Lessons V and VI: Overview

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1. FX parity conditions
2. Do the PPP and the IRPs (CIRP and UIRP) hold in practice?

FX parity conditions

FX parity conditions

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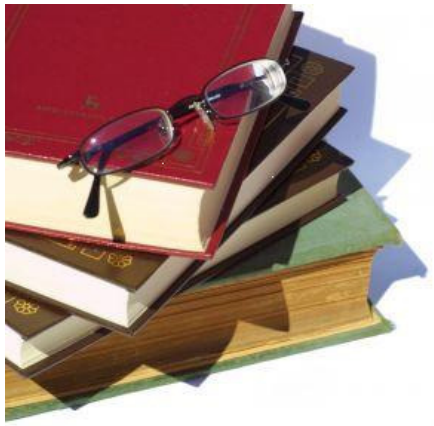
1. The Law of One Price and the Purchasing Power Parity
2. The Covered Interest Rate Parity (Lesson III)
3. The Uncovered Interest Rate Parity
4. The Fisher-open condition
5. The Forward Rate Unbiased



The usefulness of parity conditions

Parity conditions should be thought of as "**break- even values**", where the decision-maker is indifferent between two available strategies

Parity conditions rely heavily on the "**no free lunch** " principle→ violations of parities may give rise to arbitrage opportunities, that would be exploited and reabsorbed in a very short span of time.

The Law of One Price I

Ceteris paribus, the price of a product, when converted into a common currency using the spot exchange rate, is the same in every country.

$$P_{iD} = S_{(D/F)} \cdot P_{iF}$$

with i= i^{th} product

Law of One Price II

Delving with the *ceteris paribus* condition

There must be **no frictions** for the LOP to hold, meaning no legal restrictions on the movement of goods, no transportation costs and no tariffs.

The Purchasing Power Parity I

If the LOP were to hold for a certain basket of goods and services, we get the **Purchasing Power Parity** relation (in **absolute** or **static form**):

$$P_D = S(D/F) \cdot P_F$$

with P = price index of the underlying basket of goods/services

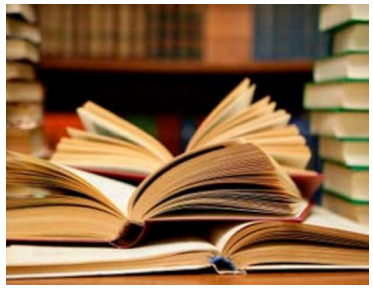
The **CIRP** applies to **financial markets**: the **PPP** can be conceived as a parallel parity condition referring to the **products market**.

The Purchasing Power Parity II

Based on the PPP condition, it must be that:

$$S_{PPP} = \frac{P_D}{P_F}$$

1. Whenever $\mathbf{S_{D/F} > S_{PPP}}$ → the **domestic currency** (D) is **undervalued/** the **foreign currency** (F) is **overvalued**;
2. Whenever $\mathbf{S_{D/F} < S_{PPP}}$ → the **domestic currency** (D) is **overvalued/** the **foreign currency** (F) is **undervalued**



The Purchasing Power Parity III

In practice, however, it is **difficult** to **test the validity** of PPP in absolute form.

Different baskets of goods are used in different countries to compute price indexes, given that tastes and needs differ on an international scale, affecting what people buy.

The Purchasing Power Parity IV

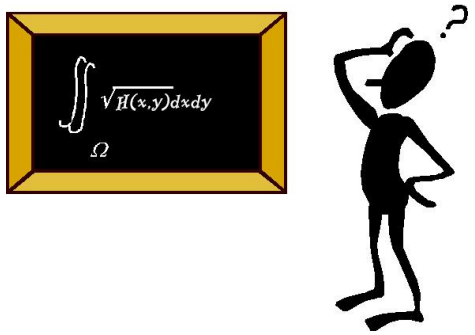
Price levels could be substituted with inflations rates

