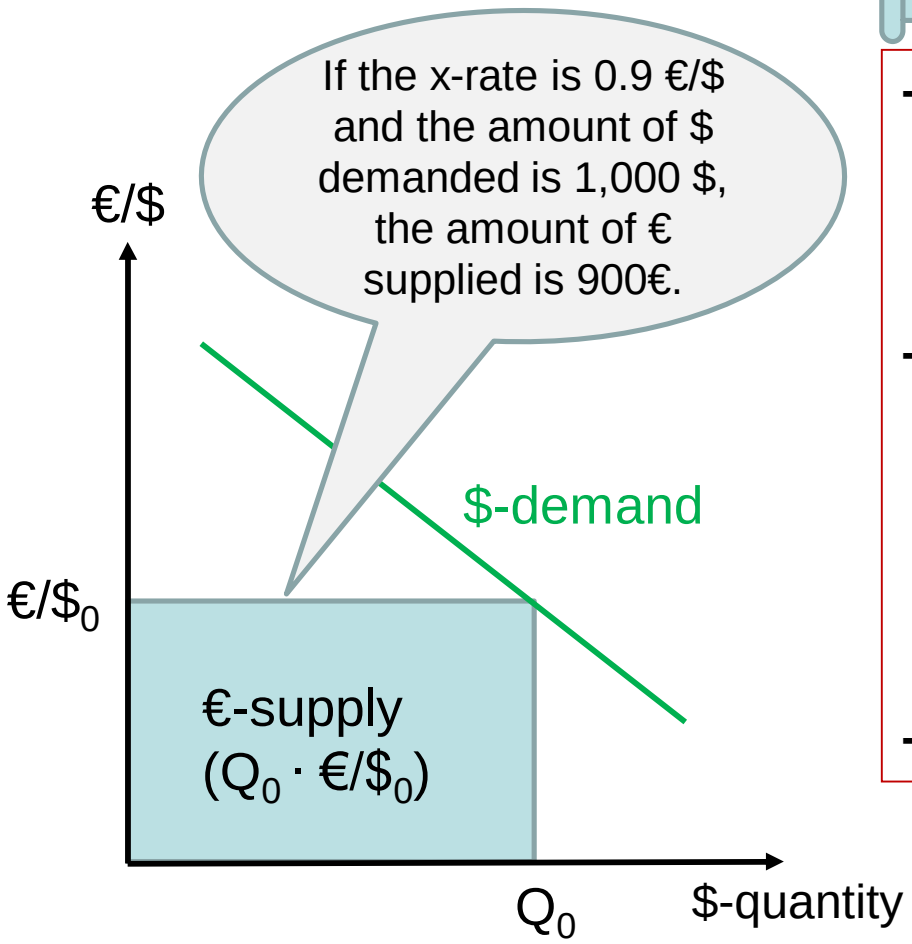
Supply and demand in the fx-market



In the balance of payments we can find the different sources of **$-demand**.

- **Current account transactions**
  - Imports (goods + services)
  - Transfers
  - Capital income payable
- **Financial account transactions** (capital exports):
  - investment into $-assets (by €-locals)
  - sales of €-assets (by $-locals)
  - borrowing of € (by $-locals)
  - repayments of debt (to $-locals)
- **Increase of international reserves**

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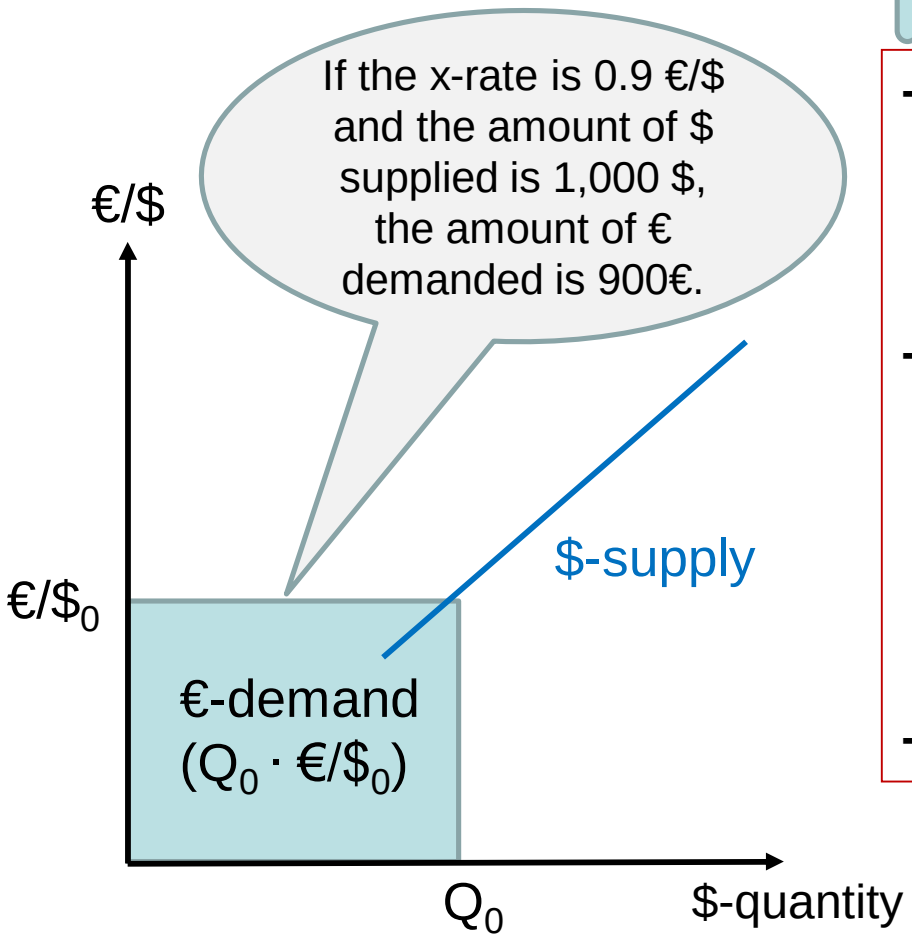
Supply and demand in the fx-market



In the balance of payments we can find the different sources of **$-supply.**

- **Current account transactions**
  - Exports (goods + services)
  - Transfers
  - Capital income received
- **Financial account transactions** (capital imports):
  - investment into €-assets (by $-locals)
  - sales of $-assets (by €-locals)
  - borrowing of $ (by €-locals)
  - repayments of debt (to €-locals)
- **Reduction of international reserves**

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Supply and demand in the fx-market

So, we can conclude:

Basically, the components of supply and demand for foreign exchange are driven by the main items of the balance of payments.

In particular:
- The balance of trade (ex and im)
- The financial account (capital ex and im)
- The capital income account

Less interesting:
- Transfers

There may be countries for which transfers are important. This is the case, for instance, for many of the least developed countries.

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Exchange rate drivers:
a look at the current account

Foreign trade and relative prices:
Purchasing Power Parity

Literature on purchasing power parity can be found in:
Feenstra/Taylor, p. 485-498
Carbaugh, ch. 12
Mankiw, ch. 25

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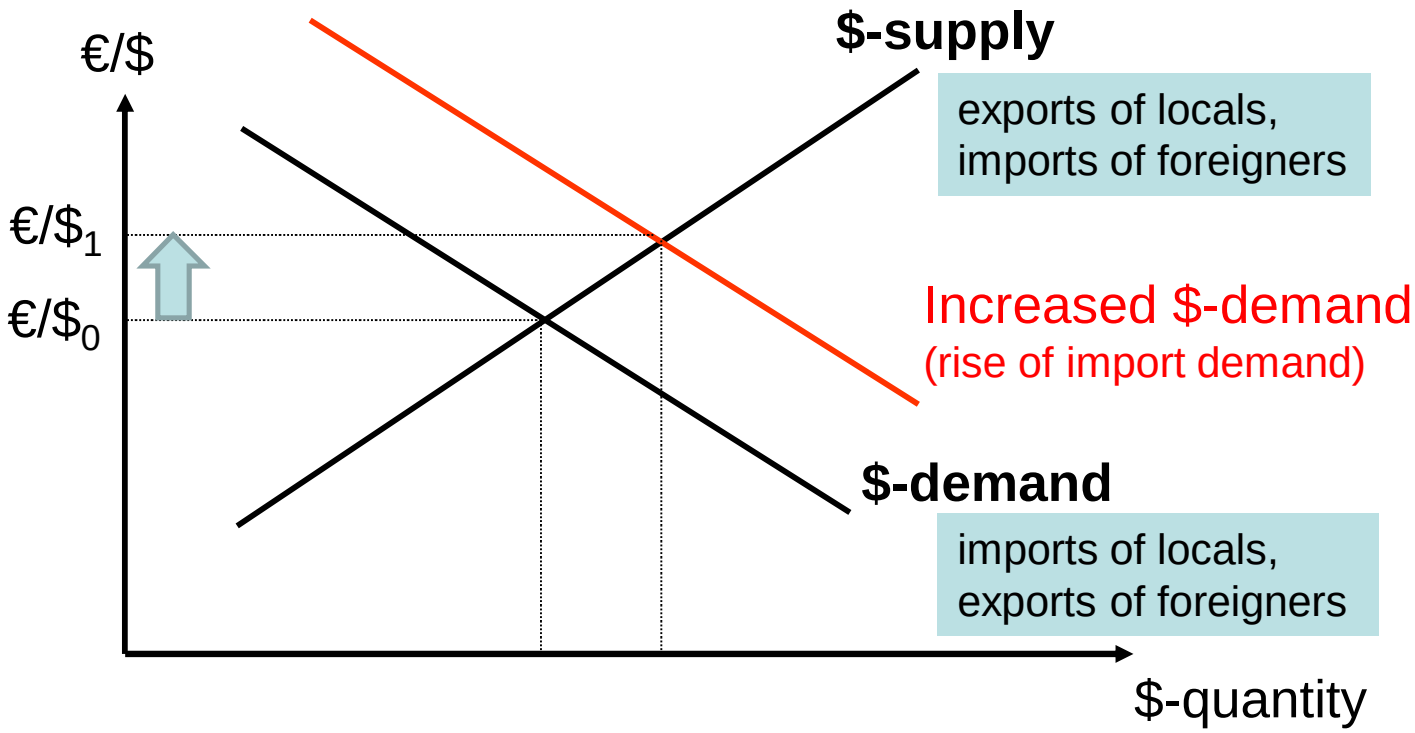
Exports and imports as drivers of fx-supply and demand

An example:
The demand for imports rises because products in the US have become cheaper.
As a consequence, the $-demand curve shifts outward and the € depreciates.



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Purchasing power parity theory (PPP)

Here the focus is on the balance of trade, on imports and exports.

The principle idea:

X-rates are driven by **goods‘ arbitrage.**

It is assumed that, all over the world, people are buying goods **where they can get the lowest prices**.

In addition, it is assumed that there are **no trade restrictions** (tarifs, NTBs,* transport costs, etc.)

Given these assumptions for each good it must be true that:

- ⇒ **calculated in the same currency**
- ⇒ **everywhere in the world**
- ⇒ **there can only be one price**

This condition is summarised as the

„Law of one price“

*: NTBs: non-tariff barriers

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Purchasing power parity theory (PPP)

Why can there only be one price?

Example: Purchase of an ebook reader

Suppose that initially
the price in the US is lower than in Germany

German consumers rather buy ebook readers in the US

⇒ Demand for ebook readers in the US rises
⇒ Demand for ebook readers in Germany falls
⇒ Prices for ebook readers can be raised in the US
⇒ and/or prices have to be lowered in Germany
⇒ and/or exchange rate adjustment (dollar appreciates)

The law of supply and demand in action.

Germans who want to buy ebook readers in the US need to buy USD first.

Without trade impediments there is perfect arbitrage
⇒ **„law of one price“**

Additional questions.

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Purchasing power parity theory (PPP)

Using the law of one price to derive PPP

A quick look at the dimensions.

Law of one price: $P_x = w \cdot P_x^*$ $\quad [€] = [€/US\$] \cdot [US\$]$

P_x: the price of good x in €, P_x^*: the price of x in $, w: the x-rate [€/US$]

Suppose that there are many goods. In this case we could measure average prices in Germany and the US with the help of price indices. In this case, the logic of arbitrage would imply

$$P = w \cdot P^*$$

„P“ the price of a basket of goods or „price level“.

P: the price of goods‘ basket in €, P*: the price of a goods‘ basket in $

On average, goods should not be cheaper (or more expensive) in Germany than in the US. Otherwise there would be large trade flows from the cheap to the expensive country.

Note: In order to measure the price of a large basket of goods, we usually construct price indices.

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Purchasing power parity theory (PPP)

Using the law of one price to derive PPP

If we treat price levels (P and P*) as given („exogenous“ as economists say) we can solve the equation we just derived for w:

APPP $w = P / P^*$ [€/US$] = [€] / [US$]

This equation is known as **Absolute Purchasing Power Parity**.

APPP implies that the x-rate is determined by the relative level of prices.

What happens if there is a deviation from APPP?

Suppose, on average goods are cheaper in the US than in Euroland: $P > w P^*$. In this case

a) Imports from the US are rising, exports to the US falling

b) → excess demand for USD → appreciation of the USD

c) *w* rises until APPP is restored

The validity of APPP is based on the working of goods‘ arbitrage – just like the validity of the law of one price.

Ch. 3: Exchange rate theory

Suppose wheat costs (per metric ton)
in the US: 200$
in euroland: 190€
The x-rate is: 0.92 €/$
Assume that there are no costs of transportation and that international trade is completely free.

- Where would grain traders rather buy wheat?
- What would be the consequences for the x-rate?

Problems to solve.

Literature:
Feenstra/Taylor, ch. 14.1.
Carbaugh, ch. 12.1-12.3

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Purchasing power parity theory (PPP)

Absolute Purchasing Power Parity

Let‘s take **another look** at the simple exchange rate equation based on APPP (with the dimensions added for convenience):

$$\hat{w}[€/\$] = P[€] / P^*[\$]$$

We have seen that exchange rates go up down, sometimes bouncing around significantly. So, often one gets the impression that they may be „too high“ or „too low“. But what should be the proper standard? APPP is one answer.

If a basket of goods costs 400€ in Germany and the same basket of goods costs 500$ in the US, we should expect the exchange rate to be equal to **400€/500$=0.8[€/$]**.

If the actual market rate would be 0.9[€/$] then the US consumer basket would cost Germans 450€ and the German goods‘ basket would cost Americans 444.44$. So we could say the x-rate of 0.9 [€/$] would make the US **relatively expensive**. Or put differently, the **USD would be overvalued in this case** (and the EUR undervalued).

You are not sure? So, make the calculation yourself.

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Purchasing power parity theory (PPP)

Absolute Purchasing Power Parity

APPP as a „standard“ or a method to calculate „equilibrium exchange rates“:*

$$\hat{w}[€/\$] = P[€] / P^*[\$]$$

the equilibrium x-rate according to APPP

$$w[€/\$] > P[€] / P^*[\$]$$

The EUR is undervalued (the USD overvalued). So, based on APPP we should expect that sooner or later the EUR will be appreciating (w↓).

$$w[€/\$] < P[€] / P^*[\$]$$

The EUR is overvalued. So, based on APPP we should expect that sooner or later the EUR will be depreciating (w↑).

So, APPP can be a tool to evalute x-rates and to predict future changes.

But …

*: There is more than one exchange rate theory. Therefore, different notions of „equilibrium“ exist.

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Purchasing power parity theory (PPP)

Absolute Purchasing Power Parity

In applied economics, APPP is little used.

One important reason is pragmatic.

1. The representative consumer goods basket for the US is likely to contain **different goods,** and for the same goods **different weights,** compared to a representative German consumer goods basket. So, even if there is perfect goods' arbitrage, we should not expect APPP to be fulfilled.

2. Statistical offices usually calculate **price indices** and not the value of a goods' baskets in terms of USD or EUR. But a direct comparison of index values of two countries is meaningless. For instance, if the US and German statistical offices both use 2005 as base year and set the index value for this year equal to 100 then we cannot infer that the representative goods' baskets cost the same in both countries.

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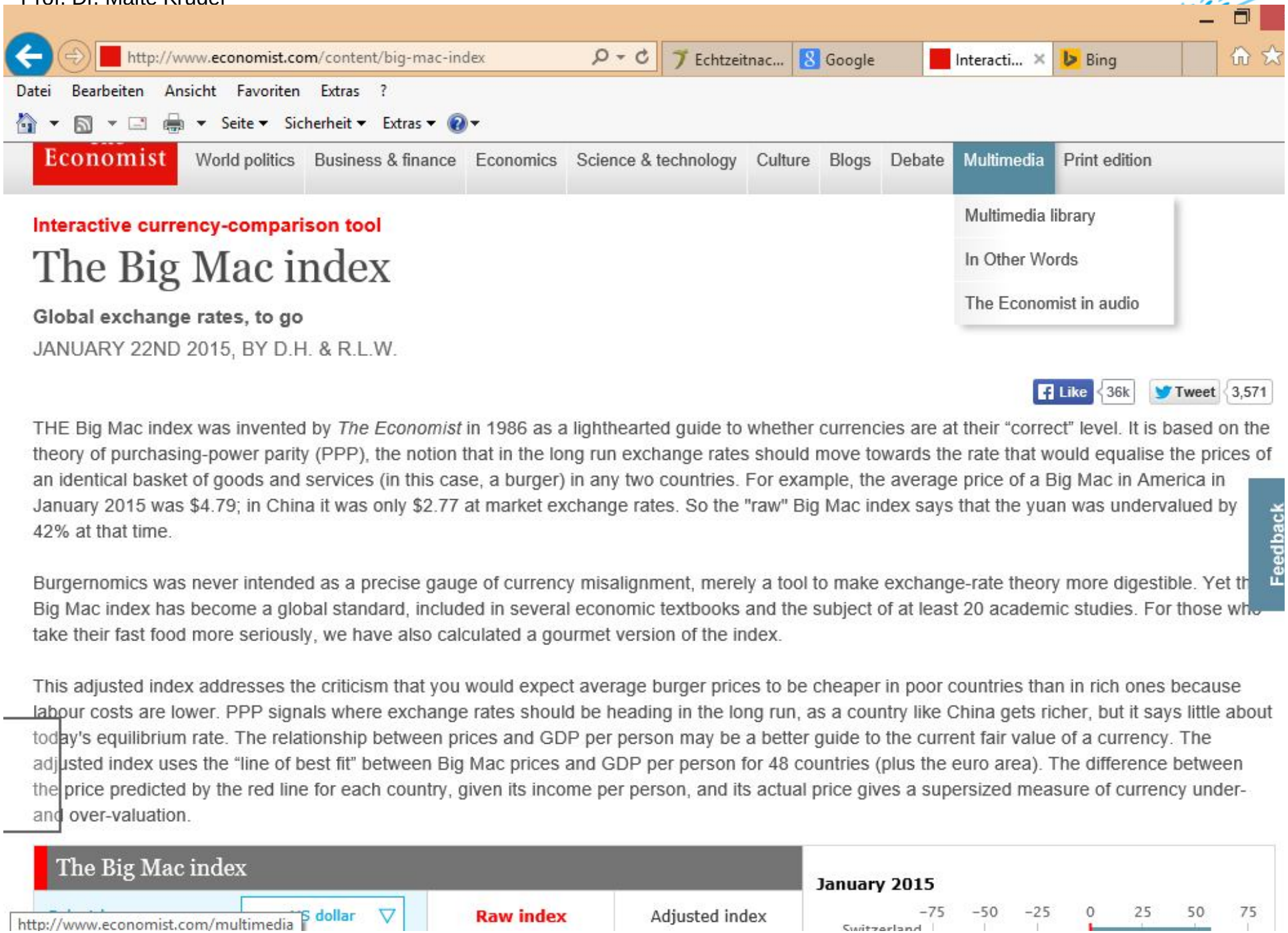
Purchasing power parity theory (PPP)

Absolute Purchasing Power Parity

Given the practical problems that stand in the way of using APPP to evaluate and predict exchange rates, the magazine „**The Economist**“ has come up with a „quick and dirty“ way of estimating APPP exchange rates.

The Economist collects Big Mac prices around the world and uses these prices as estimates of the price levels in these countries.

What started out a little bit like a joke has become „serious business“. The results of the **Big Mac Index** are widely published and have found their way into almost any textbook dealing with international economics.(See Feenstra/Taylor, p. 496/7.)


http://www.economist.com/content/big-mac-index
Echtzeitnac...
Google
Interacti...
Bing
Datei Bearbeiten Ansicht Favoriten Extras ?
Seite Sicherheit Extras
Economist
World politics
Business & finance
Economics
Science & technology
Culture
Blogs
Debate
Multimedia
Print edition
Multimedia library
In Other Words
The Economist in audio
Interactive currency-comparison tool
The Big Mac index
Global exchange rates, to go
JANUARY 22ND 2015, BY D.H. & R.L.W.
Like 36k
Tweet 3,571
THE Big Mac index was invented by The Economist in 1986 as a lighthearted guide to whether currencies are at their "correct" level. It is based on the theory of purchasing-power parity (PPP), the notion that in the long run exchange rates should move towards the rate that would equalise the prices of an identical basket of goods and services (in this case, a burger) in any two countries. For example, the average price of a Big Mac in America in January 2015 was $4.79; in China it was only $2.77 at market exchange rates. So the "raw" Big Mac index says that the yuan was undervalued by 42% at that time.
Feedback
Burgernomics was never intended as a precise gauge of currency misalignment, merely a tool to make exchange-rate theory more digestible. Yet th
Big Mac index has become a global standard, included in several economic textbooks and the subject of at least 20 academic studies. For those wh
take their fast food more seriously, we have also calculated a gourmet version of the index.
This adjusted index addresses the criticism that you would expect average burger prices to be cheaper in poor countries than in rich ones because labour costs are lower. PPP signals where exchange rates should be heading in the long run, as a country like China gets richer, but it says little about today's equilibrium rate. The relationship between prices and GDP per person may be a better guide to the current fair value of a currency. The adjusted index uses the "line of best fit" between Big Mac prices and GDP per person for 48 countries (plus the euro area). The difference between the price predicted by the red line for each country, given its income per person, and its actual price gives a supersized measure of currency under- and over-valuation.
The Big Mac index
dollar
Raw index
Adjusted index
January 2015
−75 −50 −25 0 25 50 75
http://www.economist.com/multimedia

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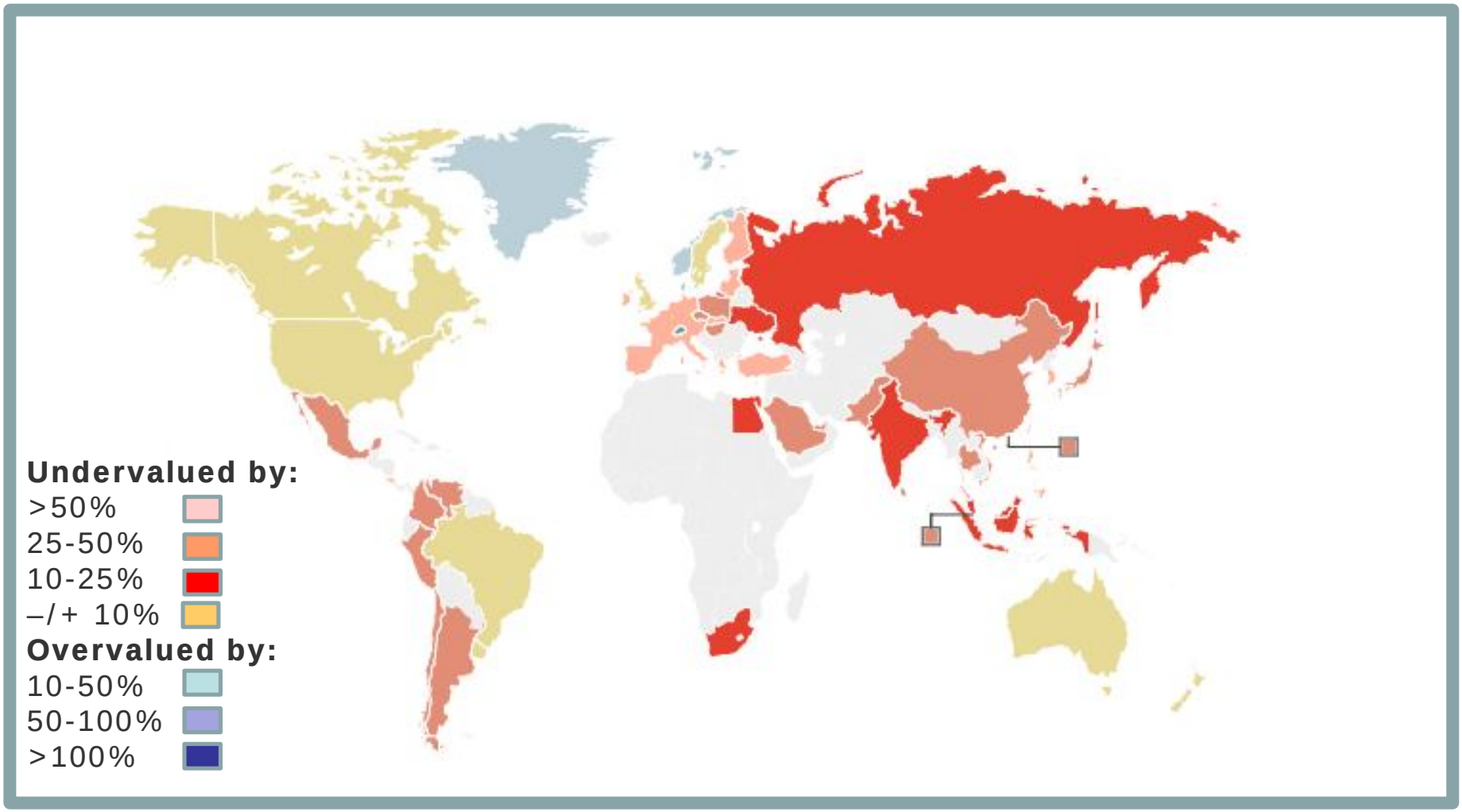
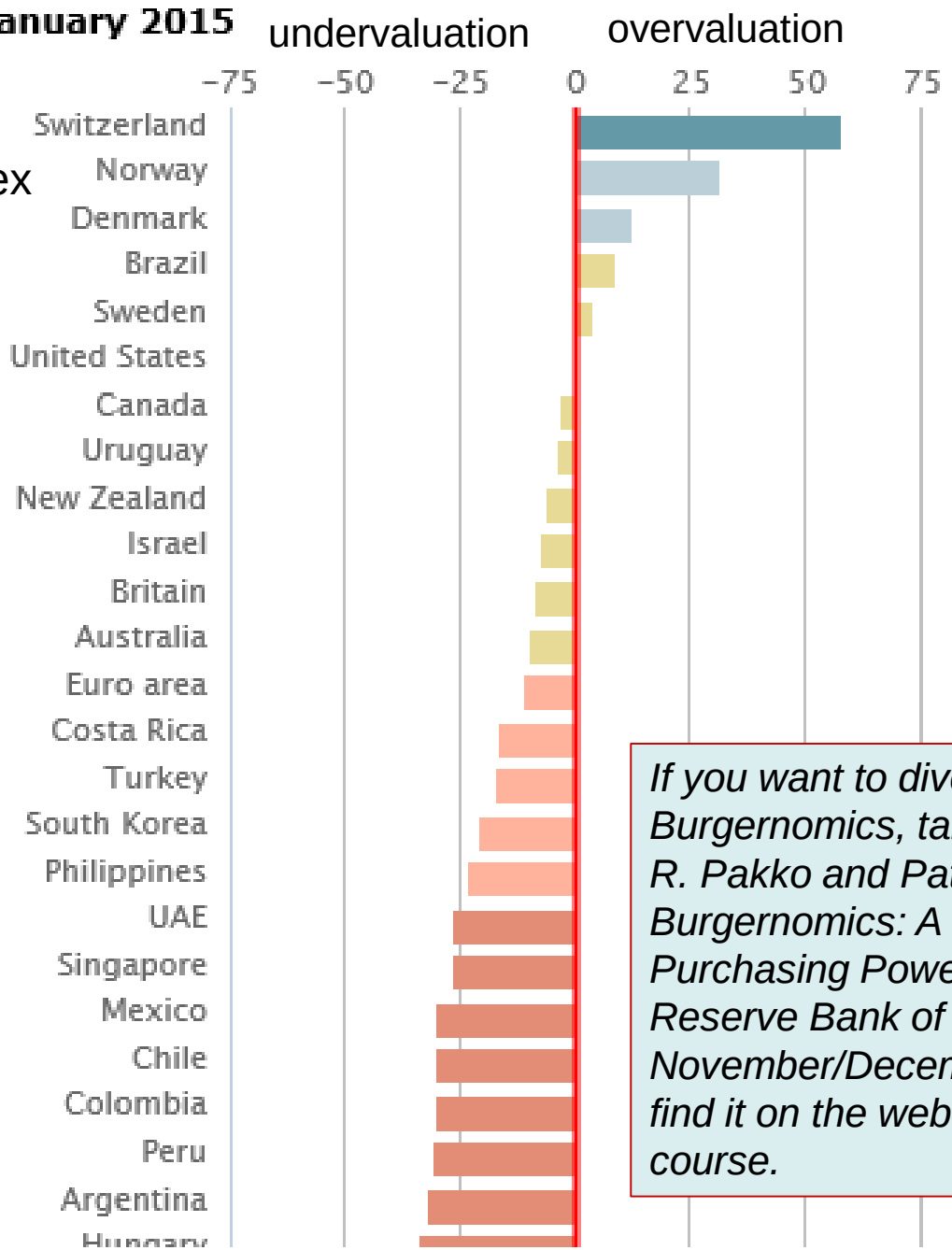
The world according to the Big Mac index: January 2015



Ch. 3:

The Big Mac index



If you want to dive deeper into Burgernomics, take a look at: Michael R. Pakko and Patricia S. Pollard: Burgernomics: A Big Mac™ Guide to Purchasing Power Parity, Federal Reserve Bank of St. Louis Review, November/December 2003. You can find it on the web or in my Moodle course.

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Exercises

1. Try to find the **July 2022** results of currency valuations based on the Big Mac index. (Try to go to the original source, The Economist.)
2. Relative to the US dollar, by how much were the following currencies under- or overvalued in **July 2022**: Switzerland, Canada, Mexico, the Euro area?
3. Relative to the EUR, by how much is the UK Pound under- or overvalued?
4. What can we learn from the index? What does it imply if a currency is "overvalued"?
5. How useful is the Big Mac index? What do you think?

Problems to solve.

This exercise is also a good opportunity to get to know The Economist. It is the leading international magazin in the field of business and economics. As Master students in Int. Management you shoud regularly inform yourself about what's going on in your field. The Economist would be a good starting point. We have the paper edition in the library. Some of the online content is free, as for instance the Big Mac index.

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Purchasing power parity theory (PPP)

APPP and the real x-rate

APPP is a theory that is meant to explain where the „correct“ level of the x-rate should be, the „equilibrium x-rate“.
As we have seen already when studying Big Mac prices, actual x-rates differ from their equilibrium values. Therefore, we make the distiction between the actual market x-rate „w“ and its APPP value „$\widehat{w}$“.

$$\widehat{w} = \frac{P}{P^*}$$ APPP equilibrium value

For instance, in our exercise we saw the Big Mac prices in the euro zone and in the UK: P = 5.00 EUR and P* = 4.00 GBP

$$\widehat{w} = \frac{5.00 EUR}{4.00 GBP} = 1.25 \left[\frac{EUR}{GBP}\right]$$ APPP equilibrium value

At the same the market rate „w“ is $1.10 \left[\frac{EUR}{GBP}\right]$

To make calculations a little easier I have used rounded figures.

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Purchasing power parity theory (PPP)

APPP and the real x-rate

If APPP holds, we get the same amount of Big Macs* for 5 EUR.

$$\hat{w} = \frac{5.00 EUR}{4.00 GBP} = 1.25 \left[\frac{EUR}{GBP}\right]$$

*: Or other goods.

At home a Big Mac costs 5 EUR. If you want to buy a Big Mac in the UK, you need 4 GBP. And 4 GBP cost you 5 EUR.

But if the market x-rate differs from APPP then Big Macs are cheaper in one country then in the other. In our example the market x-rate is 1.10 EUR/GBP. So 4 GBP only cost you 4.40 EUR. This market rate makes the UK relatively cheap and the euro zone relatively expensive.
So, in general we can say that the relative size of w and $\hat{w}$ is important:

$w < \hat{w} \quad or \quad \frac{w}{\hat{w}} < 1$ EUR is overvalued

$w > \hat{w} \quad or \quad \frac{w}{\hat{w}} > 1$ EUR is undervalued

$w = \hat{w} \quad or \quad \frac{w}{\hat{w}} = 1$ EUR x-rate is in equilibrium (in line with APPP)

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Purchasing power parity theory (PPP)

APPP and the real x-rate

The term w/$\hat{w}$ is known as the real exchange rate (z):

$$z = \frac{w}{\hat{w}}$$

The real x-rate indicates how the current market x-rate values a currency relative to APPP.

Since we know that $\hat{w}$ is equal to $\hat{w} = \frac{P}{P^*}$

we can also write

$$z = \frac{w}{\frac{P}{P^*}} \quad \text{or} \quad z = w\frac{P^*}{P}$$

This is the standard definition of the real exchange rate.

The real exchange rate is an index. **If APPP holds, the real exchange rate is constant and equal to 1**. Deviations from 1 indicate over- or undervaluation.

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Purchasing power parity theory (PPP)

APPP and the real x-rate

So, how useful is APPP? This is difficult to tell because it is little applied in practice. One reason why the Economist‘s Big Mac index has become so famous is that there are few serious attempts to apply APPP.

But if the BigMac index is indicative of the true APPP values of x-rates we can see that there can be large and persistent deviations from APPP. We will later discuss the reasons of such deviations.

But before that we will look at a related concept:

Relative Purchasing Power Parity

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Purchasing power parity theory (PPP)

Relative Purchasing Power Parity (RPPP)

RPPP is much more widely known than APPP and it is more widely employed.
RPPP is based on the same logic as APPP. Instead of looking at absolute values, RPPP looks at rates of change.

$$\frac{\Delta w}{w} = \pi - \pi^*$$

Δ (spoken „delta“) is often used to indicate the change of a variable.

$\pi = (P_t - P_{t-1})/ P_{t-1}$ rate of change of the price level (inflation rate)
$\Delta w/w = (w_t - w_{t-1})/w_{t-1}$ rate of change of the exchange rate

Relative PPP implies that the rate of change of the x-rate is determined by the difference in inflation rates of two countries.

The formula above is widely used but it is only an approximation.
The exact formula is:

$$\frac{w_t - w_{t-1}}{w_{t-1}} = \frac{\pi - \pi^*}{(1+\pi^*)}$$

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Purchasing power parity theory (PPP)

Relative Purchasing Power Parity (RPPP)

RPPP is really very straight-forward and easy to apply.
In a nutshell it implies that the currency of the country with the relatively higher inflation rate should depreciate.

Does it work?

As a **rule of a thumb** it is not bad, in particular when the inflation differences between two countries are large.

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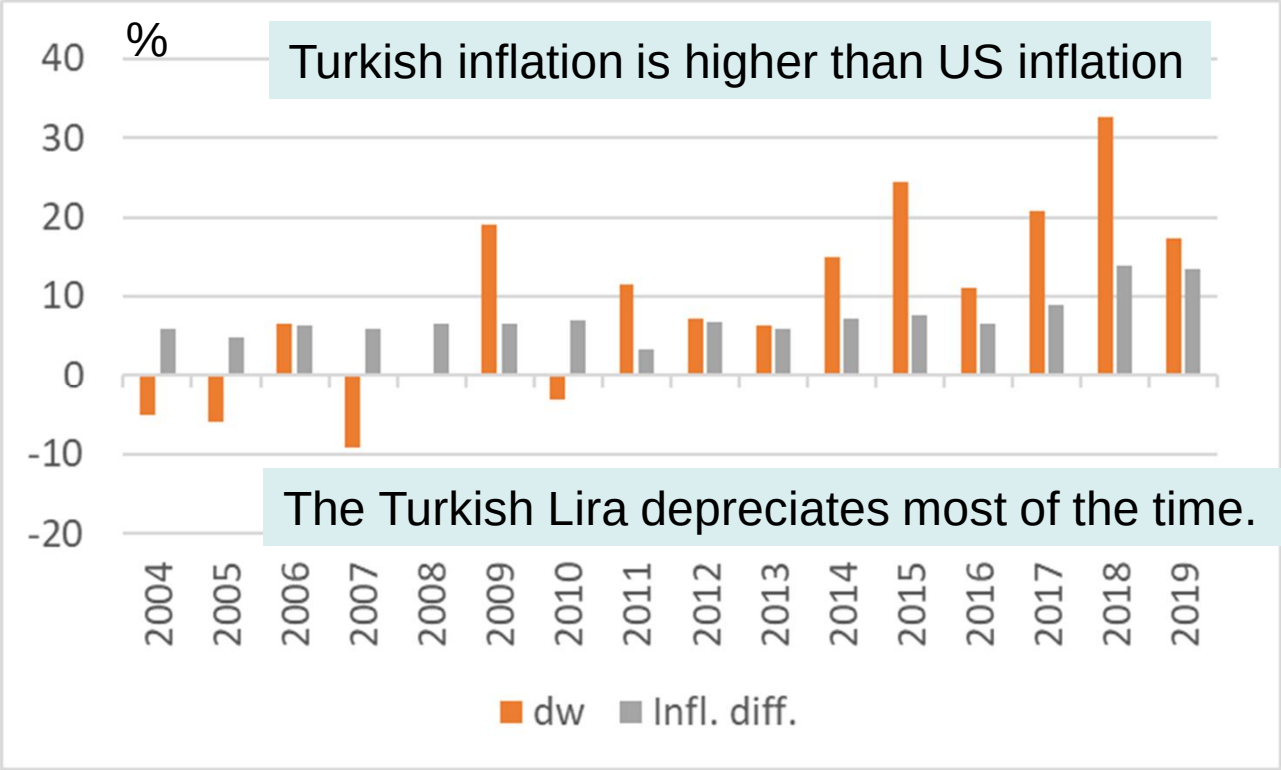
Purchasing power parity theory (PPP)

Relative Purchasing Power Parity (RPPP)

The example of the Turkish Lira – USD x-rate



Most of the time, the x-rate moves into the right direction (predicted by RPPP).
But not always.
And if it does, the magnitude often is not as is predicted by RPPP.

infl. diff.: Turkish inflation minus US inflation
w: Turkish Lira per USD (dw>0 implies depreciation of Turkish Lira)

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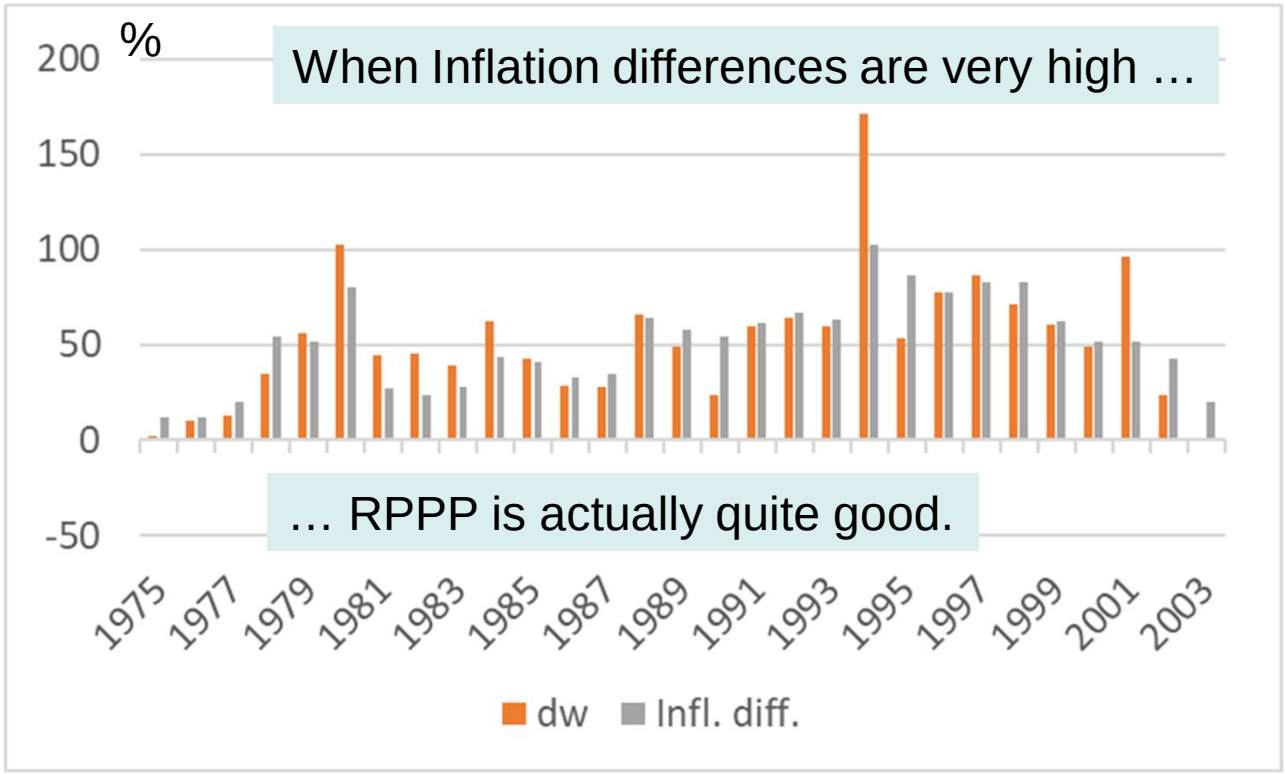
Purchasing power parity theory (PPP)

Relative Purchasing Power Parity (RPPP)

Turkish Lira and USD: Looking futher into the past



In many years the depreciation of the Turkish Lira was almost exactely as predicted by RPPP.

infl. diff.: Turkish inflation minus US inflation
w: Turkish Lira per USD (dw>0 implies depreciation of Turkish Lira)

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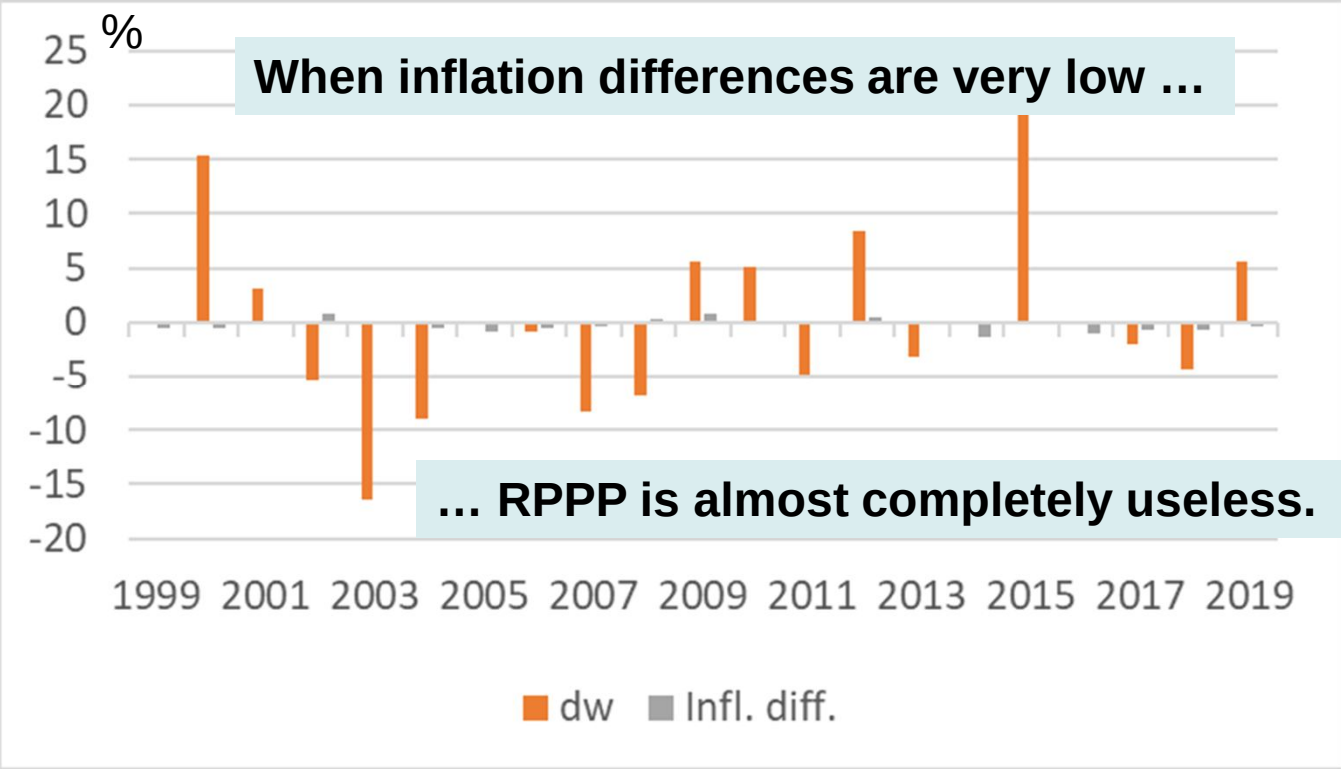
Purchasing power parity theory (PPP)

Relative Purchasing Power Parity (RPPP)

The Euro and the USD: RPPP is almost completely useless



infl. diff.: Euro zone inflation minus US inflation
w: EUR per USD (dw>0 implies depreciation of the EUR)

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Purchasing power parity theory (PPP)

Relative Purchasing Power Parity (RPPP)

RPPP: empirical performance: summing up

- There are large deviations from RPPP
- RPPP performs better, if there are large inflation differences between currency areas.
- But even in this case, there can be years with substantial deviations from RPPP

In general:
It is highly likely that countries with relatively high inflation rates will depreciate against countries with low inflation rates.