PPP in **relative** or **dynamic terms**

Dealing with algebra I

Suppose that at t_0:

$$P_D = S(D/F) \cdot P_F$$



In 1 year's time, it will be:

$$P_D(1+\Delta P_D) = S(D/F)(1+\Delta S_{D/F}) \cdot P_F(1+\Delta P_F)$$

Divide the latter by the former and get:

$$(1+\Delta P_D) = (1+\Delta S_{D/F}) \cdot (1+\Delta P_F)$$

Dealing with algebra II

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Rearranging the terms:

$$\Delta S_{D/F} = \frac{(1+\Delta P_D)}{(1+\Delta P_F)} - 1$$

Or, equivalently:

$$\Delta S_{D/F} = \frac{(\Delta P_D - \Delta P_F)}{(1+\Delta P_F)}$$

Dealing with algebra III

When inflation is low:

$$\Delta S_{D/F} \cong (\Delta P_D - \Delta P_F)$$

The exchange rate offsets inflation differentials between countries.

Terminology

From the PPP to the real FX rate

The real interest rate can be defined as:

$$q_{(D/F)} = \frac{S_{(D/F)} \cdot P_F}{P_D}$$

$q_{(D/F)}$ is a broad summary measure of the prices of one country's goods and services relative to the prices of another's.

The real exchange rate I

Consider the $/€ real FX rate

$$q_{(\$/€)} = \frac{S_{(\$/€)} \cdot P_{€}}{P_{\$}}$$

$q_{\$/€}$ can be conceived as the USD price of European products (goods and services) in terms of American products.

Real depreciation/appreciation of the USD against the EUR: fall/increase of the purchasing power of a $ within Europe's borders

The real exchange rate II

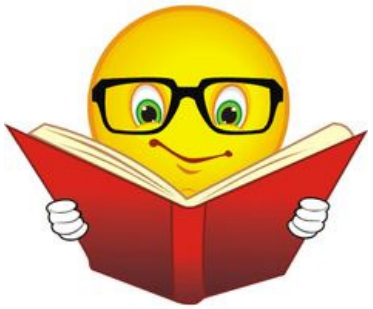
$$q_{(\$/€)} = \frac{S_{(\$/€)} \cdot P_{€}}{P_{\$}}$$

If PPP holds, the real exchange rate is perfectly **constant**.

From the CIRP to the UIRP

As long as $F({}_nD/F) = S^E(D/F)$ (assuming, as usual, risk neutrality and zero transaction costs)…

$$(1+r_D)^n = \frac{F({}_nD/F)}{S(D/F)}(1+r_F)^n$$



The UIRP

$$(1+r_D)^n = \frac{S^E({}_nD/F)}{S(D/F)}(1+r_F)^n$$

Uncovered interest rate parity: the mathematical expression is almost analogous to the one used for CIRP, apart from the fact that foreign exchange exposure is **not** covered with a forward exchange contract.

Playing with UIRP I

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By definition, it must be that:

$$S^{E}(_{D/F}) = S(_{D/F})(1+\Delta S^{E})^{n}$$

Substituting

$$(1+r_D)^n = (1+\Delta S^{E})^{n} \cdot (1+r_F)^n$$

Playing with UIRP II

Taking the n^{th}-root and multiplying yield

$$1 + r_D = 1 + \Delta S^E + \Delta S^E \cdot r_F + r_F$$

If we ignore interaction terms, we will get

$$\Delta S^E = r_D - r_F$$

Higher-yield currencies are expected to depreciate

Combining PPP and UIRP

If we combine

$$\Delta S^E = r_D - r_F$$

and

$$\Delta S^E = \Delta P^E{}_D - \Delta P^E{}_F$$

we get

$$r_D - \Delta P^E{}_D = r_F - \Delta P^E{}_F$$

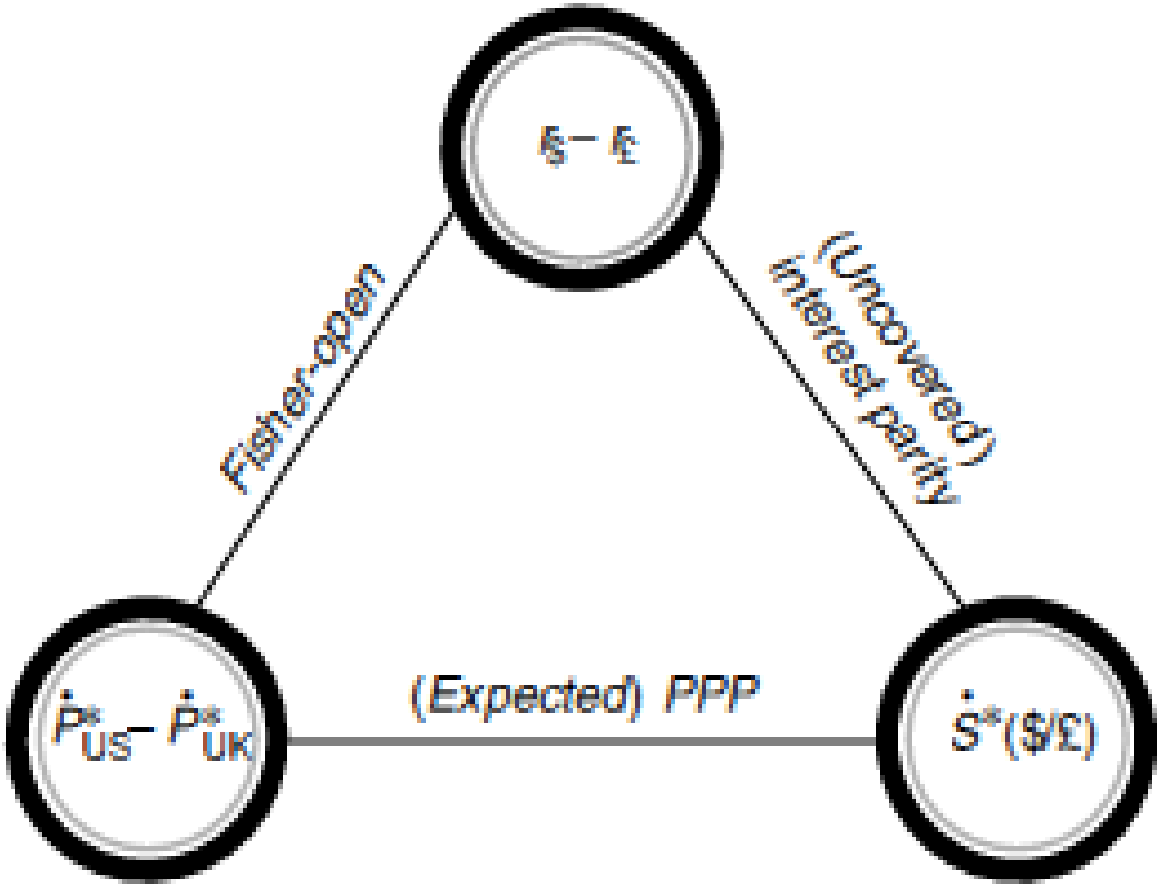
The Fisher-open condition

$$r_D - \Delta P^E{}_D = r_F - \Delta P^E{}_F$$

Fisher-open condition: real interest rates are equal in different countries.

High-yield currencies carry more **inflation risk** and tend to **depreciate** over time

UIRP, PPP and Fisher-open condition



The Fwd Rate Unbiased

If $F({}_{n}D/F) = S^{E}(D/F)$, we could infer that

$$\frac{F({}_{n}D/F) - S_t}{S_t} = \frac{S^{E}(D/F) - S_t}{S_t}$$

Today's fwd premium/discount equals…

…the expected percentage change in the spot rate

Do the PPP and the IRPs (CIRP and UIRP) hold in practice?

Does PPP hold in practice?