But even in such cases, there may be exceptions
(to be discussed later on).

Ch. 3: Exchange rate theory

Purchasing power parity theory (PPP)

Relative Purchasing Power Parity (RPPP)

Deviations from RPPP and real x-rate changes

We have seen: There can be deviations from RPPP. These deviations can be large, at times. Whenever such deviations occur, there are **changes of the real exchange rate**.

$$\frac{\Delta w}{w} > \pi - \pi^*$$

Examples:
10% > 8% - 3% depreciation larger then predicted by RPPP
-2% > 4% - 10% appreciation smaller then predicted by RPPP

In this case, **the local currency is depreciating in real terms**.
Compared to the past, foreign goods have become more expensive.

$$\frac{\Delta w}{w} < \pi - \pi^*$$

Examples:
2% < 11% - 3% depreciation smaller then predicted by RPPP
-10% < 4% - 6% appreciation larger then predicted by RPPP

In this case, **the local curency is appreciating in real terms**.
Compared to the past, foreign goods have become cheaper.

Ch. 3: Exchange rate theory

Purchasing power parity theory (PPP)

Relative Purchasing Power Parity (RPPP)

Real x-rates and relative PPP

Real x-rate	$z = w\,(P^* / P)$
Change of the real x-rate	$\Delta z/z \approx \Delta w/w + (\pi^* - \pi)$
Relative PPP	$\Delta w/w \approx \pi - \pi^*$

If the nominal x-rate moves in line with RPPP, we can write:

$$dz = \underbrace{\pi - \pi^*}_{dw} + (\pi^* - \pi) = 0$$

If RPPP holds, the real x-rate is constant.

$$\Delta z/z \approx \Delta w/w - (\pi - \pi^*)$$

Ch. 3: Exchange rate theory

Purchasing power parity theory (PPP)

Real x-rates and PPP

Summing up:

Absolute PPP: the real x-rate is equal to 1.

Relative PPP: the real x-rate is constant.

It follows directly that:

Absolute PPP implies relative PPP

The reverse is not true:

Relative PPP does not imply absolute PPP.

See example next page.

Ch. 3: Exchange rate theory

Purchasing power parity theory (PPP)

The relationship between APPP and RPPP

⇒ **APPP implies RPPP but the reverse is not true**

An example in which relative PPP holds but not absolute PPP:

„Today“

Cd player: 100EUR in the EU
100USD in the US
X-rate = 1,20USD/EUR

⇒ Absolute PPP violated

„1 year later“

Cd player 105EUR in the EU
110USD in the US
X-rate = 1,26USD/EUR

⇒ Absolute PPP violated
Relative PPP applies.
$\pi_{EU} = 5\%$
$\pi_{us} = 10\%$
$dw = 5\%$

	Inflation in % US	Inflation in % Turkey	Inflation in % Euro zone	Trk.Lira/USD	EUR/USD
2016	1.26	7.78	0.183	3.022	0.903
2017	2.13	11.14	1.381	3.649	0.885
2018	2.44	16.33	1.703	4.840	0.846
2019	1.81	15.18	1.446	5.676	0.893

A. On the basis of the information above, calculate the changes of the real x-rate of the Turkish Lira against the USD and the EUR (for the years 2017 to 2019).
If you want to use a spread sheet software (it makes life definitely easier).
You can use the data of the accompanying excel file „real x-rate“.

B. In Nov. 2019 Argentiniens had to pay 59 Pesos for a USD. In April 2020 they had to pay 66 Peso per USD. Does that mean that the US has become relatively more expensive for Argentinians?

Ch. 3: Exchange rate theory

Purchasing power parity theory (PPP)

Why are there deviations from PPP?

Or rephrased:
What determines the real x-rate?

To answer this questions we have to look at the assumptions underlying PPP.

In fact, PPP is based on extreme assumptions:

- No costs of arbitrage
- The same basket of goods is consumed in all countries

If these assumptions are violated there will be deviations from PPP.

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Purchasing power parity theory (PPP)

Why are there deviations from PPP?

1) Tariffs and transport costs

=> Impediments to goods‘ arbitrage

- If these costs are equal to 10€: CD-players have to cheaper by more than 10€ in the US, in order for Germans to start purchasing them in the US.
- If, for instance, the US-price is 250$ (=200€ if w=0.8 €/$): the German price can move freely between 190€ und 210€ – without any effect on exports and imports. This argument can be applied to other goods.

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Purchasing power parity theory (PPP)

Why are there deviations from PPP?

2) Different goods‘ baskets

Example: Country A => spends 25% on cars
Country B => spends 5% on cars

Assumption: the law of one price holds

→ $PC_{A0} = wPC_{B0}$ (PC_{A0} = Price of a car in country A in period 0).

- Prices of cars (PC) are rising by 60% all over the world
- The x-rate (w) and other prices (PX) are remaining constant.

A: $\pi_A = 0.75\ (0) + 0.25\ (0{,}6) = 0{,}15\ (=15\%)$
B: $\pi_B = 0.95\ (0) + 0.05\ (0{,}6) = 0{,}03\ (=3\%)$

Because of the different demand structures in different countries, PPP may be violated – even if the law of one price holds!

Thus, changes in the structure of demand and supply may effect real exchange rates. Such changes are hard to predict.

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Purchasing power parity theory (PPP)

Why are there deviations from PPP?

3) Non-tradeable goods

Even if goods' baskets are identical, PPP can be violated, if some goods are non-tradables.
For instance, a hair cut may be cheaper in Portugal than in Germany. Still, Germans will not drive to Portugal in order to get a hair cut there.
The price level can be expressed as a weighted average of the prices of tradeables and non-tradeables

$P^* = a P^*_n + bP^*_t$ and $P = cP_n + eP_t$

[a,b,c,d are weights with a+b=1 and c+e=1]

Thus we can write the real x-rate as

$$z = w (P^* / P) = w(a P^*_n + bP^*_t) / (cP_n + eP_t)$$

If w is determined by the prices of tradables, different price movements for non-tradables may lead to real x-rate changes (deviations from PPP).

People in Frugalia consume just 2 goods:
Wheat and meat.
In 2018 there are the following prices:
PW = 1$/kg, PM = 6$/kg
In 2019 there are the following prices:
PW = 1.5$/kg, PM = 5$/kg
In the price index of Frugalia, the two goods have followings weights
Wheat: 60% and meat 40%. (Same weights in both years.)

Calcuate the rate of inflation.

Calculate the inflation rate assuming that the 2019 weights are
Wheat: 50% and meat 50%.

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Understanding real x-rate changes

In the last lecture we looked at factors that may help us to explain why there are **deviations from PPP**. In other words: **Why are there real x-rate changes?**

However, understanding „in principle“ why there may be real x-rate changes, does not necessarily imply that it is easy to understand actual real x-rate changes or even predict them.

One particularly noteworthy example is the evolution of the USD in the 1980s. In the first half of the 1980s the USD seemed to defy gravity and appreciated substantially in real terms. To the present day, economists do not really agree on how to explain this event.

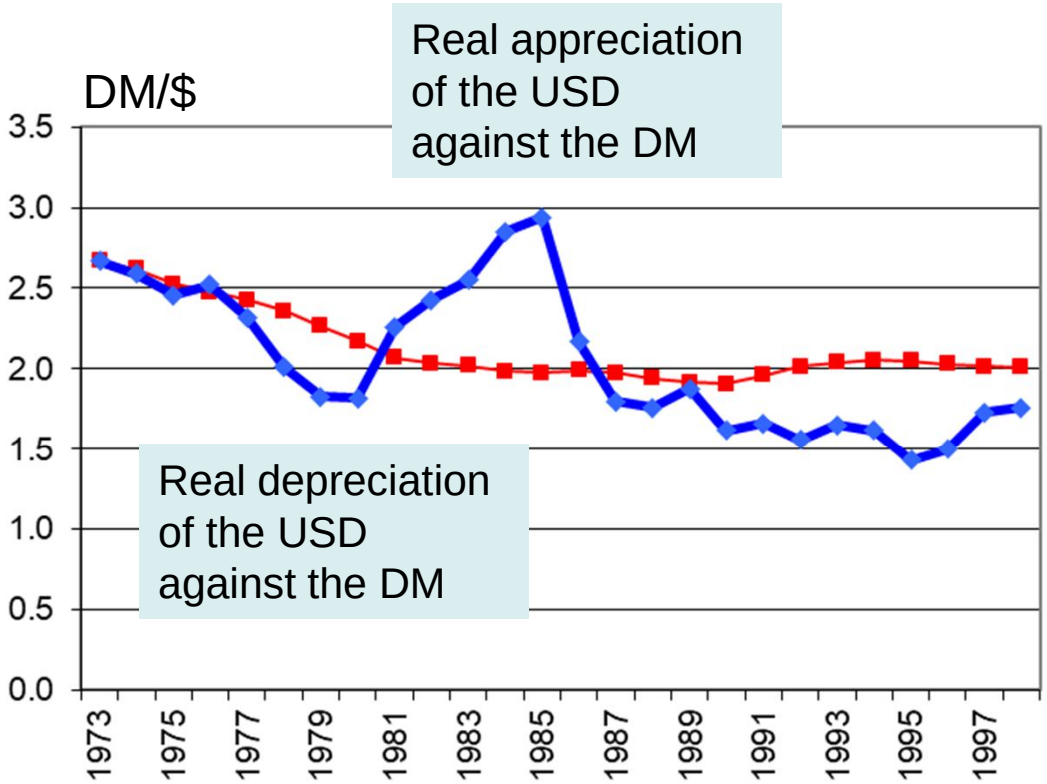
But there is one thing occurring fairly regularly:

high-growth countries are often appreciating in real terms.

Ch. 3: Exchange rate theory

Understanding real x-rate changes

The remarkable story of the The US$ in the 1980s:
After a real depreciation in the second half of the 1970s there was a huge real appreciation in the the first half of the 1980s. This followed again by a steep decline.



This shows that real x-rate changes can be large.

But it is difficult to predict such changes.

PPP

DM/$

Deviation from PPP = real x-rate change

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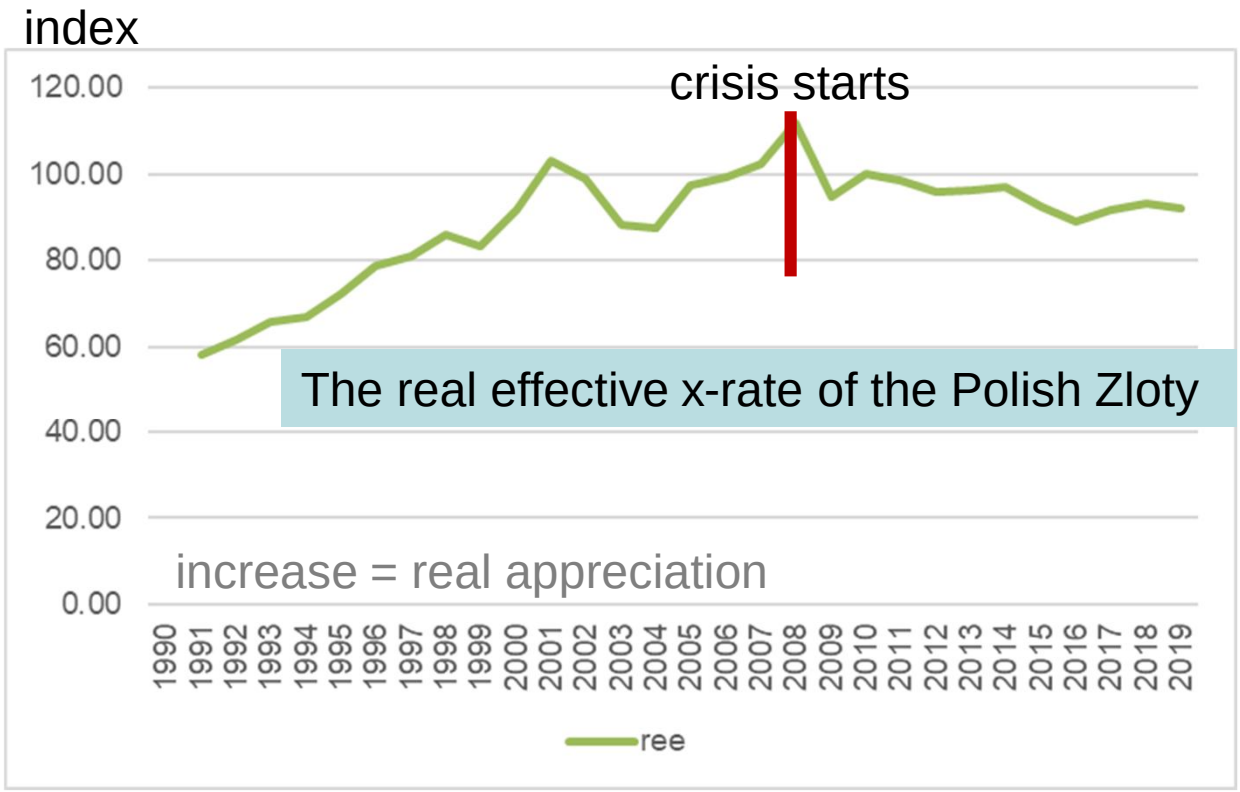
Understanding real x-rate changes

After the opening of the iron curtain, the Polish economy has grown rapidly. As we can see, its currency has been appreciating in real terms up to the financial crisis of 2008.



Source: IMF, IFS

For many fast growing countries the same can be observed.

But there are also many exceptions.

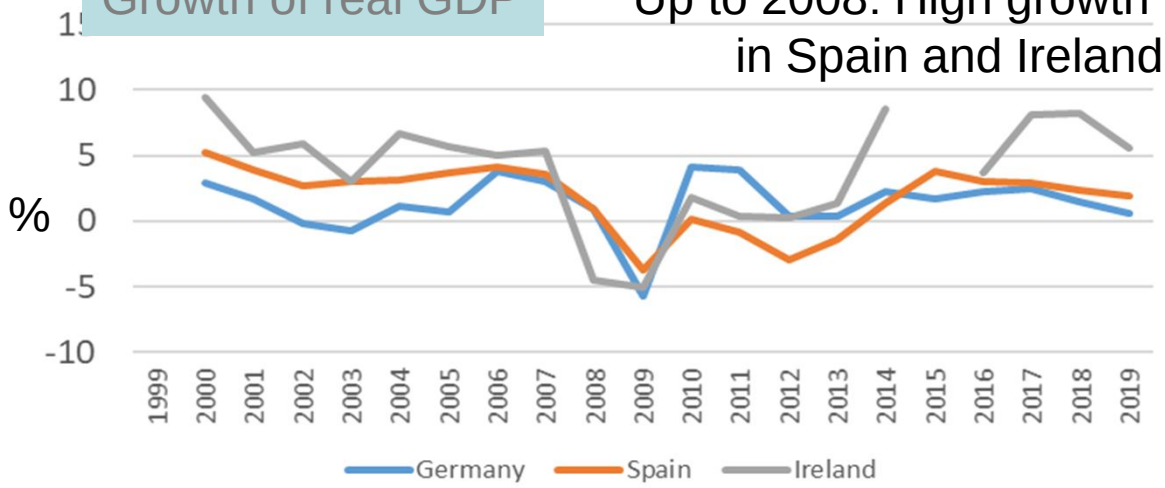
So it is not a „law“ on which we can safely rely.

Ch. 3: Exchange rate theory

Understanding real x-rate changes

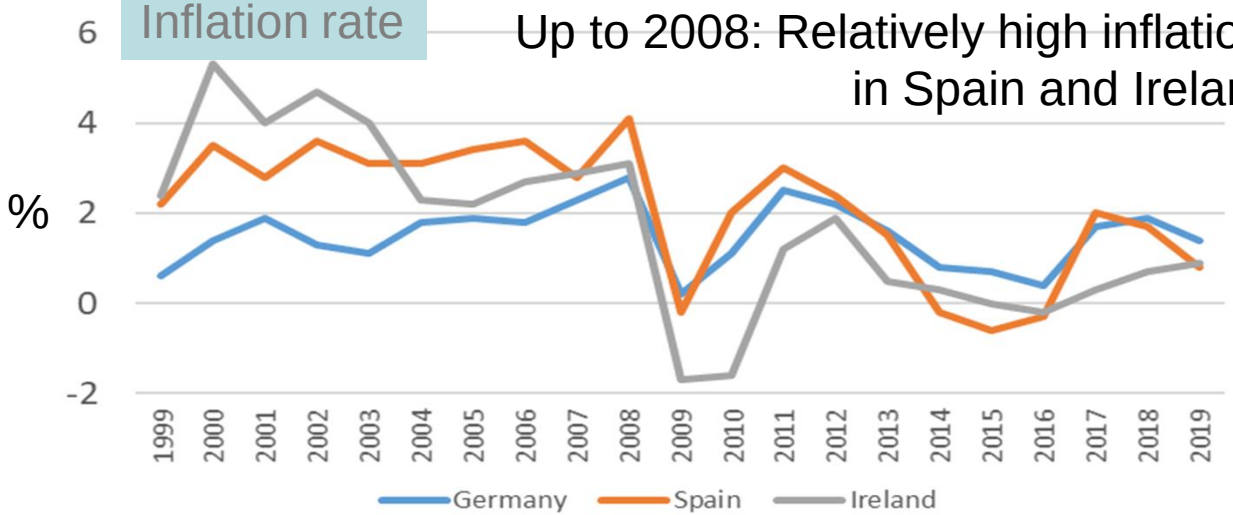
Growth of real GDP

Up to 2008: High growth in Spain and Ireland



Inflation rate

Up to 2008: Relatively high inflation in Spain and Ireland



Even in monetary union: the real x-rate can change.

In EMU high-growth countries experienced higher inflation than low-growth countries.

Remember?
z = w (P*/P)

So even if w is fixed, different growth rates of P and P* will lead to real x-rate changes.

Ch. 3: Exchange rate theory

Understanding real x-rate changes

To sum up the evidence:

We often find that **fast growing countries** are appreciating in real terms.

Such countries are often countries that are **relatively poor and** manage to get a catching-up process going.

As they are catching up, they are often b**ecoming more expensive**. That is also an observation travellers are frequently making.

When visiting a „poor“ country, **many things are often cheaper**: meals in a restaurant, foreign language classes, a taxi ride, …. When we go to a rich country like Norway or Switzerland, many things are expensive for us.

Such a finding **seems to contradict PPP,** because measured in the same currency, prices should be the same in all countries.

However, if we include **non-tradable goods**, then there is a type of goods where **PPP does not apply.**

The goods mentioned above are typical examples: many personal services cannot be traded internationally.

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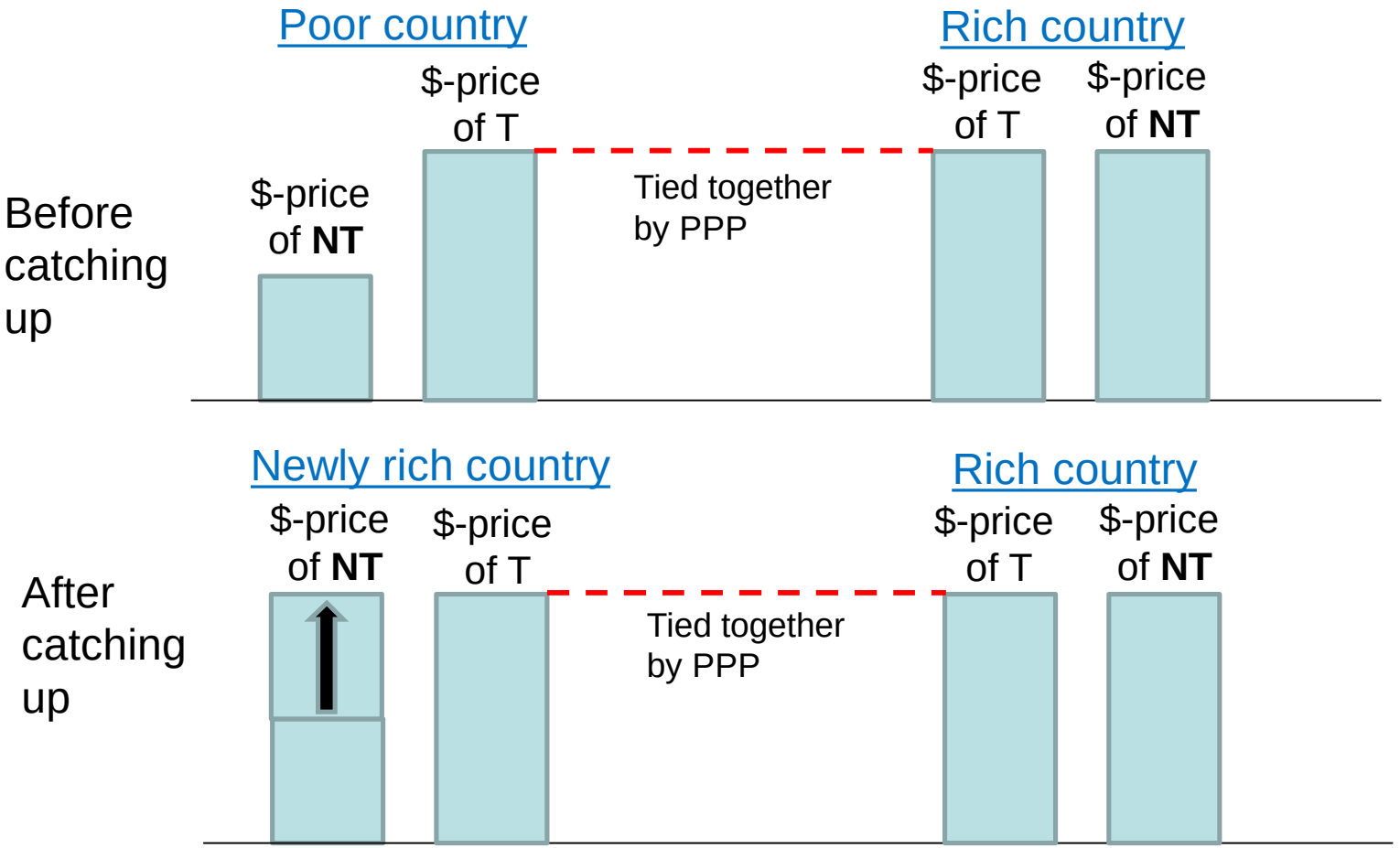
Understanding real x-rate changes

The role on non-tradables



NT: non-tradable goods, T: tradable goods

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Understanding real x-rate changes

Implications for inflation differences:

Let us look at a very simple case:

- the x-rate is fixed and equal to 1 (like in a currency union)
- the two weights (a and b) have the same value
- APPP applies to traded goods.

The inflation rates can be written as:

$$\pi = \Delta P/P = (a\,\Delta P^{t} + (1-a)\,\Delta P^{nt}) \,/\, (aP^{t} + (1-a)P^{nt})$$ „Rich“

$$\pi^* = \Delta P^*/P^* = (b\,\Delta P^{t*} + (1-b)\,\Delta P^{nt*}) \,/\, (bP^{t*} + (1-b)P^{nt*})$$ „Poor“

Given our assumptions: $P^{t} = P^{t*}$ and $\Delta P^{t} = \Delta P^{t*}$

⇒ Differences between π* and π are due to different changes in the prices of non-tradables.

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Understanding real x-rate changes

Suppose:

- The relatively poor country is in a catching up process and growing relatively fast.
- In the relatively poor country prices of non-tradables are rising.
- The relatively rich country is stagnating.
- The ratio of prices for tradables and non-tradables is constant.

In this case, π^* will be higher than π. Since we have assumed a constant w, this implies that the foreign country is appreciating in real terms.

This is the Balassa-Samuelson Effect

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Understanding real x-rate changes

Assuming flexible x-rates things are a little more complicated:

If we stick to the example above, the foreign country is appreciating in real terms, and the local currency experiences a real depreciation:

$$\Delta z/z > 0 \quad \text{if} \quad \Delta w/w > (\pi - \pi^*)$$

In this case, there is a real depreciation of the local currency whenever $\Delta w/w$ is larger than the inflation difference.

For which range of nominal x-rate changes will there be a real depreciation of the domestic currency?

π	π^*	$\pi - \pi^*$	local currency must depreciate by more than or appreciate by less than
10%	4%	6%	
10%	10%	0%	
4%	10%	-6%	

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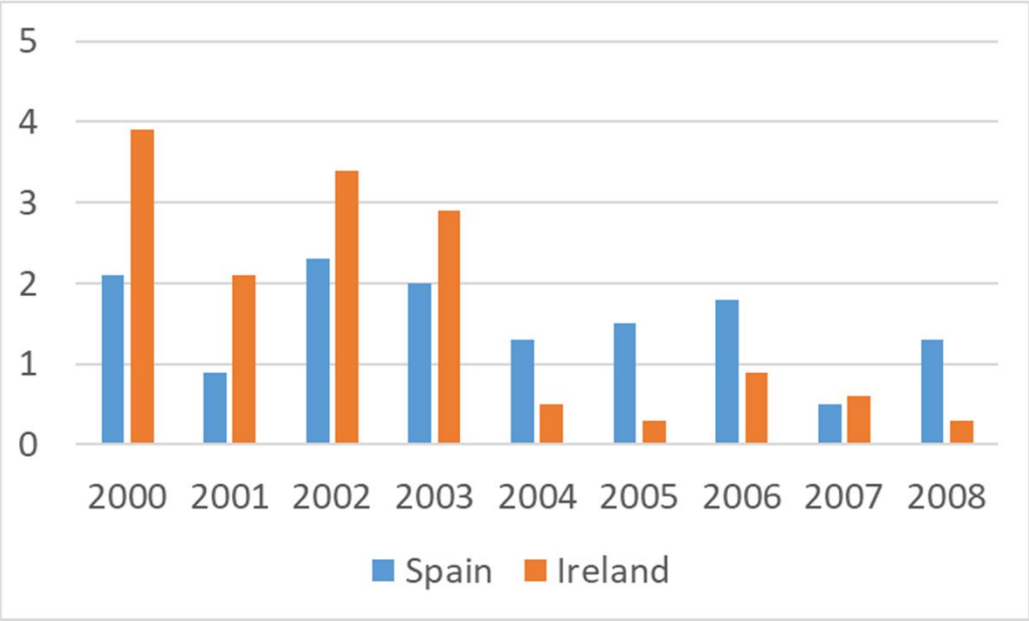
Inflation in a Currency Union

So even in a currency union we may have differences in inflation. Over time, such differences may substantially alter the real exchange rate.

Spanish or Irish inflation minus German inflation



Cumulative effect over the period 2000 to 2008:
Real appreciation vis-á-vis Germany:
Spain: 15%
Ireland: 16%

After the financial crisis, which hit other countries harder than Germany, some of the real appreciation has been reversed.

Ch. 3: Exchange rate theory

Before we conclude this chapter let us look at some „real world“ exchange rate economics.

On the following slides I have summarised an article that has been published in the Financial Times Deutschland (which no longer exists).

The author makes some very strong statements and criticises standard economic thinking.

But there is one big fundamental mistake in his argument and the selection of data he uses to support it.

Take your time, look at the slides and think about it.

Ch. 3: Exchange rate theory

The role of exchange rates: An example from the financial press

Financial Times Deutschland

11. Februar 2005

Thomas Fricke (Chefökonom der FTD)

Fünf Millionen für `ne harte Mark

Untragbare Tarifabschlüsse und Lohnnebenkosten gelten seit Jahren als Hauptgrund für hohe deutsche Kosten und die Jobmisere. Unsinn. Die Deutschen sind international so relativ teuer, weil die eigene Währung seit 1970 dramatisch hochgeschnellt ist. Erfolgreiche Länder werten erst einmal ab - kleiner Geheimtipp.

For years, increasing labour costs have been cited as the main cause of missing jobs. Nonsense. Germany is too expensive internationally because the D-Mark has increased dramatically since 1970. Successful countries are depreciating – that is my little secret advice.

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The role of exchange rates: An example from the financial press

The **empirical „proof“** presented by Mr. Fricke: unemplyment has been rising roughly in parallel with the effective x-rate of the D-Mark.
(Note: Here, a rise of the x-rate implies an appreciation of the D-Mark)

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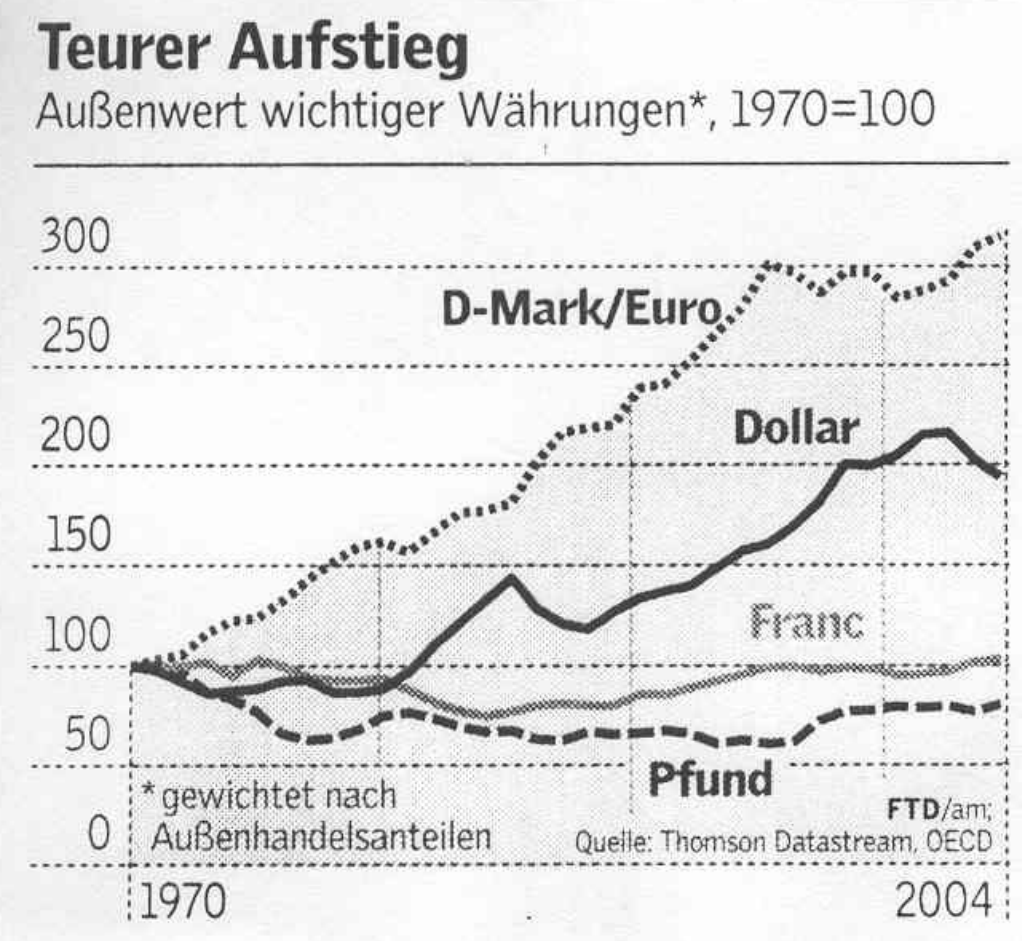
The role of exchange rates: An example from the financial press

He contrasts the evolution of the D-Mark with the effective x-rates of other industrial countries.
The other currencies have been appreciating mich less or even mildly depreciating.



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The role of exchange rates: An example from the financial press

And he compares the increase in wages (in national currencies) in the OECD-countries (industrialsied countries and some emerging markets“) with wages increases in Germany. As can be seen, wage increases have been relatively modest in Germany.

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The role of exchange rates: An example from the financial press

So, these are the facts:
Unemployment has been rising.
Wage increases in Germany have been relatively modest.
The x-rate of the D-Mark has appreciated considerably.

Looks like Mr. Fricke‘s argument is correct, isn‘t it?

What do YOU think?

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3. Exchange rate theory continued

The role of capital flows and interest rates

Literature:
Feenstra/Taylor (2017), p. 473-479 (ch. 13)

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Exchange rate drivers:

Capital flows, relative interest rates and exchange rate expectations

We have come across **Covered Interest Parity (CIP)**.

Now we will get to know **Uncovered Interest Parity (UIP)**

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New focus: capital markets:

So far, we have looked at goods‘ markets in order to explain x-rates.

PPP: basic mechanism:

→ **goods‘ arbitrage (or „goods‘ mobility“)**

Now, we will shift to capital markets

Uncovered interest parity (UIP): basic mechanism:

→ **capital mobility („capital arbitrage“)**

Basic idea:
Capital is invested in those places where the expected return is the highest.

Note!

In the case of fx investments not only interest rates are important but also **expected rates of change of the x-rate.**

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Uncovered Interest Parity (UIP)

In order to understand the logic of UIP, let's look at a German investor.

She has a choice between German and US government bonds

€-return of an investment in EUR: $(1 + i_€)$ after one year

Expected €-return of an investment in USD: $\frac{1}{w}(1 + i_\$) \cdot w^e$

How did we get there? It is almost identical to the case of CIP!

Buy $ with € yields: 1/w $

This $-amount can be invested yielding after 1 year: $\frac{1}{w}(1 + i_\$)$

This $-amount is exchanged for € yielding: $\frac{1}{w}(1 + i_\$) \cdot w^e$

This looks almost like CIP, doesn't it? But there is one fundamental difference. Here we are dealing with an expected return.

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Uncovered Interest Parity (UIP)

Let us assume that we can treat bonds issued by the US government and the German government as safe assets. So there is no default risk.

In this case, there is a **riskless €-return** in case of investments in German bonds.

But **the €-return of an investment in US bonds is risky**. So we can say that an inhabitant of the euro zone who is investing in US bonds, based on her beliefs about the future value of the $ is engaged in **fx-speculation**.*

We will keep that in mind. But for the moment we will assume that market participants do not care about risk. As economists say, we assume „risk neutrality“. So, in our analysis market participants only care about returns (profits).

Under this assumption, market participants will always pick the investment that promisses the highest return – irrespective or risks.

*: Feenstra and Taylor use the strange expression „risky arbitrage“ which is a contradiction in terms..

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Uncovered Interest Parity (UIP)

Given our assumptions, it is easy to define an equilibrium:

The expected €-return of an investment in USD has to be equal to the return of an investment in EUR.
Or from the perspective of a US investor:
The expected $-return of an investment in EUR has to be equal to the return of an investment in USD.

$$(1 + i_€) = \frac{1}{w}(1 + i_\$) \cdot w^e \quad \text{or} \quad \frac{(1 + i_€)}{(1 + i_\$)} = \frac{w^e}{w}$$

This is the **Uncovered Interest Parity** condition. It is an important equilibrium condition in financial markets.

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Uncovered Interest Parity (UIP)

$$\frac{(1 + i_€)}{(1 + i_\$)} = \frac{w^e}{w}$$

Uncovered Interest Parity condition

There are four variables in this equation.

But the equation itself says **nothing about causality**.

As we will see below, **it can be interpreted in different ways.**

It can help us to understand x-rates as well as international interest rates differences.

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Uncovered Interest Parity (UIP)

UIP theory as a theory of short-term x-rate determination

Starting point UIP: $$\frac{(1 + i_€)}{(1 + i_\$)} = \frac{w^e}{w}$$

Solving for the spot x-rate w yields $$w = w^e \frac{(1 + i_\$)}{(1 + i_€)}$$

On the right-hand side we have **two interest rates**. If we take a short-term view, say a few days, weeks or months these two interest rates should be short-term rates. Short-term interest rates are almost entirely determinated by central banks.

w^e is an expected value – reflecting the expectations of international investors. How do investors form their expectations? We do not know exactely. They could use a theory such as PPP and form expectations regarding future x-rate on the basis of expected inflation. In practice they are likely to incorporate all kinds of „news“ that may have an effect on the two economies: oil price changes, political conflicts, GDP growth etc.

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Uncovered Interest Parity (UIP)

UIP theory as a theory of short-term x-rate determination

If monetary policy is steady, short-term interest rates are fairly stable. Thus, we may as well regard them as constants.

In this case, w^e only changes because of news. Since news are hitting the maket all the time, w^e and thus the spot rate w are moving all the time.

$$w = w^e \frac{(1 + i_\$)}{(1 + i_€)}$$

⇒ $w^e \uparrow \Rightarrow w\uparrow$ and $w^e \downarrow \Rightarrow w\downarrow$

⇒ The short-run ups and downs of the spot rate mainly reflect changing expectations.

*: Many textbooks (incl. Feenstra/Taylor) make a complicated story at this point. They assume that central banks determine the supply of money and that short-term interest rates are the outcome of supply and demand in the market for money. In practice, central banks simply set an interest rate and the market rates closely follow it.

Box: x-rates in the financial news

yahoo! finance

Investing.com • 8 hours ago

Dollar Strengthens as U.S.-China Tensions Rise

Protests occurred in Hong Kong Wednesday as the national security law - which critics have called a direct attempt to curtail the city's unique freedoms - underwent a second reading in the city's Legislative Council.

MarketWatch • 28 minutes ago

Euro surges on reports of €750 billion EU stimulus package

The euro rose and Italian bond yields rallied Wednesday, on a report the European Union plans to announce a stimulus package worth as much as €750 billion ($823 billion). Citing an official with knowledge of the plan, Bloomberg reported that the package would be split between €500 billion loans and €250 billion grants, funded by borrowing on financial...

Benzinga • 14 hours ago

EUR/USD Forecast: Testing The Elusive 1.1000 Threshold - 5/26/2020

* Optimism about economic recoveries overshadowed US-China tensions. * U.S. President's advisor Kudlow said the trade deal with China is intact, for now. * EUR/USD is bullish in the...

Such news give you an idea of what markets are looking at. However, the explanations provided should be taken with a grain of salt. Interpretations can be contradictory (today the stimulus packet seems to be good news, maybe in a few weeks it will be a cause for concern) and sometimes the economics behind it can be definitely false.

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Uncovered Interest Parity (UIP)

UIP as a theory of long-term interest rate determination

Another interpretation:

We have assumed that interest rates are given (that they are „exogenous“). This may be a permissable assumption when analysing the short term.

Short-run interest rates (money market rates) are, indeed, strongly influenced by central banks.

When looking at **long-term interest rates** (a year or more) things are more complicated.

For longer maturities market forces have much more influence over interest rates. Thus, we cannot simply take them as given. Rather they are market prices (endogenous variables) that have to be explained.

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Uncovered Interest Parity (UIP)

UIP as a theory of long-term interest rate determination

Assumptions:

- For a small country, the foreign interest rate is given.
- Economic agents are forming expectations with respect to the rate of change of the x-rate (not the level).

In this case, we can solve UIP for $i_€$:

$i_€ = (1+ i_\$) (w^e/w) - 1$ or approximately $\boxed{i_€ = i_\$ + dw^e}$

The local interest rate is determined by the foreign interest rate and the expected rate of change of the exchange rate (dw^e).

→ In this case, it is still true that the interest rate differential should be equal to the expected rate of change of w. But now **the variable that adjusts is the local interest rate**.

→ Countries with a „weak“ currency (one that is expected to depreciate) should have relatively high interest rates.

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Uncovered Interest Parity (UIP)

Interest rates and exchange rates

No matter whether we interpret UIP as a theory of x-rate determination or interest rate determination – the interest rate difference always should equal the expected rate of change of the x-rate. This follows from the assumption that investors are risk-neutral:

⇒ local and foreign assets are perfect substitutes

⇒ any difference in returns triggers large capital flows

UIP: How well does it work?

Empirical confirmation is hard to get because expectations cannot be observed directly.

Using survey data: Feenstra/Taylor, p.477 quote some supporting evidence but the results should be interpreted with caution.

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Uncovered Interest Parity (UIP)

Again: the logic underlying UIP

What we can say in general is:
If UIP correctly describes the behaviour of fx market participants then investors‘ speculative transactions should drive the expected returns of a local investment and a foreign currency investment towards equality.

We cannot directly check that. But we can check whether **actual returns** have been equated.

Actual returns are equated if the following condition holds:

$$i_{€} - i_{\$} = dw$$

If returns are equated, we have an indication (not a proof) that UIP may be a good explanantion of the real world.

If returns are not equated, we must ask ourselves how to explain this.

Let‘s look at some historical data.

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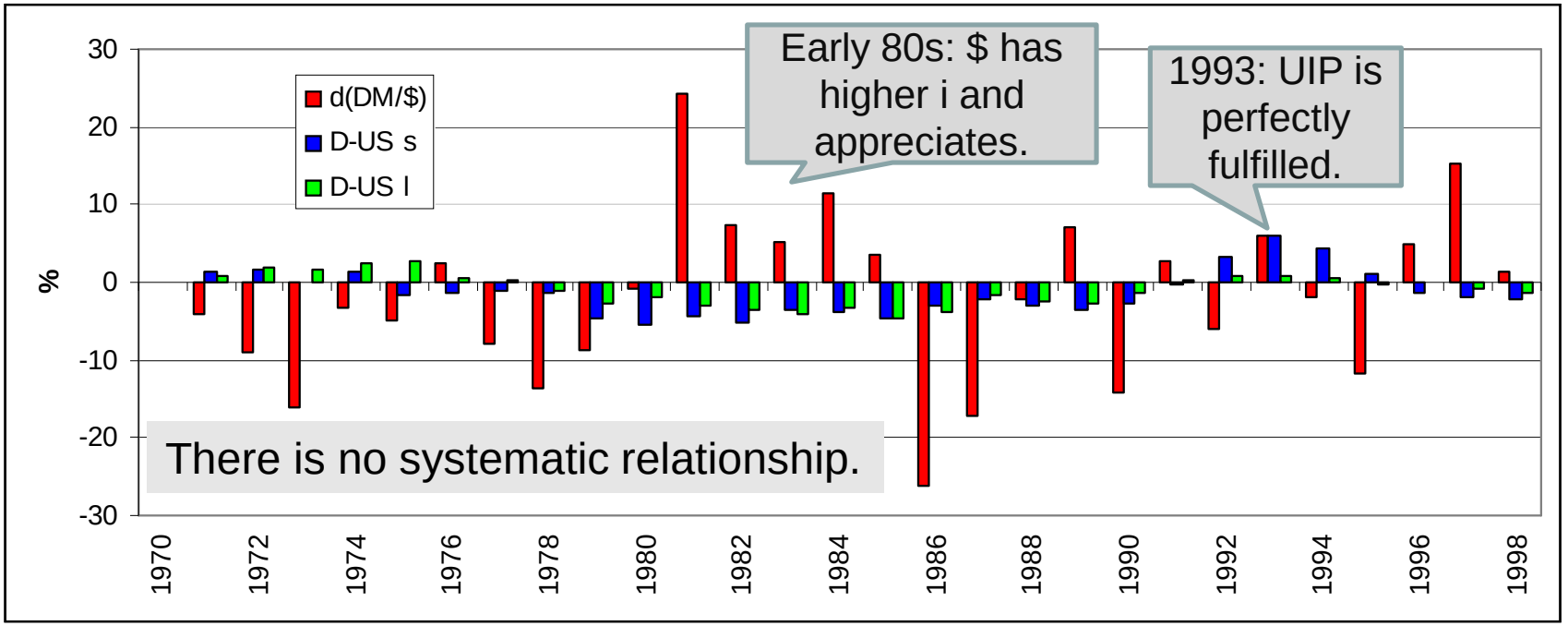
Uncovered Interest Parity (UIP)

Looking at the US and Germany in the times of the D-Mark.

Is the condition $\mathbf{i_{DM} - i_{\$} = dw}$ fulfilled on an annual basis?

Clearly not!

Interest rate difference and x-rate changes: DE - USA



S: short-term rates, l: long-term rates, D-US: German rates minus US rates

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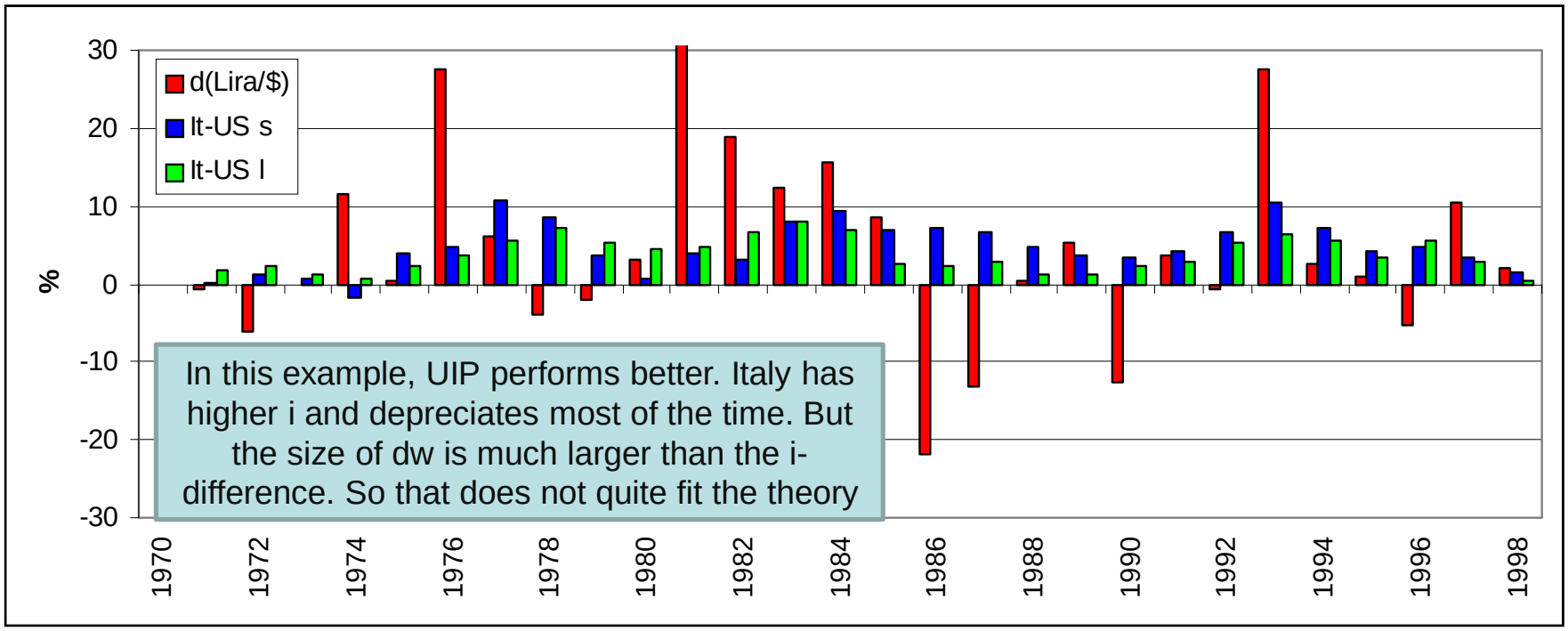
Uncovered Interest Parity (UIP)

In this example, UIP performs better. Italy has higher i and depreciates most of the time. That is what we should expect. But the size of dw is much larger than the i-difference. So that does not quite fit the theory.