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Testing the validity of PPP may be troublesome as a consequence of:

1. **Different baskets of goods** underlying the price index;
2. **Non tradable goods**;
3. **Transaction costs** (quotas, tariffs, duties);
4. **Different** consumers' preferences = Different **price indexes' weighting schemes**;
5. **Oligopolistic markets**

Statistical evidence I

The emerging empirical evidence suggests that:

- **PPP performs poorly** in the **short run**;
- Prices seem to revert to their PPP levels in the long run→ **mean reverting processes**;
- The **speed of adjustment** towards the PPP level is a **positive function of the size of the deviation**;
- **PPP deviations may be permanent** if a permanent **real shock** affects one country but not the other

Statistical evidence II

High productivity gains

↓

Higher real income growth

↓

Appreciating (**non constant**) real exchange rates

↓

Deviations from PPP

Balassa-Samuelson effect I

The **Balassa-Samuelson effect** focuses on the relation between

Productivity Gains

RER Appreciations

Deviations from PPP

Balassa-Samuelson effect II

Would you be able to explain why productivity gains generally go hand in hand with RER appreciations?

Can you explain why richer countries tend to exhibit relatively higher price levels?

Does CIRP hold in practice?

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Very closely, but **not exactly** as a consequence of:

1. **Execution risk**
2. **Transaction costs** (Is it really so?...)
3. **Political risk**
4. **Tax advantages**
5. **Liquidity differences**

The CIRP and the execution risk

There might be **time lags during execution**, thus implying some extra risk→ placing orders takes time and market prices may change

This tends to create a "band" around the CIRP line

The CIRP and the transaction costs

Transaction costs do **not always** contribute to deviations from IRP

Round-trip arbitrages tend to create a "band" around the CIRP line, whilst one-way arbitrages do not (Lesson III)

The CIRP & the political risk I

Political risk involves the **uncertainty** that while **funds** are invested in a foreign country, they may be **frozen** (they cannot be repatriated), **confiscated** or even **made incovertible** into other currencies.

Investors typically require a **risk premium** from foreign investments *versus* domestic investments

The CIRP & the political risk II

Political risk creates a "band" around the CIRP line.

The band does not have to be of equal width on the two sides of the CIRP line, if one country is seen as riskier than the other.

The CIRP and tax dynamics

As long as tax rates depend on the country in which funds are borrowed/invested, the interest parity condition will be affected.

Two ways in which taxes can affect the parity condition:

1. **Withholding taxes**;
2. **Differences** between the tax rate on income ($\boldsymbol{\tau_I}$) and the tax rate on capital gains ($\boldsymbol{\tau_K}$)

Withholding tax

Withholding tax: tax applied to foreigners at the source of their earnings.

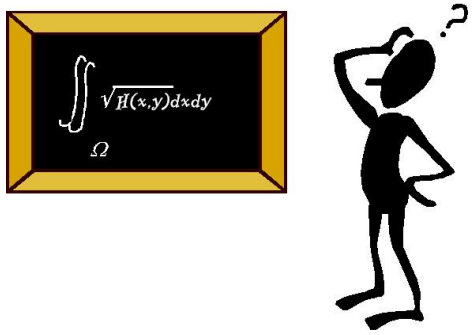
Withholding taxes are unlikely to create any "band" around the parity line **"iff"** the **rate of withholding ≤** the tax **rate** that would be **applied to the earnings at home**, since domestic withholding tax credits (purposely designed to avoid double taxation) will offset the tax withheld.

Income vs K gains taxation I

$$r_{\$} - r_{£} = \frac{1-\tau_K}{1-\tau_I} n \left[\frac{F^{\frac{1}{n}}{}_{\$/£} - S_{\$/£}}{S_{\$/£}} \right]$$

As long as $\tau_K < \tau_I$,

$$\frac{1-\tau_K}{1-\tau_I} > 1$$



Investors (borrowers) with favorable capital gains treatment will prefer investments denominated in currencies trading at a forward premium (discount)

Income vs K gains taxation II

If $\tau_{\text{Capital Gains}} \neq \tau_{\text{Interest Income}}$, the slope of the CIRP line may be affected.