Interest rate differences and x-rate changes: Italy - USA



S: short-term rates, l: long-term rates, It-US: Italian rates minus US rates

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Uncovered Interest Parity (UIP)

A first assessment

- interest rate differentials are much smaller than x-rate changes
- often x-rate changes are in the „wrong“ direction
- this can happen even for many periods
- interest rate differentials seldom change their sign

Before we come to a verdict, we will take another look:

extending the time horizon.

We will look at a US investor who can earn US interest rates over a long period or who can invest in Europe over the same period, earn European interest rates and exchange the foreign money back into USD at the end of the period.

According to UIP we should expect that both options yield the same return.

Ch. 3: Exchange rate theory

Uncovered Interest Parity (UIP)

Interest differentials and x-rate returns: point of view of a US-investor 1975-1998

	UK	Frk	Dt	It	J
Exchange rate returns	-30%	-23%	32%	-167%	60%
Relative interest return_s	31%	40%	-35%	258%	-54%
Relative interest return_l	40%	31%	-29%	164%	-57%

Source: IMF and own calculations

A „minus“ implies that the x-rate [foreign/USD] has risen.

How to interpret the table: an example. A US investor investing for the entire period in Germany would have made an x-rate gain of 32%. But the return on short-term assets was 35% lower than in the US. Overall, he would have done 3% worse than in the US.

In the very long term UIP performs relatively well.
The magnitudes of x-rate returns and relative interest returns are comparable.
They have the correct sign (if one is positive, the other is negative).
Countries with large depeciations have much higher interest rates than the US.

So, for very long time horizons UIP seems to work fairly well. For shorter time horizons this is not the case.

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Uncovered Interest Parity (UIP)

Why does UIP not perform better?

Possible explanations:

1. Expectations may be systematically wrong (use of wrong models)
2. Risk aversion
   - local and foreign assets are not perfect substitutes
   - low capital mobility
3. Restrictions on capital mobility
   Up to the late 1970s such restrictions have been wide-spread.
   Since the early 1980s they have become less important.

Ch. 3: Exchange rate theory

This is the UIP condition.

$$\frac{(1 + i_{€})}{(1 + i_{\$})} = \frac{w^e}{w}$$

1. What is the underlying economic logic of this condition?
2. How does it differ from CIP? **To be answered later.**
3. How can this condition be transformed into a theory of exchange rate determination?
4. How can this condition be transformed into a theory of interest rate determination?
5. Given the values below, should a German investor with a 3-year time horizon rather have invested in Germany or in Australia?

	AUD/EUR	i_{AUS}	i_{GER}
2016	1.4883	2.34	0.09
2017	1.4732	2.64	0.32
2018	1.5797	2.68	0.40

1% = 0.01
0.4% = 0.004
0.09% = 0.0009

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4. Exchange rate systems

Exchange rate sytems

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Exchange rate systems:

In principle, there are 2 systems:

- flexible exchange rates
- fixed exchange rates

In practice, there are a number of mixed systems.

The IMF has developed a system of exchange rate categories.

All currencies are classified as belonging to one of these categories.

Exchange rate sytems

Categories of the IMF:

Table 1. Classification of Exchange Rate Arrangements

Type	Categories				
Hard pegs	Exchange arrangement with no separate legal tender	Currency board arrangement			
Soft pegs	Conventional pegged arrangement	Pegged exchange rate within horizontal bands	Stabilized arrangement	Crawling peg	Crawl-like arrangement
Floating regimes (market-determined rates)	Floating	Free floating			
Residual	Other managed arrangement				

Exchange rate sytems

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Only very few curencies are freely floating:

Australia
Canada
Chile
Japan
Mexico
Norway
Poland
Russia
Sweden
United Kingdom
Somalia
United States
EMU (19 countries)

... and 41 currencies are floating

Afghanistan
Madagascar
Malawi
Mozambique
Seychelles
Sierra Leone
Tanzania
Albania
Madagascar
Armenia
Malawi
Mozambique
Brazil
Seychelles
Colombia
Georgia
Ghana
Guatemala
Hungary
Iceland
India
Indonesia
Israel
Kazakhstan
Korea
Moldova
New Zealand
Paraguay
Peru
Philippines
Romania
Serbia
South Africa
Thailand
Turkey
Uganda
Uruguay
Argentina8
Kenya8
Mauritius
Mongolia8
Switzerland
Ukraine
Zambia

But most countries either use a soft or hard peg.

Exchange rate sytems

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Currency pegs (fixed x-rates)

A fixed x-rate does not exist “just like that”.
Fixing an x-rate vis-á-vis another currency is a policy choice.
Fixing an x-rate can be

- a unilateral decision (i.e. Hong Kong pegging the HKD to the USD) or
- a multilateral decision (i.e. European countries agreeing to the EMS).

The peg can be

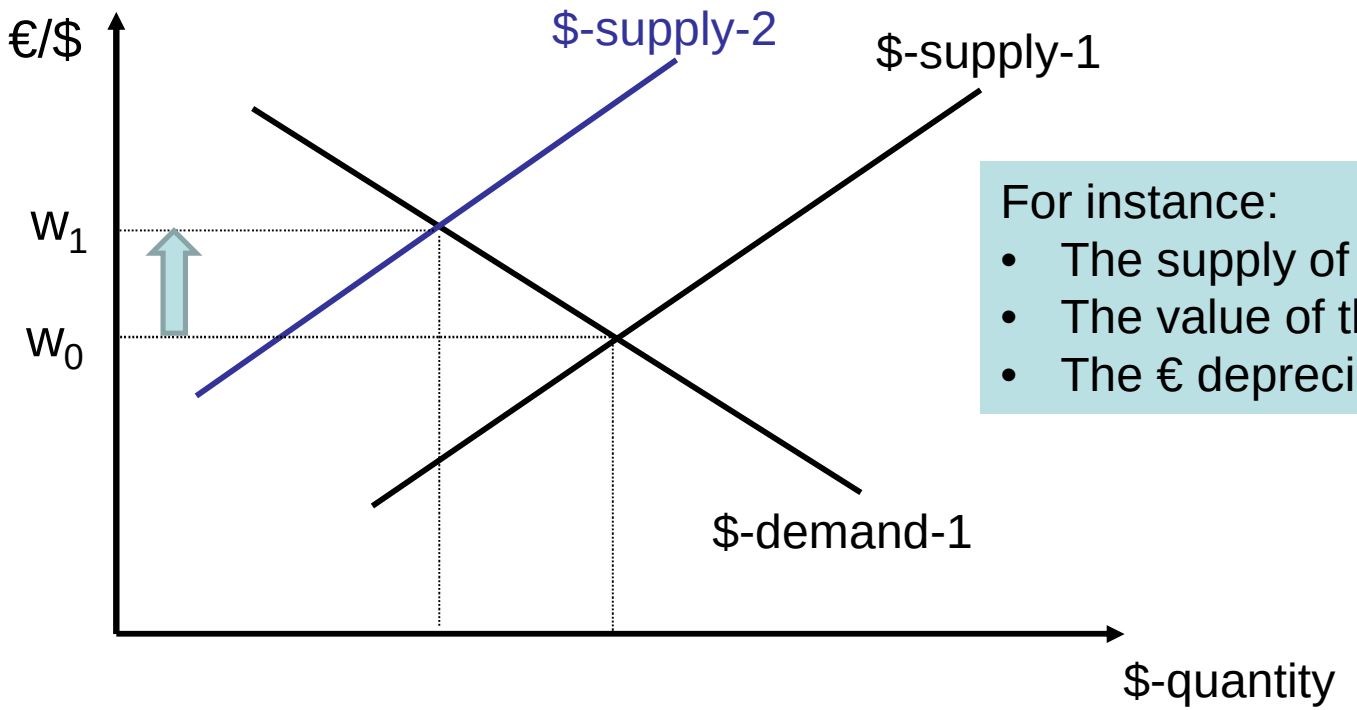
- soft (easily adjustable) or
- hard (with no or very rare adjustments)

The hardest peg is a currency union (as EMU) or the use of a foreign currency as domestic currency (as in Panama or Ecuador).

Below, we will discuss how one currency can be pegged to another and we will look at the pros and cons of fixed and flexible x-rates.

Exchange rate sytems

Flexible exchange rates → The x-rate as a market price



For instance:
- The supply of $ declines.
- The value of the $ rises.
- The € depreciates.

Under flexible x-rates:
Changes of supply and/or demand lead to x-rate changes.

But → What happens when x-rates are fixed?

Exchange rate sytems

How can x-rates be fixed?

First of all, who wants to fix x-rates?

Usually, governments are in charge of x-rate policy.

So they decide about the x-rate system. And if they want a system of fixed x-rates, they also decide about the value of the x-rate that they want to maintain.

Once this decison has been taken, governments need to implement a policy suitable to keep x-rates fixed. And they have to decide who should be in charge.

As a matter of fact, in most cases central banks are endowed with the task of keeping the x-rate fixed.

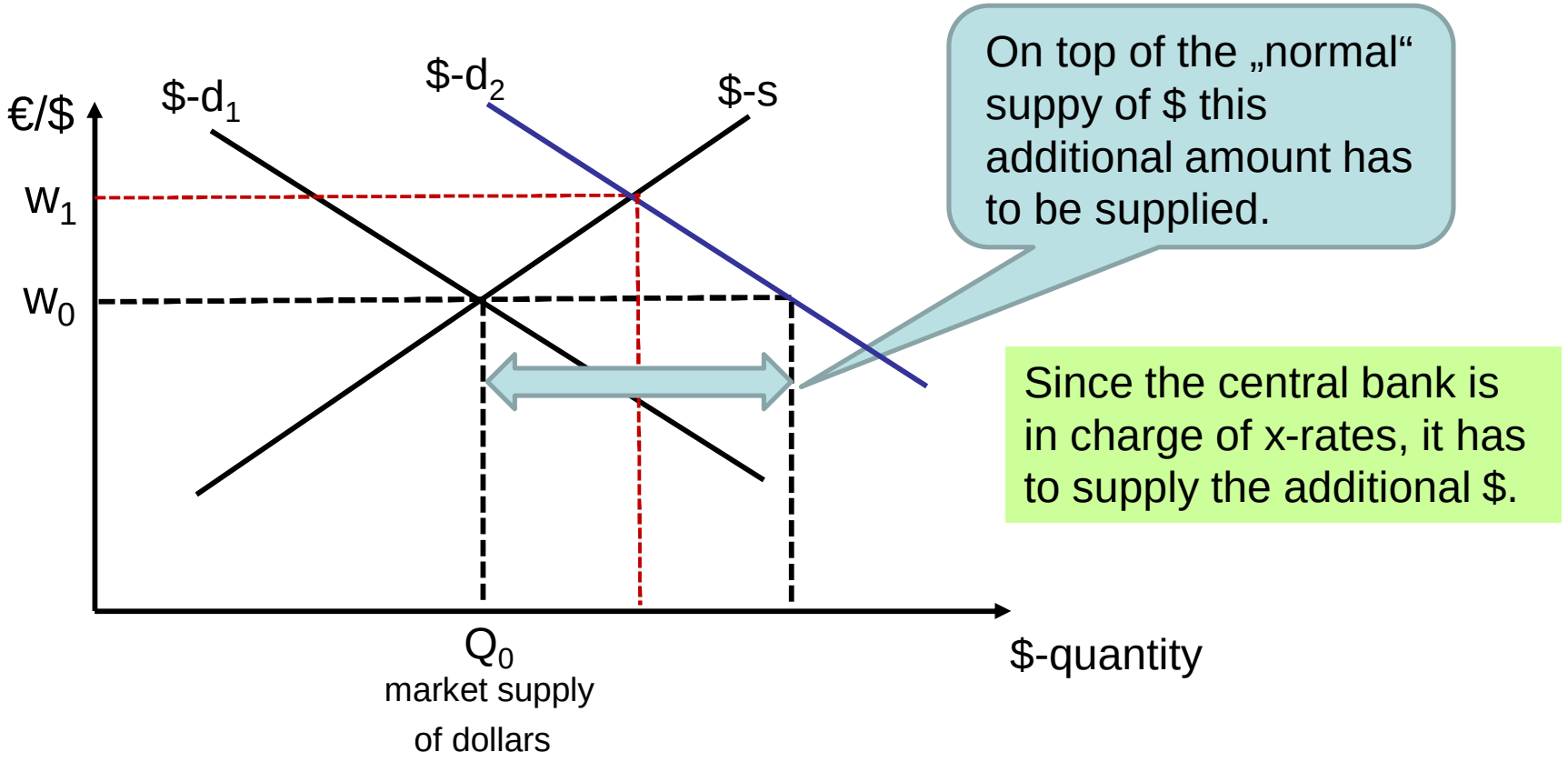
Therefore, in the following, we will also assume that the central bank takes the necessary steps to keep the value of the x-rate where the government wants it.

So, what does a central bank have to do to keep x-rates fixed?

Exchange rate sytems

Fixing x-rates

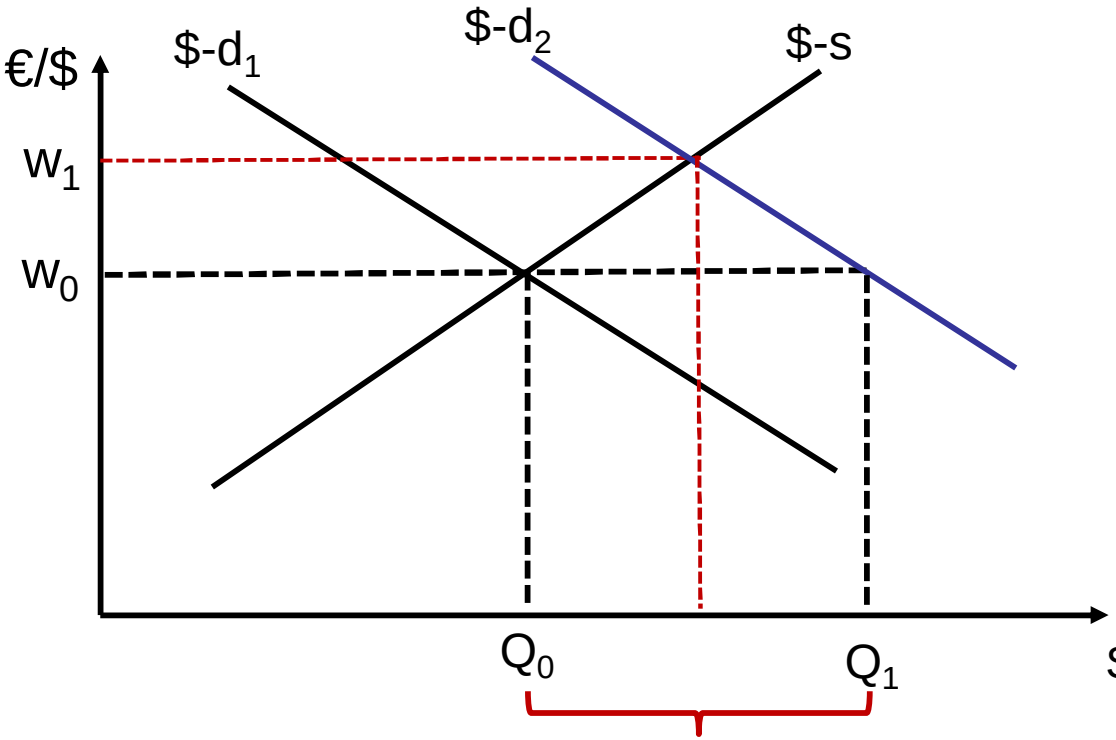
Suppose initially the x-rate is at w_0. If there is an increase in the demand for $, either the x-rate increases or somebody has to supply additional dollars at the x-rate w_0.



Exchange rate sytems

Fixing x-rates

Suppose initially the x-rate is at w_0. If there is an increase in the demand for $, either the x-rate increases or somebody has to supply additional dollars at the x-rate w_0.



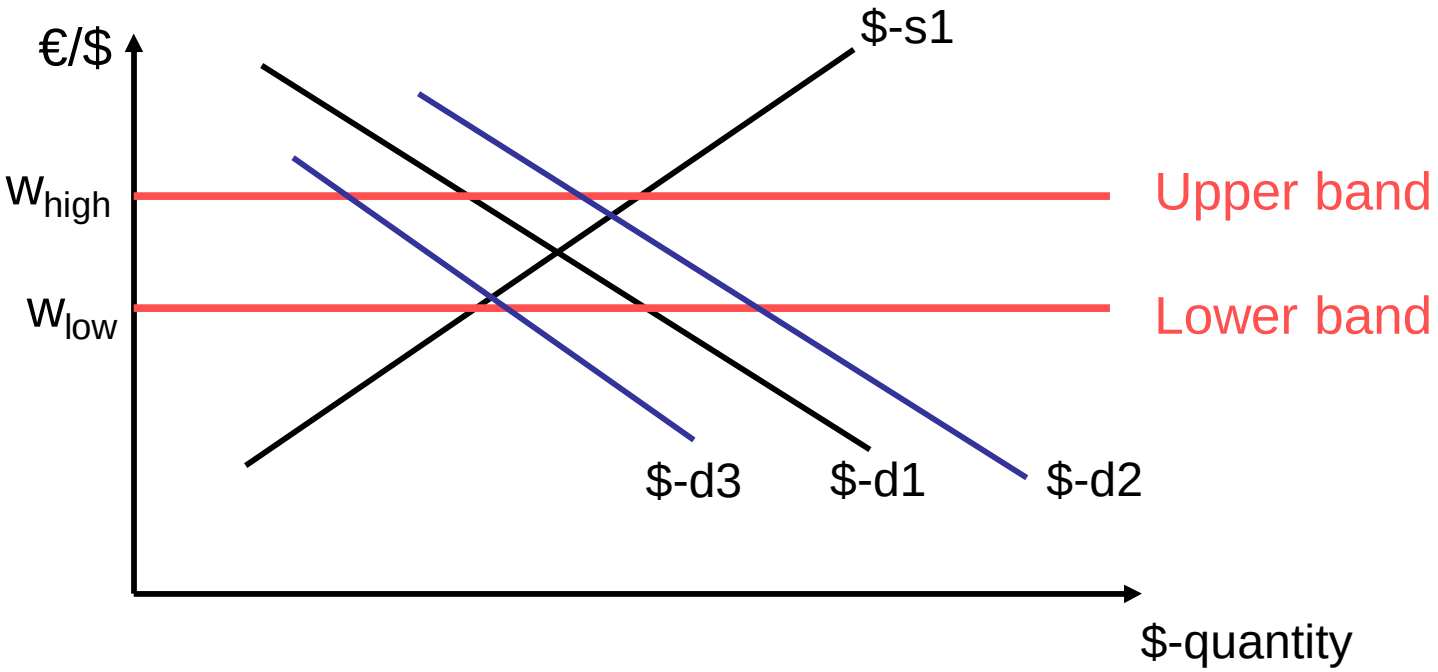
Central bank interventions are required to keep x-rates stable.

When the central banks buys or sells $ in order to keep the x-rate fixed we speak of central bank „interventions“ in the fx-market.

Exchange rate sytems

Fixing x-rates

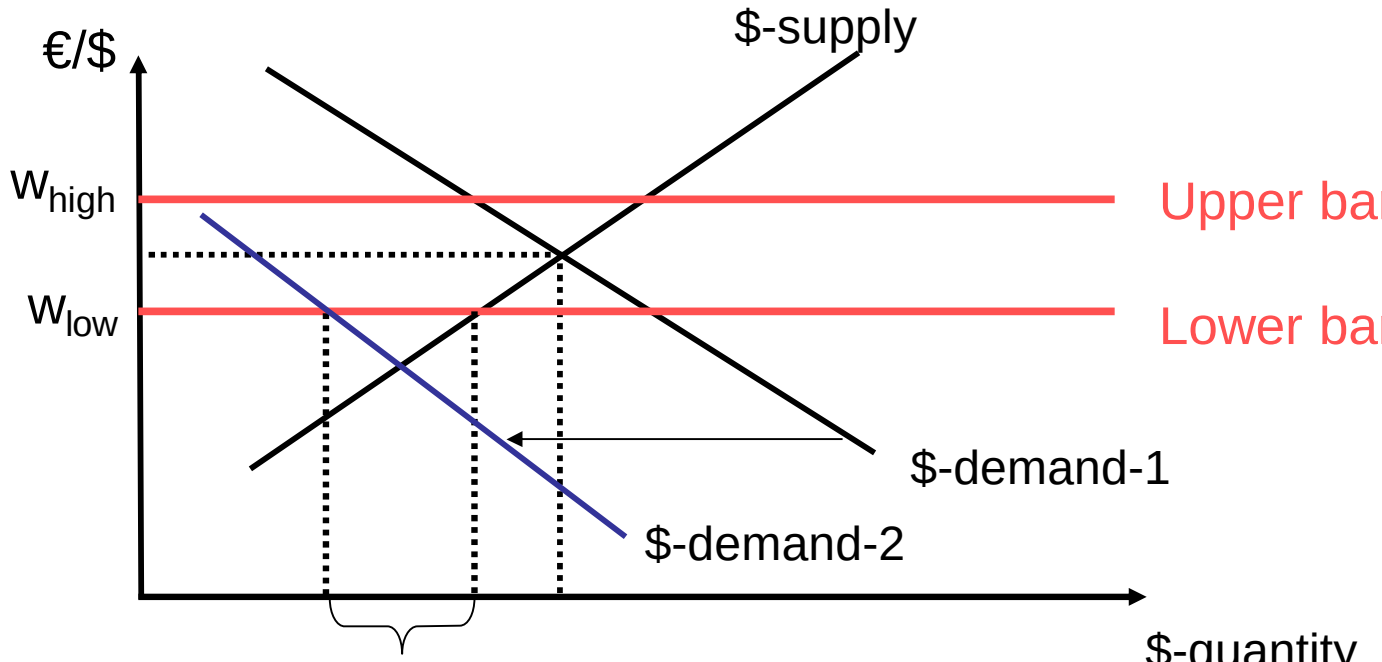
In most cases, x-rates will be allowed to vary a little. So, fixing an x-rates actually means that a lower and an upper bound are defined.



As long as the x-rate moves within the bounds, the central banks has to do nothing.

Exchange rate sytems

Fixing x-rates

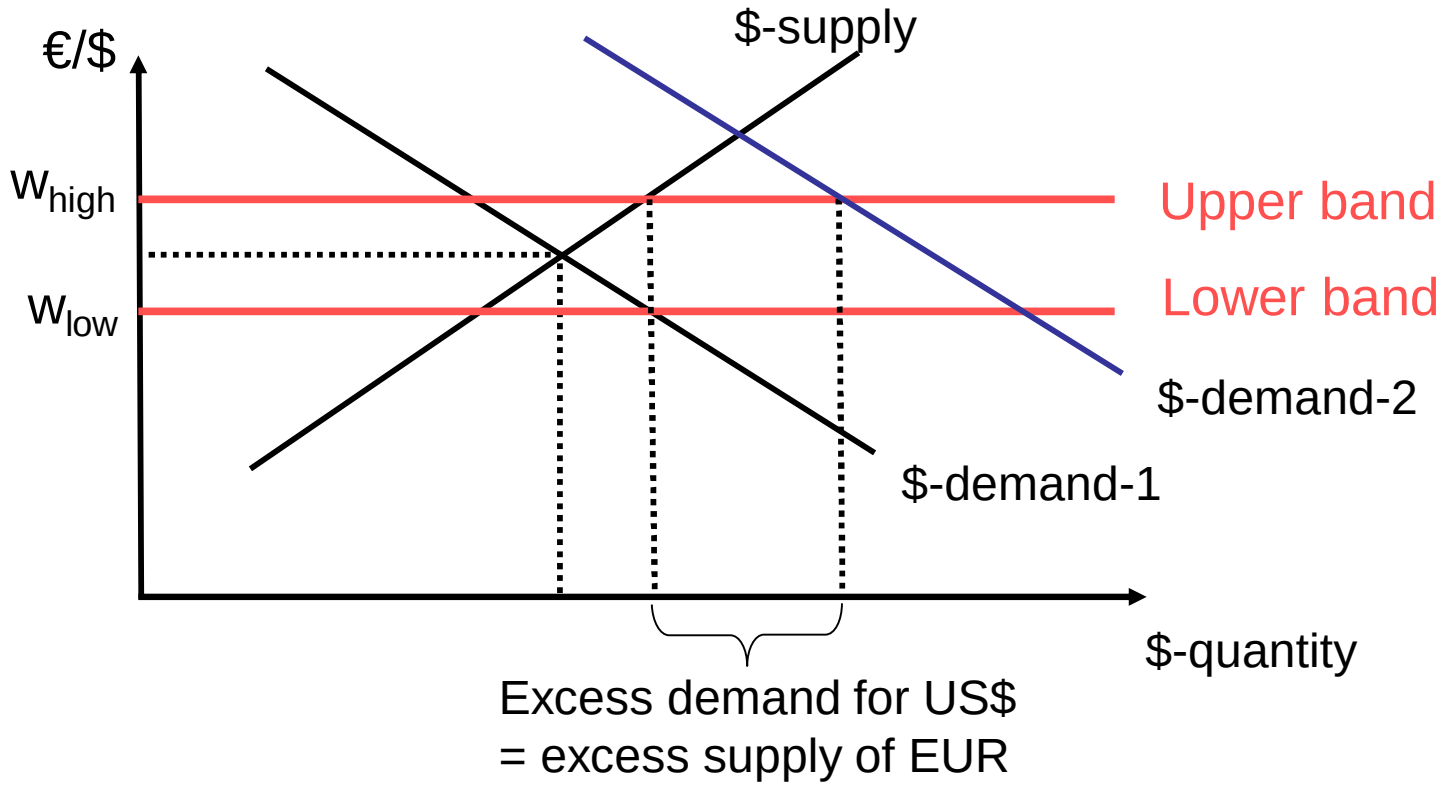


Excess supply of US$
= excess demand for EUR

FX market intervention: Purchase of US$ / sale of EUR

Exchange rate sytems

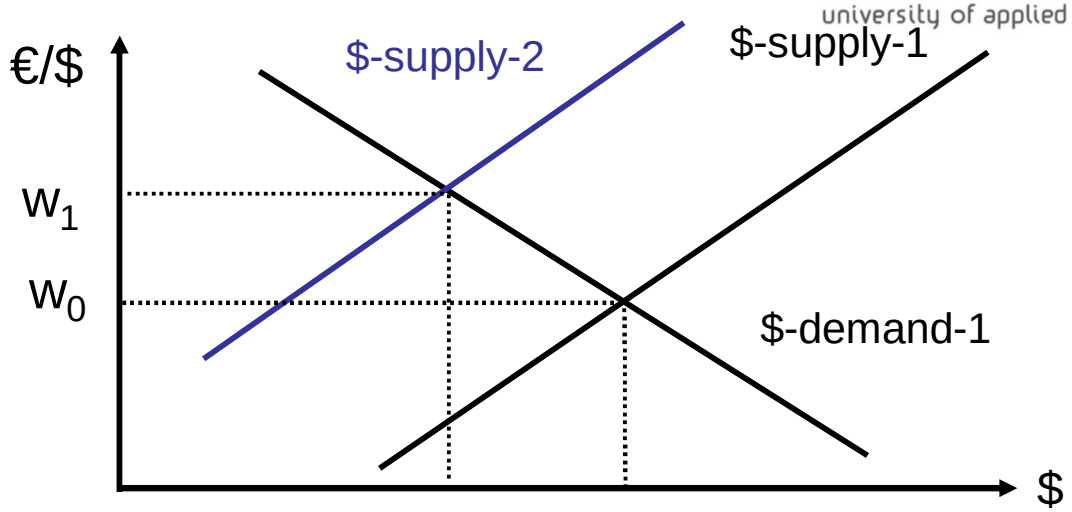
Fixing x-rates



FX market intervention: Purchase of EUR / sale of USD

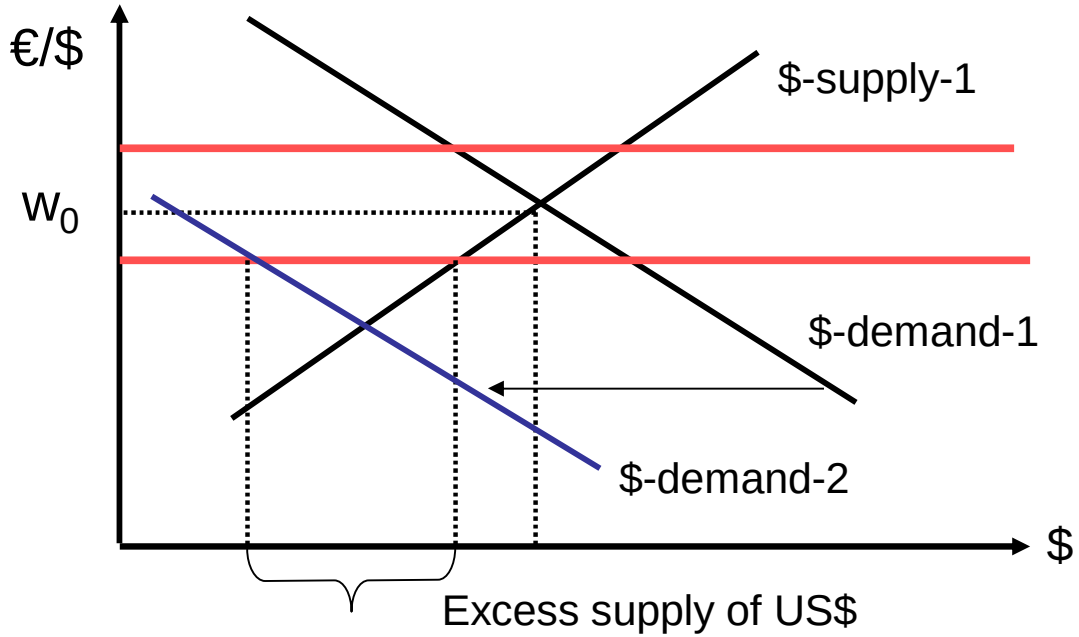
Exchange rate sytems

Flexible x-rates:
X-rate changes lead to equality of supply and demand.



Fixed x-rates:
Interventions are necessary.

But: Are central banks forced to intervene permanently, period after period?



Exchange rate sytems

Monetary effects of interventions:

Purchase of US$ by the ECB:

„Sale“ of EUR = Increase of the EUR money supply

A	ECB	L
+24 Mio USD		+20 Mio EUR

When th ECB buys USD it pays for the USD with EUR. In other words, it creates more EUR. The money supply in the euro area is increased.

Sale of US$ by the ECB:

„Purchase“ of EUR = Reduction of the EUR money supply

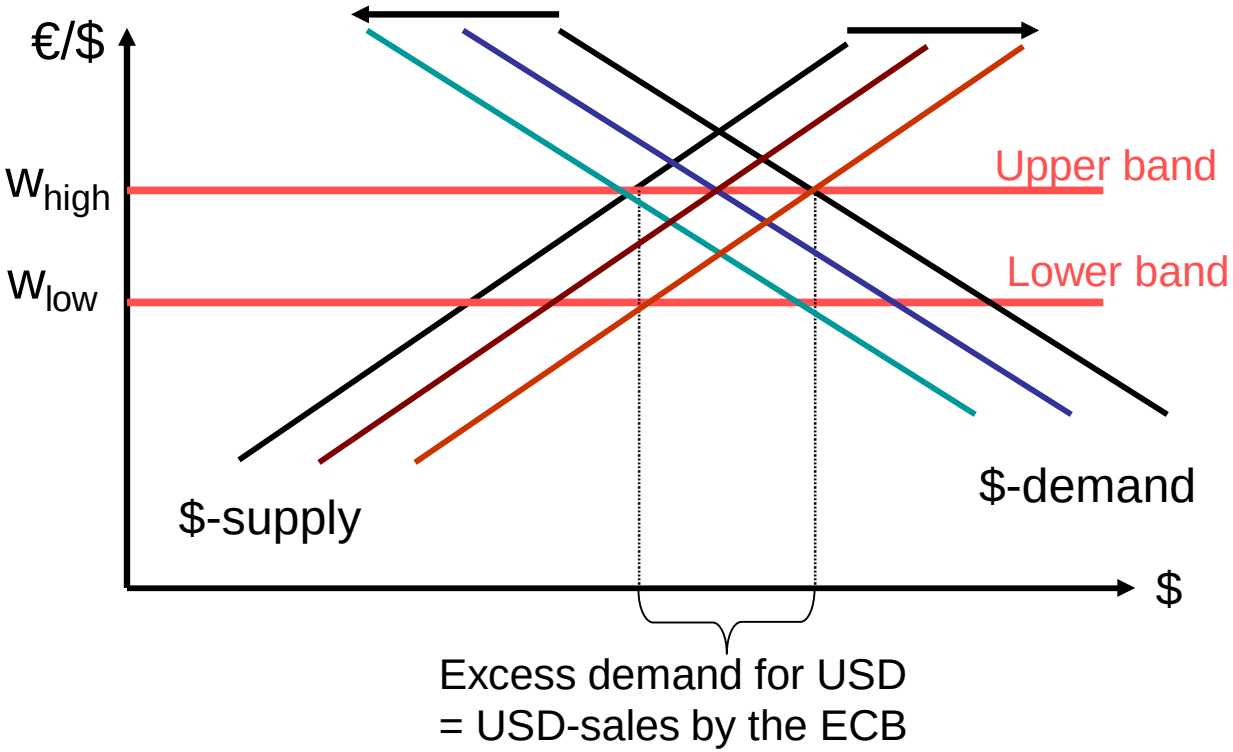
A	ECB	L
-24 Mio USD		-20 Mio EUR

When the ECB sells USD it is paid for the USD with EUR. In other words, the amount of EUR outside the ECB is reduced.

Exchange rate sytems

Interventions: Effects on the fx market

Reduction of the money supply: demand shifts to the left
supply shift to the right



Changes in demand and supply will move the equilibrium x-rate back into the band.

An increase of the money supply has the opposite effect. Thus, it will push the equilibrium x-rate upward.

Exchange rate sytems

Why are demand and supply shifting?

We have seen that fx interventions lead to changes in the supply of money.
Such money supply changes will affect an economy in different ways.
All of these effects have a tendency to restore fx equilibrium.

Effects on foreign trade

The quantity theory and PPP:

$P = Mv / Y$

$P^* = M^*v^* / Y^*$

$w = P / P^*$

The first two equations are known as „quantity equations“. They state that an increase of money (M) and velocity (v) increase the price level (P) and that an increase in real income (y) decreases the price level.
The same applies to the foreign country.
The last equation is simply PPP.

$YP = Mv$
Quantity equation

Exchange rate sytems

Why are demand and supply shifting?

If the local currency is weak and the central banks needs to supply foreign money, the local money supply declines.

All else equal, the consequence of a lower money supply (M):

- The domestic price level falls relative to the foreign price level.
- As a consequence: imports are falling (and thus USD-demand) and exports are rising (USD-supply)
- The equilibrium x-rate falls and interventions may become smaller.

If the local currency is strong and the central banks needs to supply domestic money, the local money supply rises.

All else equal, the consequence of a higher money supply (M):

- The domestic price level rises relative to the foreign price level.
- As a consequence: imports are rising (and thus USD-demand) and exports are falling (USD-supply)
- The equilibrium x-rate rises and interventions may become smaller.

Exchange rate sytems

Why are demand and supply shifting?

Effects on capital movements

Money, interest rates and UIP:

M = D (D= money demand)

M* = D*

$w = w^e (1 + i_{US}) / (1 + i_{EU})$

Consequence of lower money supply:

Everything in reverse when the central bank is buying foreign money and thus increasing the local money supply.

- Money market disequilibrium:
  Excess demand for money: domestic interest rates are rising
- The domestic interest rate rises relative to the foreign rate
- Rising USD-supply of investors who want to invest in EUR,
  fallling USD-demand of investors wanting to invest in USD.
- For given x-rate expectations (important!) this leads to a fall of the equilibrium x-rate (interventions may become smaller)

→ Money-interest-mechanism

Exchange rate sytems

The role of trust

Important:

If there is trust in the stability of the system, the expected x-rate will lie within the band.

However, if there are doubts, the expected rate may lie outside of the band.

Thus, trust is an element that is crucial for the survival of fixed x-rate systems:

$$\frac{w^e - w}{w} = i_€ - i_\$$$ UIP re-arranged#

If there is trust: The max. difference between w and w^e is equal to the width of the band. In this case, interest rates cannot deviate by much.

If there is no trust: there can be strong deviations between w and w^e. This is particularly the case in economic crisis situations. If investors expect a depreciation of the EUR in the coming weeks, w^e is much higher than w. Consequently $i_€$ has to be much higher than $i_\$$.

#: The exact equation is $\frac{w^e - w}{w} = \frac{i_€ - i_\$}{1 + i_\$}$

Exchange rate sytems

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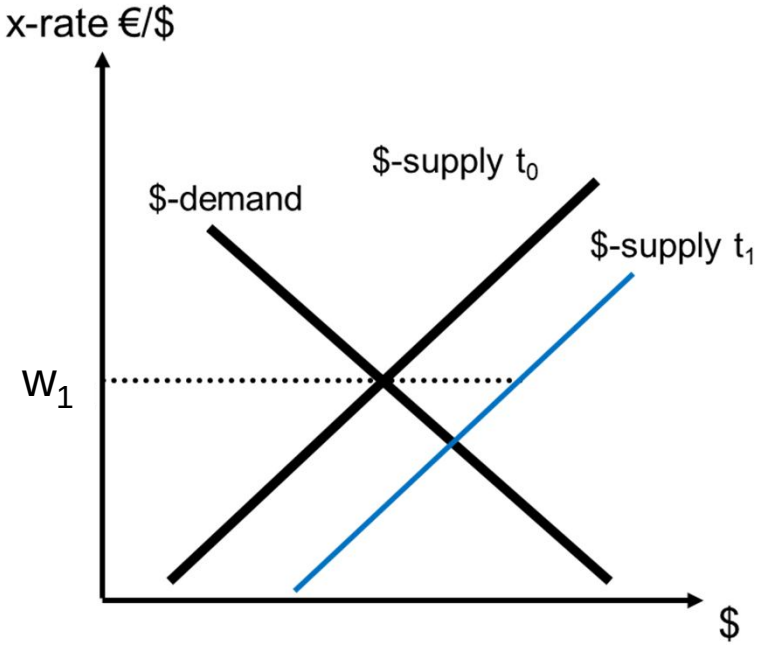
1. The eurosystem has the task to stabilise the €/$ x-rate at w_1. Show graphically what the eurosystem has to do in case of an increase of the $-supply from t_0 to t_1. How is the money supply affected?



2. What are the most important adjustment mechanisms that are triggered by foreign exchange intervention? (Short explanation of each of them.)

Exchange rate sytems

The role of trust

Let us investigate this issue some more.

Taking UIP as a starting point.
Suppose the EUR is pegged to the USD at an x-rate of 1 €/$ (=w^P) with a band around the central rate of +/- 2%.
If there is trust in the currency peg, the expected x-rate (w^e) will be equal to the central rate w^P.
So as long as there is trust we can write

$$\frac{w^e - w}{w} = \frac{w^P - w}{w} = \frac{1 - w}{w} = i_{€} - i_{\$}$$

where w is allowed to fluctuate between 1.02 €/$ and 0.98 €/$

Under these conditions, the two interest rates will always be very close.

But if there is no trust, w^e may well be outside of the band. So it may differ substantially from w.

Exchange rate sytems

Exercise

Suppose that trust in the pegged rate declines and the EUR is expected to depreciate. For the moment, the EUR rises to the upper band (1.02 €/$) (it depreciates). At this value it is stabilised by central bank intervention. But markets expect the system to break down.

1. If the expected rate 1 year in ahead is equal to 1.15 €/$, how big will be the interest rate differential?
2. Assume that the x-rate of 1.15 €/$ is expected already 3 months ahead. How big will be the interest rate differential in this case?

Exchange rate sytems

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Experience with fixed x-rates

Experience shows that fixed x-rate may be subject to frequent changes. Sometimes they completely break down.

Let us look at two examples:

Hong Kong and the European Monetary System

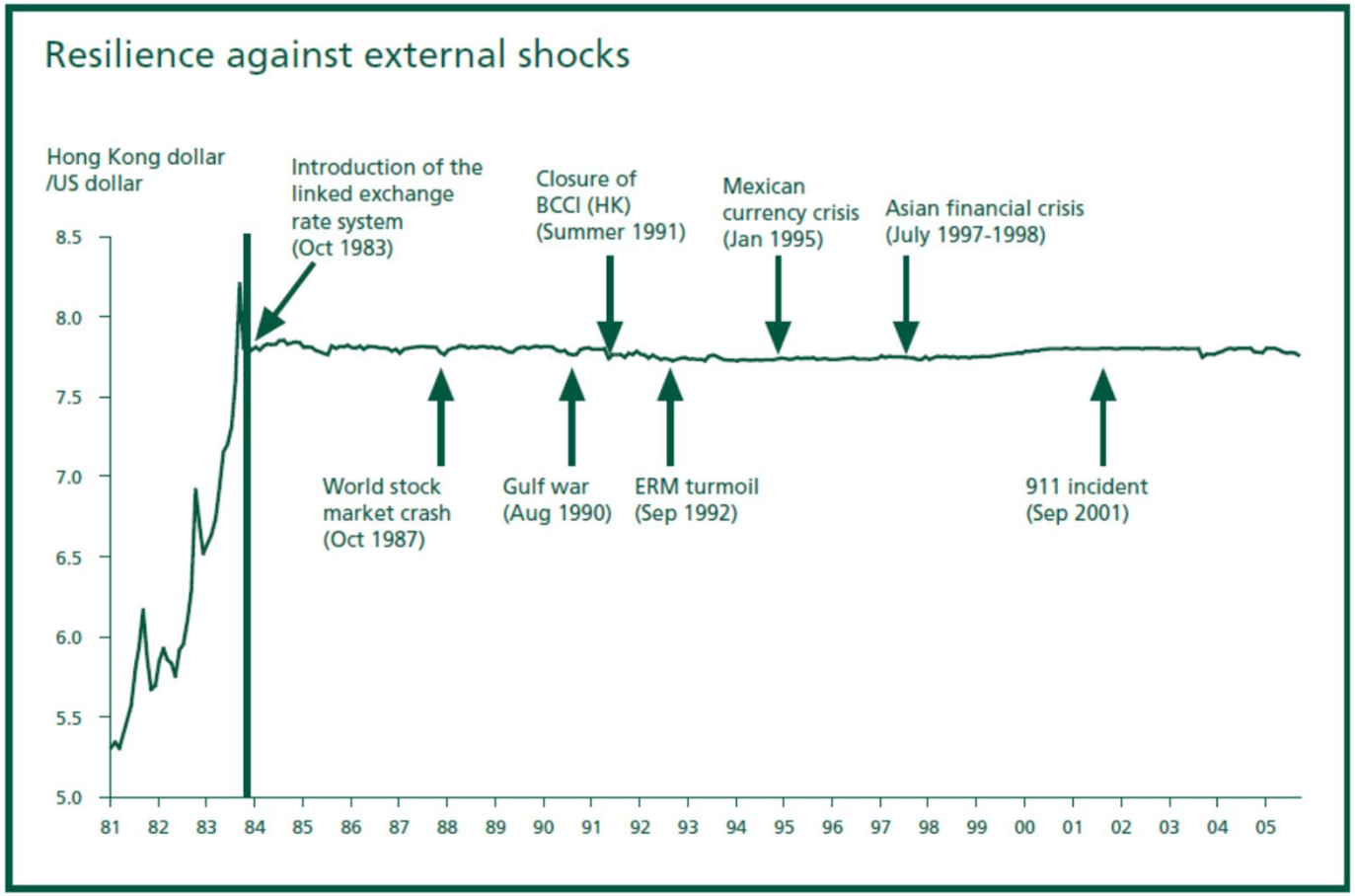
Sources:

Hong Kong Monetary Authority: Hong Kong's Linked Exchange Rate System, HKMA Background Brief No.1, 2nd edition, November 2005.