After taxes, if capital gains taxes are paid on foreign exchange earnings, even when hedged, the investor will receive only **(1- $\tau_{\text{Interest Income}}$)** of the interest and **(1- $\tau_{\text{Capital Gains}}$)** of the gain from the forward premium (considered as a K gain)

The CIRP & liquidity differences I

Liquidity refers to **how easily, quickly and cheaply an asset can be converted into cash**.

Suppose the funds put in a covered foreign investments are needed earlier → the investor might incur in potential losses when monetizing the original investment

The CIRP & liquidity differences II

Liquidity preference is likely to create a **band** around the **covered interest-parity line**.

The potential width of the band due to liquidity preference depends on the likelihood that the funds will be needed earlier.

Does the CIRP hold in practice?

Empirically, the CIRP seems to hold:

- in the eurocurrency market;
- for short term lending/borrowing.

Statistical evidence on UIRP

The empirical evidence reveals that the **UIRP holds poorly** in the **short run**.

- Whenever short term interest rates are high, currencies tend to appreciate;
- "Carry trade" strategies are profitable in the short run;
- Basket carry trade strategies perform even better

Terminology

Carry trade

Trading strategy consisting in **selling** a relatively **low interest rate currency** and using the funds to **purchase** another yielding a **higher interest rate**.

Carry Trade in practice (Q_2-2012) I

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Intensifying worries about **PIIGS**:

Increasing Government bond yields

Source: Bloomberg, 10YR Govt Bond Yields

Carry Trade in practice (Q_2-2012) II

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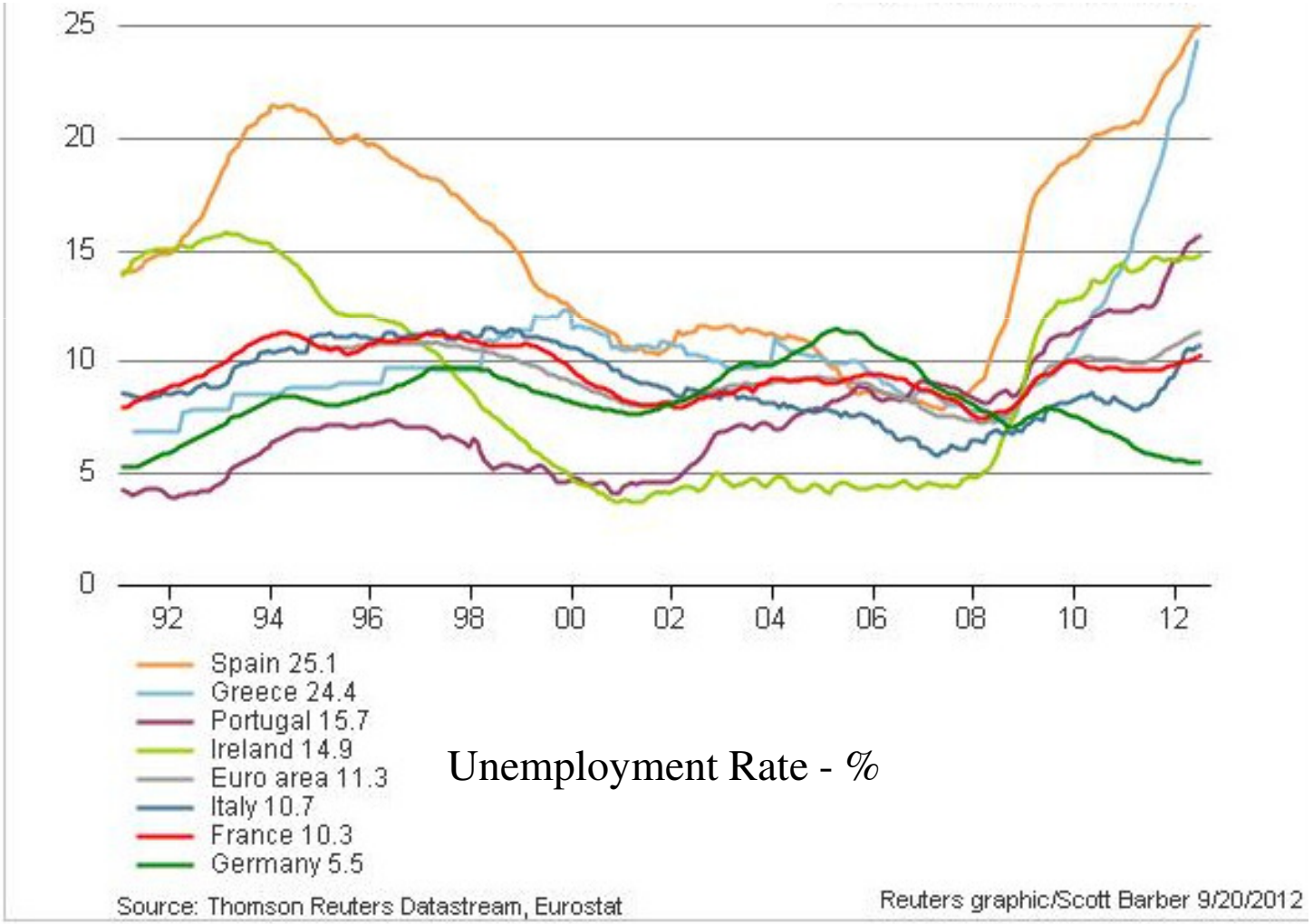
Growing unemployment rates