Swedish Riksbank: 1992 - Interest rate 500% – the krona floats (uploaded to Moodle)

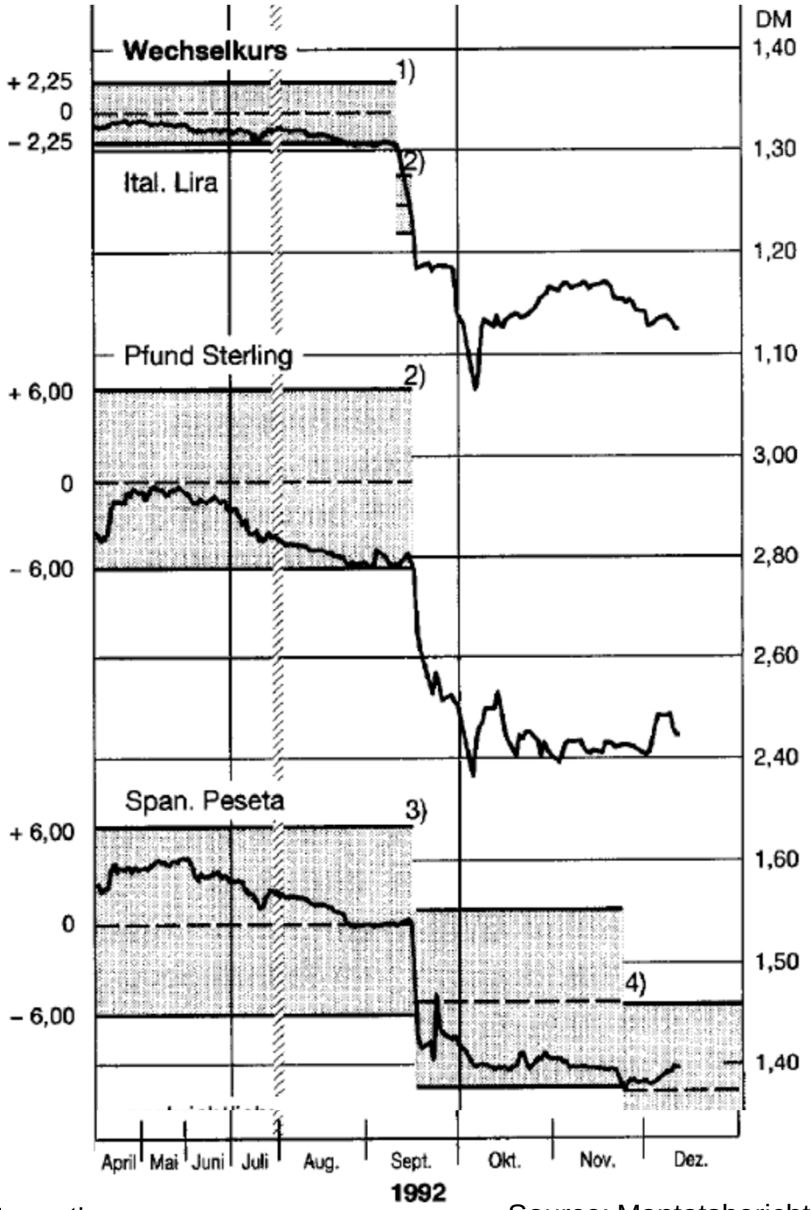
Exchange rate sytems

A fixed x-rate that has survived many international crisis:
The Hong Kong dollar – US dollar peg



Source: HKMA, 2005

Exchange rate sytems



When trust evaporates: the EMS crisis of 1992

In the summer of 1992 markets started to doubt the the exchange rates of the European Monetary System (EMS) were set at a sustainable level.

They expected an appreciation of the D-Mark and money flowed from other EMS countries into Germany.

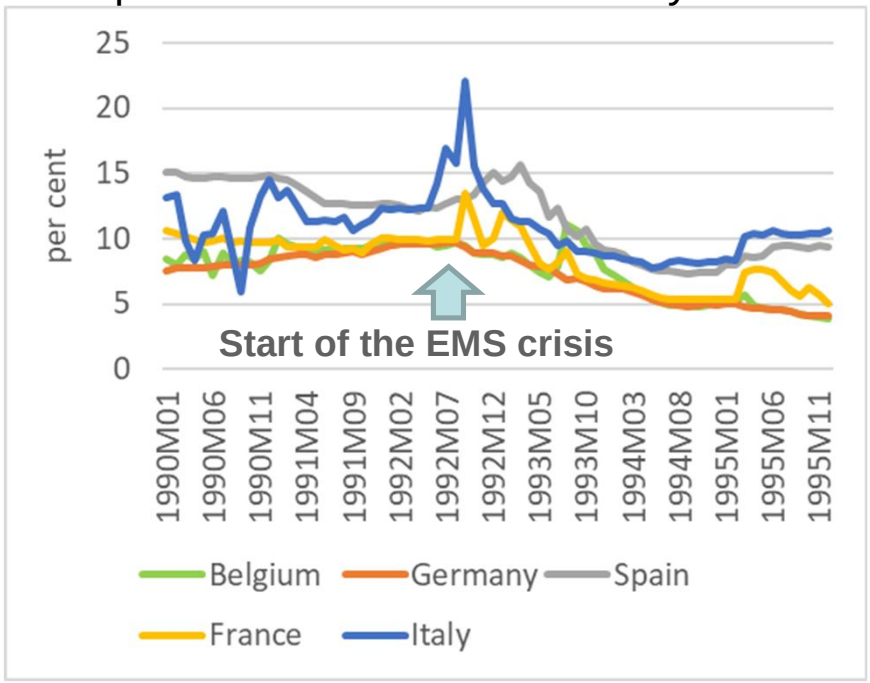
Other countries‘ central banks had to sell D-Mark and increase interest rates. Germany‘s Bundesbank had to buy other currencies.

Source: Montatsberichte der Deutschen Bundesbank, Dez. 1992, p. 47.

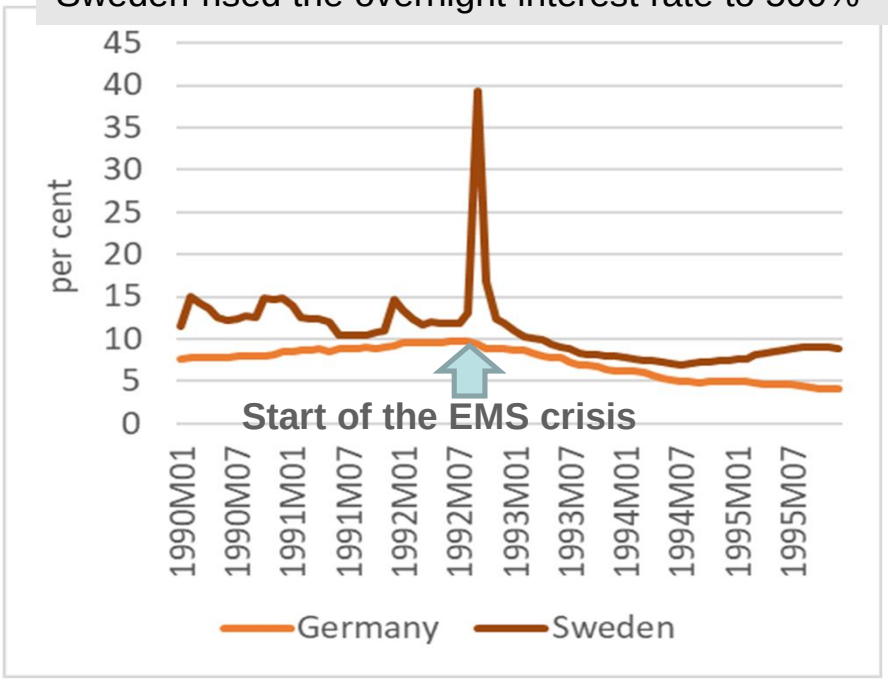
Exchange rate sytems

When there is no trust:
Countries with „weak“ currencies have generally higher interest rates.
During crisis they have to raise them even more.

European interest rates in the early 1990s



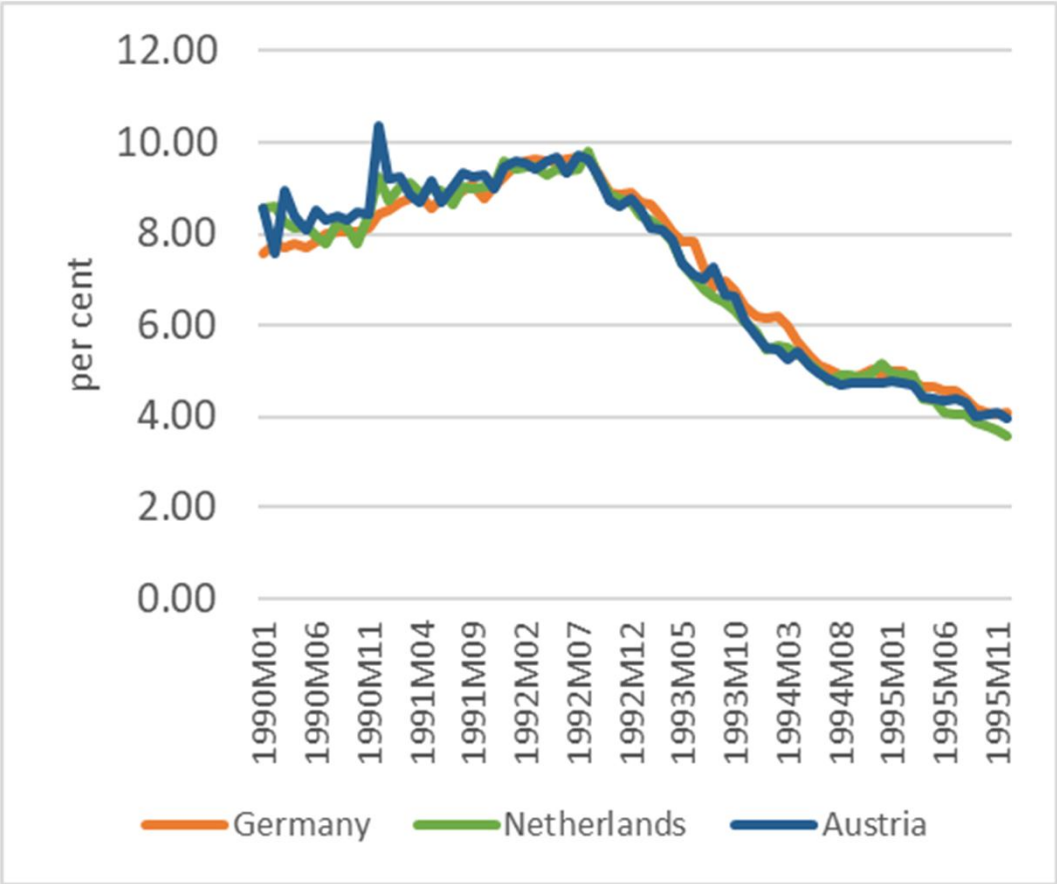
On one day in September, the Central Bank of Sweden rised the overnight interest rate to 500%



Monthly averages of overnight (day-to-day) interest rates. Source: eurostat

Exchange rate sytems

When there is trust:
The case of the Netherlands and Austria



For many years, both countries had followed a policy of D-Mark shadowing.

They had not participated in earlier depreciations and both countries could count on broad political support favouring a „hard“ x-rate policy.

Exchange rate sytems

An important distinction:
Sterilised and non-sterilised interventions

Sterilisation = Making another transaction to neutralise the monetary effects of exchange rate interventions

Example:
Purchase of foreign currency plus sale of bonds

A	ECB	L
For. currency: + 24 m. USD (=+20 m. EUR) **Bonds:** - 20 m. EUR	no change on the liability side	

→ In case of a sterilisied intervention there is an accounting exchange on the asset side of the balance sheet.

→ „Sterilisation“:
The monetary effects of an intervention are neutralised, the effects are „sterilised“.

Exchange rate sytems

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Sterilisied and non-sterilised interventions

Why are central banks using sterilised interventions?

Using non-sterilised interventions to defending an x-rate can be costly.

A central banks that wants to prevent a depreciation has to let the money supply decline triggering interest rises, pressure on prices and possibly increases in unemployment.

A central banks that wants to prevent an appreciation has to let the money supply increase triggering interest cuts, and possibly increases in inflation.

The effectiveness of sterilised interventions is controvercial

→ No change of money supply:
- no money-price-mechanism
- no money-interest-mechanism

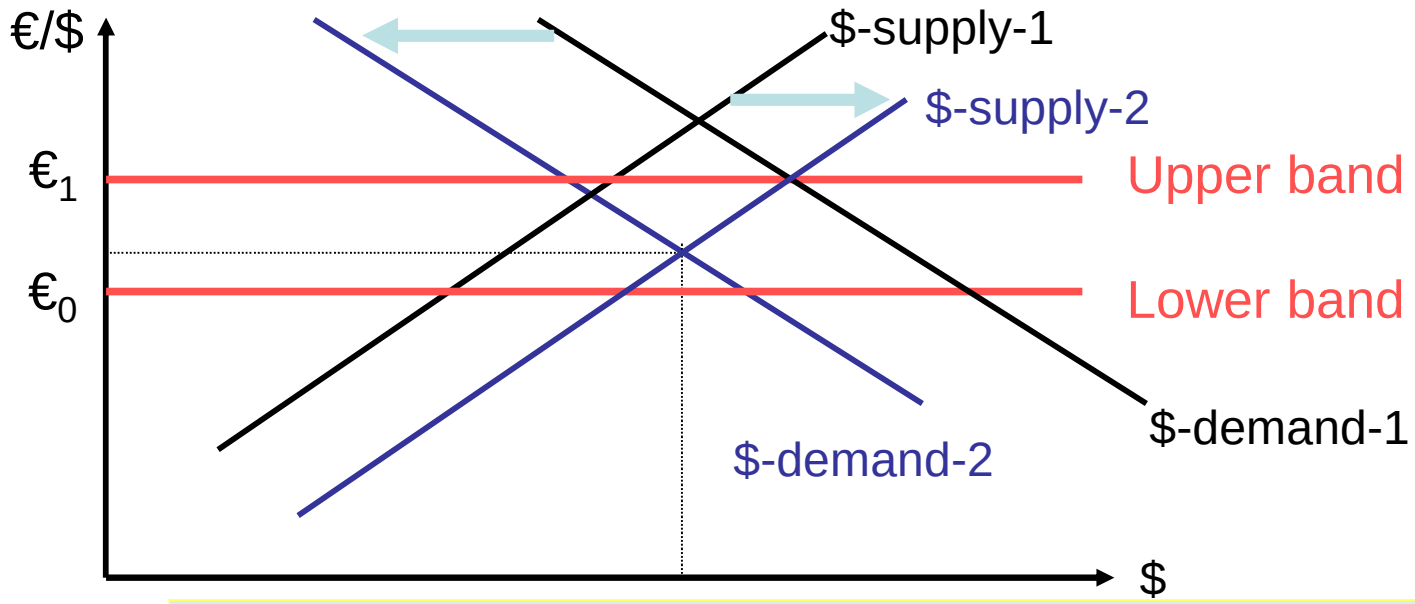
→ Maybe there is an expectations‘ effect:
- sterilisied interventions as a „signal“ of the central bank/government
- Problem: credibility

→ Other effects: existing but probably not very relevant

Exchange rate sytems

Fixing x-rates with the help of interest rate policy

Instead of buying and selling other currencies in order to maintain a certain x-rate, central banks can also use interest rate changes. An example:
With the initial equilibrium outside the band, the central bank would have to intervene. But it could also raise interest rates.



Situation 1: excess demand for USD
The ECB increases interest rates to reduce capital exports and thus the demand for USD and to increase capital imports and thus the supply of USD.

Exchange rate sytems

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Fixing x-rates with the help of interest rate policy

- A central banks does not need reserves to defend a fixed x-rate.
- Precondition for the working of interest rate policy:
  - Trust into the stability of the x-rate
  - If there is trust, small interest rate changes trigger large capital flows.
- So, are reserves important in situations with little trust?
  - Maybe large reserves help central banks to maintain confidence in difficult times.
  - But: Experience has shown that even large reserves can melt away in a few days.

Exchange rate sytems

Fixed x-rates: a clarification

In systems of fixed x-rates the nominal x-rate is fixed – not the real x-rate.

Thus, in systems of fixed x-rates as well as in systems of flexible x-rates, there can be changes of real x-rates!

Remember the definition of the real x-rate:

$$z = w \, (P^* / P)$$

There can be real x-rate changes due to:

→ Changes of w for constant P* / P

→ Changes of P* / P for constant w ← the case of fixed x-rates

Let‘s look at European Monetary Union – an extreme case of fixed x-rates. Even in this case, there can be real x-rate changes!

Exchange rate sytems

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Fixing the nominal rate does not imply that the real rate is fixed!

Inflation rates in EMU.

	Belgien	Deutschland	Irland	Griechenlan
1997	1,5	1,5	1,3	5,4
1998	0,9	0,6	2,1	4,5
1999	1,1	0,6	2,5	2,1
2000	2,7	1,4	5,3	2,9
2001	2,4	1,9	4,0	3,7
2002	1,6	1,4	4,7	3,9
2003	1,5	1,0	4,0	3,4
2004	1,9	1,8	2,3	3,0
2005	2,5	1,9	2,2	3,5
2006	2,3	1,8	2,7	3,3
2007	1,8	2,3	2,9	3,0
2008	4,5	2,8	3,1	4,2
2009	0,0	0,2	-1,7	1,3
2010	2,3	1,2	-1,6	4,7
2011	3,4	2,5	1,2	3,1
2012	2,6	2,1	1,9	1,0
2013	1,2	1,6	0,5	-0,9
2014	0,5	0,8	0,3	-1,4

Problems to solve.

We have here a table with inflation rates in 4 countries of the eurozone. Obviously, for eurozone countries there are no nominal x-rate changes. But what about real x-rates?

Exchange rate sytems

Comparing the adjustment mechanisms

No matter whether nominal x-rates are fixed or flexible, there will always be changes in supply and demand in the fx market. In such cases, there are real x-rate changes and the economy has to adjust.

The two systems differ in how adjustment is brought about:

Flexible x-rates: via change of the nominal x-rate

Fixed x-rates: via changes of reserves and the supply of money

What is better? Fixed or flexible x-rates?

This is still a controvercial issue.

When analysing this question, a number of important issues have to be taken into account.

Exchange rate sytems

A famous economist has a clear answer

Milton Friedman:

“The argument for a flexible exchange rate is, strange to say, very nearly identical with the argument for daylight savings time. Isn't it absurd to change the clock in summer when exactly the same result could be achieved by having each individual change his habits? All that is required is that everyone decide to come to his office an hour earlier, have lunch an hour earlier, etc. But obviously it is much simpler to change the clock that guides all than to have each individual separately change his pattern of reaction to the clock, even though all want to do so. The situation is exactly the same in the exchange market. It is far simpler to allow one price to change, namely, the price of foreign exchange, than to rely upon changes in the multitude of prices that together constitute the internal price structure.”

[Milton Friedman (1953): The Case for Flexible Exchange Rates, in: ders. , Essays in Positive Economics, Chicago: University of Chicago Press, 157-203]

Exchange rate sytems

Friedman: x-rates as automatic stabilisers

Summarising Friedman:

"It is far simpler to allow one price to change, namely, the price of foreign exchange, than to rely upon changes in the multitude of prices that together constitute the internal price structure."

Friedman's argument has found its way into the literature where flexible x-rates are also referred to as **„automatic stabilisers"**

- Flexible x-rates

  Negative shocks (i.e. demand for domestic goods declines) can be absorbed via depreciations of the x-rate. Prices expressed in domestic currency do not have to change.

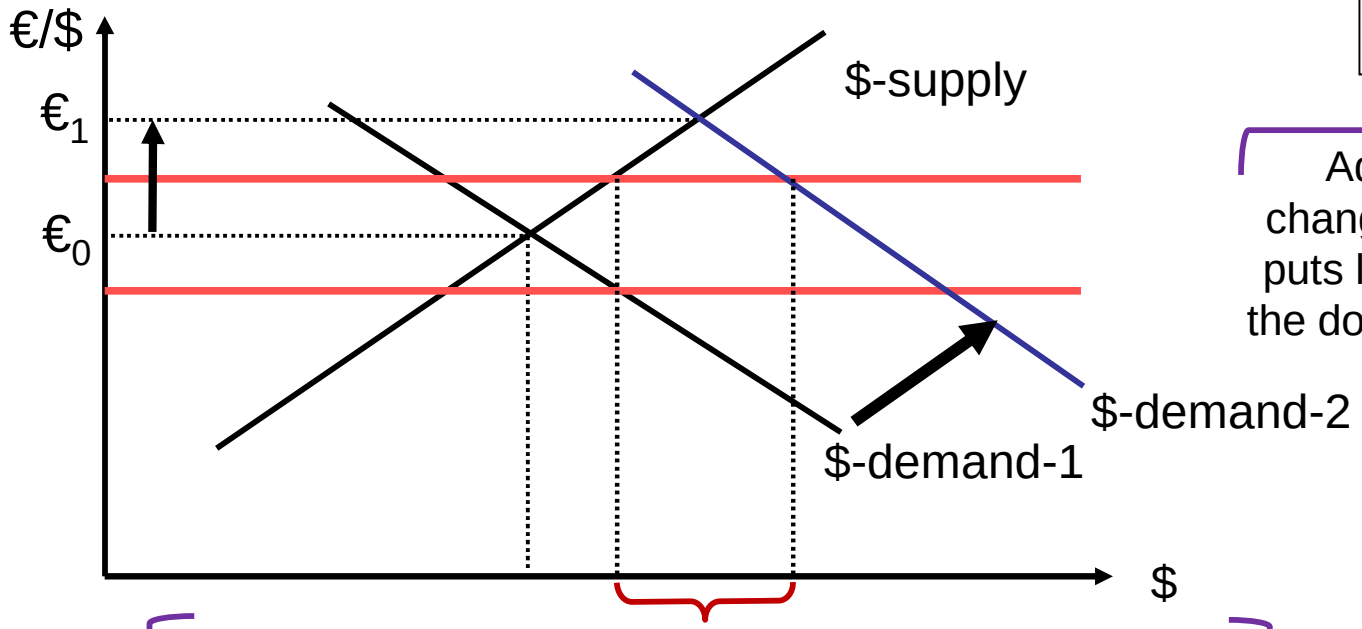
- Fixed x-rates

  A negative shock such as a decline of the demand for domestic goods must be absorbed via a change of prices. Many domestic prices (and wages!) have to decline. If prices are sticky, stagnation and unemployment can be the consequences.

Exchange rate sytems

X-rates as automatic stabilisers

Assumption: a negative shock: the $-demand increases



Flexible x-rates

Adjustment via changes of the x-rate puts less pressure on the domestic economy.

Fixed x-rates

Excess demand for US$ = excess supply of EUR

→ Intervention: Sale of USD
Reduction of the money supply
Pressure on wages and prices

During adjustment there may be **low growth** and **high unemployment**.

Eventually, equilibrium is restored within the band. But that takes time!

Exchange rate sytems

X-rates as automatic stabilisers

Flexible x-rates can serve as automatic stabilisers. **This is particularly important, if countries differ**. If one country produces agricultural products and another machinery, there may be many factors making x-rate changes necessary. Suppose, the demand for machines rises relative to the demand for agricultural products. In this case, a depreciation of the currency of the agricultural producer would make adjustment easier.

If, on the other hand, two **countries are very similar, there is little need for x-rate changes between the two.** For instance, if two countries are both important producers of cars and there is a decline in demand for cars, both need to depreciate against the rest of the world. But there is no need for an x-rate change between the two. Thus, giving up the automatic stabiliser would not be a big burden.

Exchange rate sytems

An element of asymmetry

Fixed x-rates often contain an **element of asymmetry.**

For instance:

In the post-world war 2 period, most currencies were tied to the USD. The US could basically pursue ist own monetary policy and the other countries had to follow.* Even today, quite a few currencies in the world are tied to the US-Dollar. The countries in question have **committed themselves to do everything to keep the x-rate stable**. Hong Kong is an example we have seen already. In all of these cases, the central bank of the US, the Federal Reserve Bank, is **committed to nothing**. It can pursue ist monetary policy based on domestic policy goals like low inflation and high employment **in the US**.