Carry Trade in practice (Q_2-2012) III

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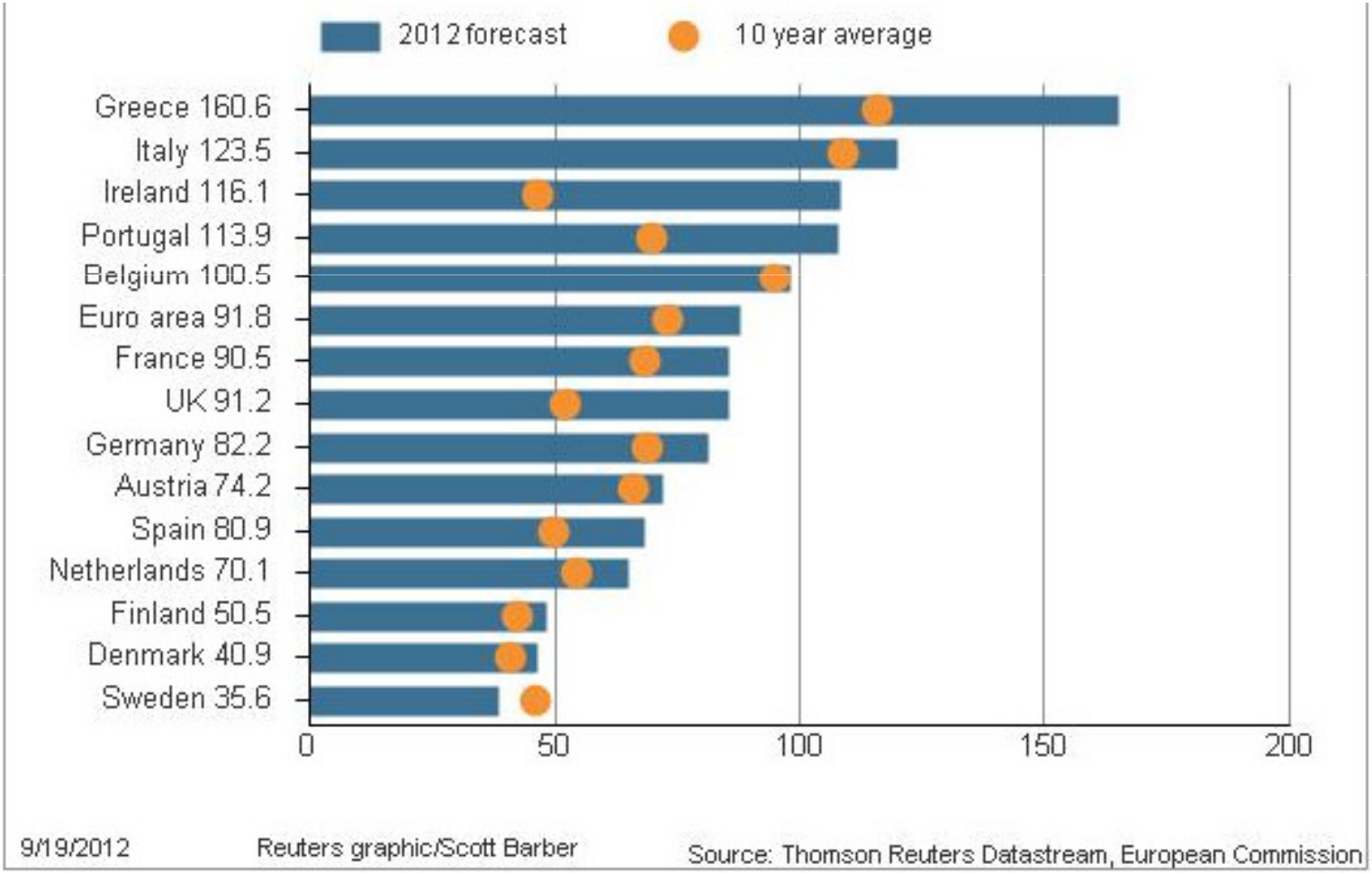
Explosive growth in DEBT/GDP ratios