Even systems that are supposed to be symmetric, like the **European Monetary System (EMS)**, have in fact one currency that functions as **„anchor“** (in the EMS it was the D-Mark). The central bank of such an anchor currency can pursue ist own policy goals and the others have to follow.

*: The USD was tied to gold. But this constraint had been increasingly ignored.

Exchange rate sytems

An element of asymmetry

- Fixed x-rates
  - There is always an „anchor currency“
  - The central bank of the anchor currency is not (or only to a limited extent) constrained by the x-rate regime
  - In the System of Bretton Woods: The US determined monetary policy in all member states
  - EMS: The Bundesbank determined monetary policy
- Flexible x-rates
  - Almost no asymmetries

This is an important issue when we discuss the implications for monetary policy.

What is said in the discussion below, does not apply to anchor currencies.

Exchange rate sytems

Autonomy of monetary policy

The choice of an x-rate regime has strong implications for monetary policy:

- Fixed x-rates
  - The first task of monetary policy is to keep the x-rate stable
  - Therefore, autonomous monetary policy is impossible
  - The central bank does not control the inflation rate
  - Frequently, capital controls as a „side effect“
- Flexible x-rates
  - The central bank does not have to intervene
  - Monetary policy can be used to stabilize the economy
  - No „import“ of inflation or deflation. A central bank can pursue its own inflation targe.
  - No need for trade restrictions and capital controls

Important
„Autonomy“ does not mean that flexible x-rates completely insulate a country from foreign shocks.

Exchange rate sytems

Autonomy of monetary policy

When fixed x-rates are a burden

- Imported inflation

After World War II, there existed a system of fixed x-rates with the USD as anchor (the System of Bretton Woods). It lasted until the early 1970s. This system came under stress when US monetary policy became expansionary in the 1960s. Countries like Switzerland or Germany would have preferred low inflation. But an expansionary policy of the US caused the USD-supply to increase. Other central banks had to buy USD in order to keep the x-rates stable. In this way, they had to increase the domestic money supply. Thus, they „imported“ US monetary policy.

- Restrictive policy when you do not need it

We have seen already how in 1992 interest rates in European countries spiked. What was the reason? After German unification and the introduction of the D-Mark in Eastern Germany, the Bundesbank feared an overheating of the German economy. As a consequence, the Bundesbank raised interest rates. All the other countries that were part of the EMS had to follow. But many of these countries were in a situation requiring constant or even lower interest rates.

Exchange rate sytems

Discipline for monetary and fiscal policy

It can be very important for a country to have policy autonomy with respect to monetray policy.

But **monetary policy autonomy is a double-edged sword**. It can be used effectively but **it can also be mis-used**, leading to high inflation and uncertain monetary conditions. Time and again, governments have used the printing press to finance spending.

If a country with **chaotic monetary policy** wants to pursue a more stable policy it often has to confront the **problem that it lacks credibility**. In such a sitaution, various countries have opted for a system of fixed x-rates. For instance, after a period of hyper-inflation Argentina opted to tie ist currency to the USD.

Credibility may also be a problem in countries with **relatively new political institutions**. An example would be the young democracies of Eastern Europe after the fall of the iron curtain. The Baltic states, for instance opted for fixed x-rates, tying their currencies to the USD or the D-Mark.

Exchange rate sytems

Discipline for monetary and fiscal policy

Discipline for monetary policy

- Flexible x-rates
  - No constraining effect
  - Danger of inflationary monetary policy
- Fixed x-rates
  - Monetary policy determined by the balance of payments
  - Stability depends on the anchor currency

The Currency Board: A particularly strict form of fixed x-rates

The domestic currency is backed 100% by the reserve currency. This system has been adopted by some countries which were particularly interested in gaining credibility via introduction of fixed x-rates.

Examples: Argentina (now flexible x-rates)
Hong Kong
Estonia (now part of the Eurozone)

Exchange rate sytems

Impediments for foreign trade

We have already seen that a flexible x-rate can move around quite a lot. **X-rates are volatile**. Such **volatility can separate markets** to some extent.

Suppose a German machine maker finds that, *at the prevailing €/$ x-rate*, **some parts can be purchased more cheaply in the US.** So, he could consider buying some inputs in the US. But the x-rate may quickly change with the effect of making US products more expensive.

Of course, there are **ways to hedge** against x-rate changes. But the use of **hedging instruments entails costs**. Therefore, **a relatively large price difference may be necessary** to prompt the machine maker to direct some of his purchases towards suppliers from the $-zone.

That is precisely what „seperation of markets“ means in this context. The **law of one price does not work as smoothly** as in a situation without x-rate risk.

In fact, empirical analysis shows that under fixed x-rates markets are more integrated than under flexible x-rates.

Exchange rate sytems

Impediments for foreign trade

We have seen that fixed x-rates can foster market integration an increase international trade. So, in this respect, fixed x-rates perform better than flexible x-rates.

However, this argument has to be taken with a grain of salt.

An „ideal“ perfectly credible fixed x-rate can indeed be beneficial for international economic integration.

But very often, systems of fixed x-rates are not fully credible. They often have to be adjusted and sometimes they have been breaking down alltogether.

Repeatedly, there have been x-rate crises. We have briely looked at one of such crises, the EMS crisis. This crisis was accompnaied by substantial market turbulence and extremely high interest rates. Such developments also come at a cost.

The certainty provided by fixed x-rates is only a partial one. It is subject to political interference and market tests (also known as „destabilising speculation“).

Exchange rate sytems

Summary of the pros and cons:

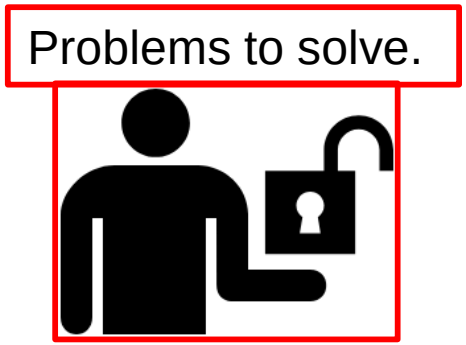
- Flexible x-rates act as automatic stabiliser.
- Flexible x-rates allow for monetary policy autonomy.
- Fixed x-rate may help to gain credibility.
- Fixed x-rate promote international trade.
- There is often an asymmetry in fixed x-rate systems

On top, it should be taken into account that maintaining a system of fixed x-rates is challenging

- Fixed rate systems have broken down time and again.
- Often, such break downs were accompanied by currency crises.
- Flexible x-rate cannot „break down“.
- Flexible x-rates are a kind of „system of last resort“.

Exchange rate sytems

Give a brief overview of the pros and cons of fixed and flexible x-rate systems.



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Appendix

Covered Interest Parity (CIP)

Supplementary reading: Ch. 23 of Feenstra/Taylor.

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Arbitrage

Definition:
Trading strategies that exploit profit opportunities arising from price differences.

Arbitrage does not involve risk-taking.*

"Arbitrage" can be divided into:

- **One-way arbitrage**: for sellers: "sell high"; for buyers: "buy low"
- **Two-way arbitrage**: "buy low, sell high."
  (Both transactions at the same time.)

The absence of arbitrage possibilities is also often treated as an equilibrium condition. As long as profitable arbitrage is possible, the market is said to be in dis-equilibrium.

*: Unfortunately, the term is sometimes used for transactions that involve certain risks. For instance, Feenstra/Taylor use the term "risky arbitrage". In this lecture, we will use the term "speculation" if risks are involved. See below.

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Arbitrage and interest rates

In Ch. 2.2 we got to know forward transactions.

Forward transactions allow you to buy or sell foreign currency at some future date at a price that is fixed already today.
Look at a German exporter for example. He knows he will be paid 100,000 USD on September 15, 2021.
If he wants to avoid x-rate risk, he can sell 100,000 USD already today in the forward market. The counterparty in such a deal would usually be a bank, say Commerzbank.

Period	**Company**	**Commerzbank**
today	makes contract with bank specifying date, amount and forward rate (say 0.94 €/$)	- makes contract with company specifying date, amount and forward rate (say 0.94 €/$)
15 Sep. 2021	delivers 100,000 USD to Commerzbank	delivers 94,000 EUR to the company

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Arbitrage and interest rates

Forward transactions can be very useful to reduce risk.*

They allow someone to sell something she does not yet have

or

to buy something today without paying for it.

All the important things of the transaction (price, quantity and date) are fixed today, but the actual exchange takes place in the future.

The price that is agreed in a forward transaction is **the forward rate.**

In the following, we will use the letter "w" to denote the spot rate and "w^t" to denote the forward rate. For both we will use the price notation [EUR/USD]. (Note that Feenstra and Taylor are also using the price notation. But since their home country is the US, for them it is [USD/EUR])

*: Forward transactions can also be found in other markets, for instance in commodity markets.

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Arbitrage and interest rates

Forward transactions and international interest arbitrage

Example: A German company ("A") owns 1 million EUR and wants to invest this amount for 3 months. It does not want to take any risks because it will need the money after 3 months.

What can it do?

- Option 1:

Invest the amount in the German "money market".*
In this case it will earn the interest rate for short-term loans in EUR.

- Option 2:

Assume that interest rates are higher in the US.
So, it would be nice to invest the amount in the US money market.
The problem is that, over a week, the x-rate may move against the USD. So an investment in the US implies x-rate risk.
But: Company A could use the forward market to eliminate the risk.

What does company A have to do in order eliminate x-rate risk?

*: The „money market" is a market for short-term lending and borrowing between banks, large corporations and public institutions.

Arbitrage and interest rates

Forward transactions and international interest arbitrage

If company A wants to invest its fund in the US money market it needs to carry out the following transactions:

- buy USD with its 1 million EUR (at the x-rate w)

  ⇒ the USD equivalent of 1 million €: $\frac{€1m}{w\left[\frac{€}{\$}\right]}$

- invest the USD at the current interest rate

  ⇒ the USD amount received after 3 months: $\frac{€1m}{w\left[\frac{€}{\$}\right]} \cdot (1 + i_{\$})$

- sell USD in the forward market

  ⇒ the EUR amount received after 3 months: $\frac{€1m}{w\left[\frac{€}{\$}\right]} \cdot (1 + i_{\$}) \cdot w^{t}\left[\frac{€}{\$}\right]$

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Arbitrage and interest rates

Forward transactions and international interest arbitrage

Suppose the spot rate is 0.95 [EUR/USD], the forward rate is 0.94 [EUR/USD], and the US interest rate is 6%.

⇒ What is the EUR amount company A receives after 3 months?

Answer: It is equal to 1,004,316 EUR.

Suppose the EUR interest rate is 2%.

⇒ What is the EUR amount company A receives after 3 months?

3 months is equal to 1/4 of a year. So the interest paid out is equal to 0.5%. Thus, principle plus interest is equal to 1,005,000 EUR.

A comparison of options 1 and 2 shows that the investment in the German money market is slightly better – although US interest rates are higher.

1. Can you explain why the low-interest investment is better in the case above?
2. What does this result imply for US companies with short-term lending needs?

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Arbitrage and interest rates

Forward transactions and international interest arbitrage

1. Can you explain why the low-interest investment is better in the case above?

Investment at home (Option 1)

1 million EUR becomes $€1m \cdot (1 + i_€)$

Investment in the US (Option 2)

1 million EUR becomes $€1m \cdot (1 + i_\$) \cdot \frac{w^t}{w}$

If the forward rate and the spot rate are not equal, there is an fx gain or fx loss. For $w^t < w$ there is a loss. Company A is buying USD at a higher price than it is selling USD. In the example above, the US has a higher interest rate. But due to the fx loss, it is still better for company A to invest at home.

2. What does this result imply for US companies with short-term lending needs?

For US companies, investments in Germany would imply an x-rate gain. They would buy EUR at a lower price than they would be selling EUR. Even with higher US interest rates, it would be better to invest in Germany.

Problems to solve.

One more for the road. ☺

A US company needs to borrow 100,000 USD for half a year. Suppose the US interest rate is 3%, the German interest rate is 6%, the spot rate is 0.95 [EUR/USD], the forward rate is 0.96 [EUR/USD].

The US company can borrow USD (option 1) or it can borrow EUR and eliminate the x-rate risk by using a forward transaction (option 2).

Which option is better?

$$\frac{w^T - w}{w} + i^* = i$$

$$\frac{1/0.96 \quad - 1/0.95}{1/0.95} + \frac{0.06}{2} <> = 0.03/2$$

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Arbitrage and interest rates

Forward transactions and international interest arbitrage

The perspective of German and US investors:

If we find that for German companies a EUR investment is better than a hedged USD investment than it is also true that for US companies a hedged EUR investment is better than a USD investment.
So**, it does not matter whether you need to hedge the EUR investment or the USD investment**. The preferred currency (the one that yields a higher riskless return) is the same.

If equation 1. is true, equation 2. is equally true.

1. $(1 + i_€) > (1 + i_\$) \cdot \frac{w^t}{w}$ return of a hedged USD investment

2. $(1 + i_€)\frac{w}{w^t} > (1 + i_\$)$ return of a hedged EUR investment

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Arbitrage and interest rates

Forward transactions and international interest arbitrage

The perspective of US and German borrowers:

If the EUR is the preferred currency for investors (US and German), the USD is the preferred currency for borrowers. Again this applies no matter whether we look at a German or US borrower.

If equation 1. is true, equation 2. is equally true.

1. $(1 + i_€) > (1 + i_\$) \cdot \frac{w^t}{w}$ cost of hedged USD borrowing

2. $(1 + i_€) \frac{w}{w^t} > (1 + i_\$)$ cost of hedged EUR borrowing

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Arbitrage forward rates and interest rates

2-way arbitrage with forward transactions and foreign borrowing/lending

We have seen that hedging USD exposure can be done in two ways.*
If these two ways yield different results, there are options for 2-way arbitrage, i.e. riskless profits.
Suppose you find that a hedged investment in the US yields a higher return than an investment in EUR.
For a borrower that implies that borrowing is cheaper in EUR.
Putting both findings together results in a marvelous profit-opportunity!

Can you spot it?

*: There are other ways which we will not discuss.

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Arbitrage and interest rates

Forward transactions and international interest arbitrage

Putting together what we have learned:

- one can invest in foreign currencies without taking fx risk
- if there is no fx risk a foreign investment is a substitute for a local investment
- if arbitrage opportunities exist, they will be used
- arbitrage leads to price changes that eliminate arbitrage opportunities

From this we can conclude:

⇒ Arbitrage will make the returns of local and hedged foreign investments equal.

$$(1 + i_{€}) = (1 + i_{\$}) \cdot \frac{w^t}{w}$$

This equation is known as „Covered Interest Parity“ (CIP)

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Covered Interest Parity (CIP) and the forward rate

CIP can be used to determine the forward rate

$$(1 + i_€) = (1 + i_\$) \cdot \frac{w^t}{w}$$

Solving for the forward rate

$$w^t = w \cdot \frac{(1 + i_€)}{(1 + i_\$)}$$

In fact, if there are no impediments to foreign borrowing and lending, this formula is used to determine the forward rate by banks who offer to undertake forward transactions with their customers.*

*: In practice, interest rates and the spot rate are used to determine the swap rate and the forward rate is calculated as swap rate plus spot rate.

Ch. 2: The x-rate and the fx market

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Covered Interest Parity (CIP) and the forward rate

Some variations

The forward rate **The forward discount/agio**

$$w^T = w \cdot \frac{(1+i)}{(1+i*)} \Leftrightarrow \frac{w^T - w}{w} = \frac{i - i*}{1+i*}$$

where *i* is the local interest rate and *i** is the foreign interest rate

Simplified version of the forward discount:

$$\frac{w^T - w}{w} = i - i^*$$

This is an approximation. But it is widely used and you can do so, as well

forward discount = interest rate difference

Problems to solve.

The spot rate is 1.2 EUR/USD
The 6 months forward rate is 1.25 EUR/USD
According to CIP, how large should the interest rate differential be? (Which interest rate should be higher?)
Use the simplified formula.

$$\frac{w^T - w}{w} = i - i^*$$

$$\frac{1.25 - 1.2}{1.2} = \frac{0.05}{1.2} = 0.042$$

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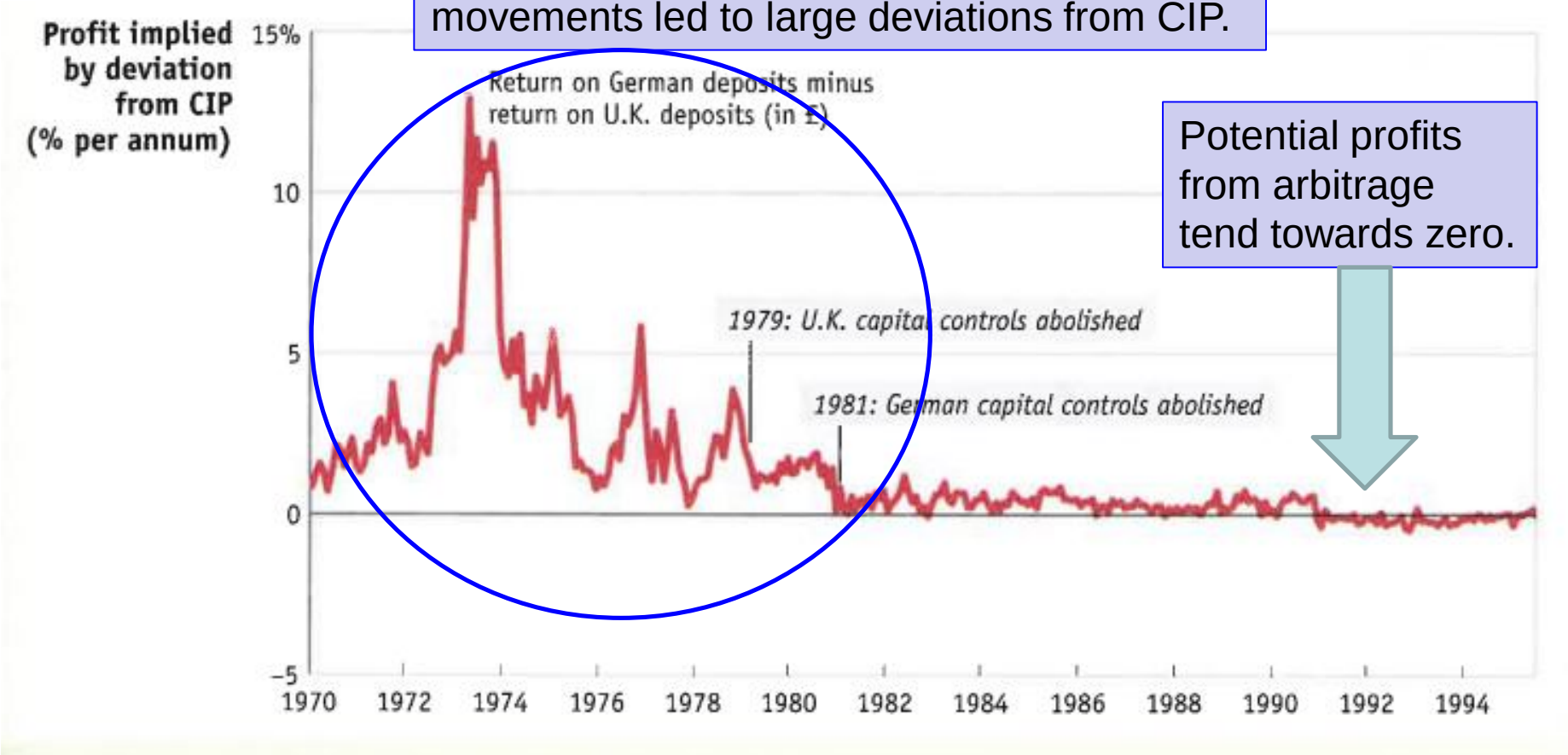
Covered Interest Parity (CIP) in practice

Restrictions of international capital movements led to large deviations from CIP.



Feenstra/Taylor, p. 473.

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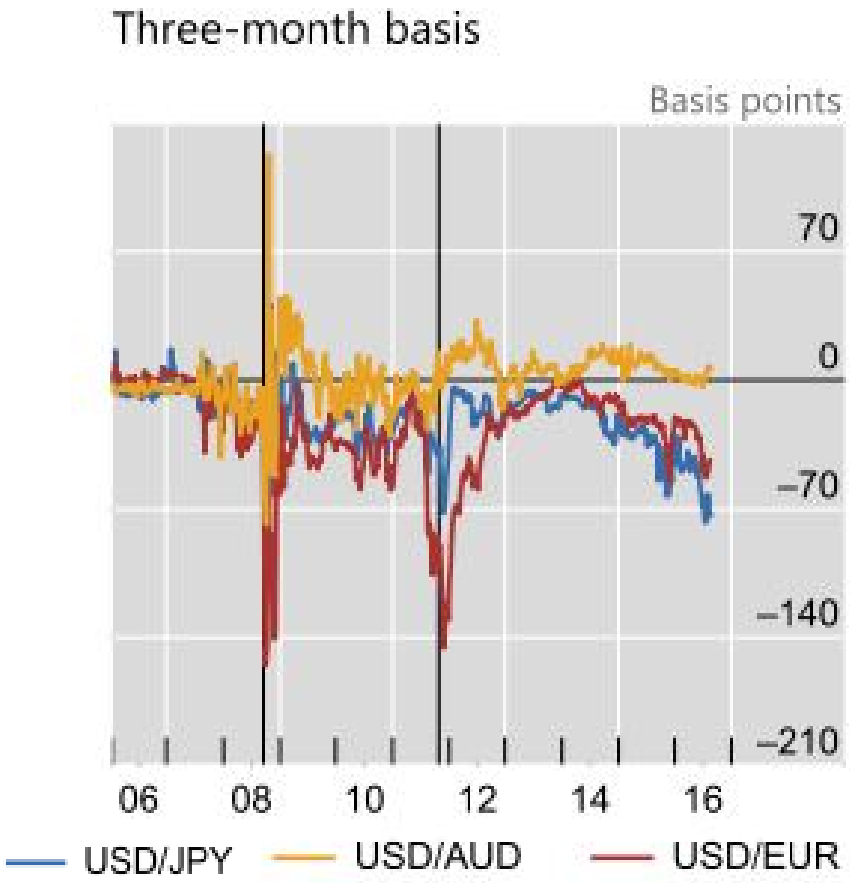
Covered Interest Parity (CIP) since Lehman

The financial crisis has caused substantial deviations from CIP.



The cross-currency basis indicates the amount by which the interest paid to borrow one currency by swapping it against another differs from the cost of directly borrowing this currency in the cash market. Thus**, a non-zero cross-currency basis indicates a violation of CIP.**

Since 2007, the basis for lending US dollars against most currencies, notably the euro and yen, has been negative: borrowing dollars through the FX swap market became more expensive than direct funding in the dollar cash market.

Covered interest parity lost: understanding the cross-currency basis, by Claudio Borio, Robert N McCauley, Patrick McGuire and Vladyslav Sushko, BIS QR, 18 September 2016, p. 45-46.