Carry Trade in practice (Q_2-2012) IV

As if it were not enough…

Increasing worries about a possible Italian default

Lack of confidence in the interbank market

Increasing worries about a possible fall of the Euro

July 2012:
ECB decided to cut interest rates

Increasing worries about a disordered "GREXIT" (contagion?)

International K leaving the Eurozone

Increased segmentation in K mkts

Carry Trade in practice (Q_2-2012) V

The **Euro** started to be conceived as a **funding currency**

BORROW
€

INVEST
in higher-yielding assets
(Australian Dollar, New Zealand Dollar, Hungarian Forint, Polish Zloty, South African Rand)

Carry Trade in practice (Q_2-2012) VI

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Speculative bet against the **Euro**

26th July 2012: *"Within our mandate, the ECB is ready to do whatever it takes to preserve the Euro. And believe me, it will be enough*".

To put it into practice I

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You have been given the following information:

$r_{\$}$	$r_{£}$	$S_{(\$/£)}$	$F_{(\$/£)}$
5%	6%	1.5	1.4895

where

r$ = annual interest rate on US-dollar short term paper

r£ = annual interest on British-pound short term paper

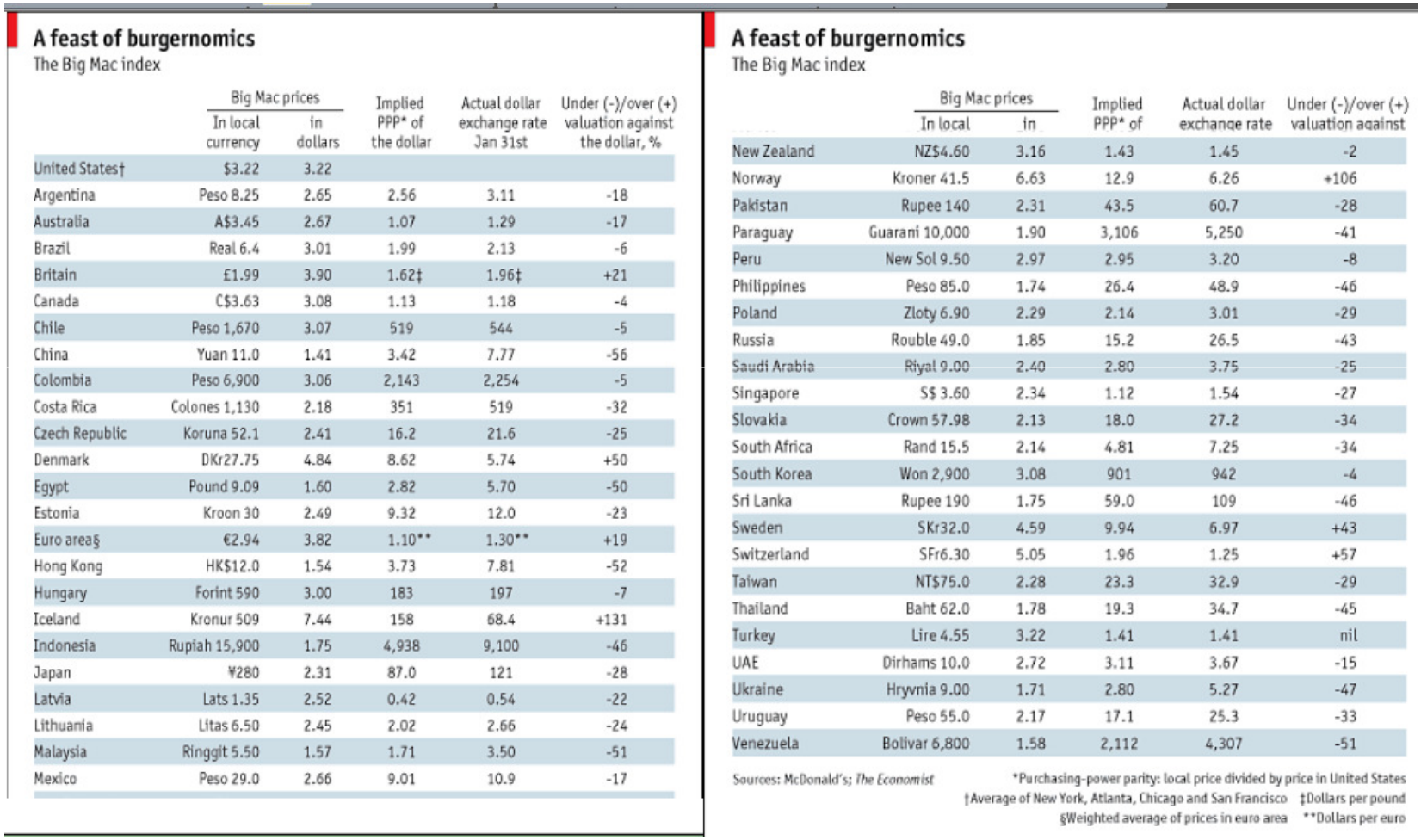
On the basis of the foregoing data:

a. In which paper would you invest?

b. In which currency would you borrow?

c. What is the profit from interest arbitrage?

To put it into practice II



A feast of burgernomics

The Big Mac index

	Big Mac prices		Implied PPP* of the dollar	Actual dollar exchange rate Jan 31st	Under (-)/over (+) valuation against the dollar, %
	In local currency	in dollars			
United States†	$3.22	3.22			
Argentina	Peso 8.25	2.65	2.56	3.11	-18
Australia	A$3.45	2.67	1.07	1.29	-17
Brazil	Real 6.4	3.01	1.99	2.13	-6
Britain	£1.99	3.90	1.62‡	1.96‡	+21
Canada	C$3.63	3.08	1.13	1.18	-4
Chile	Peso 1,670	3.07	519	544	-5
China	Yuan 11.0	1.41	3.42	7.77	-56
Colombia	Peso 6,900	3.06	2,143	2,254	-5
Costa Rica	Colones 1,130	2.18	351	519	-32
Czech Republic	Koruna 52.1	2.41	16.2	21.6	-25
Denmark	DKr27.75	4.84	8.62	5.74	+50
Egypt	Pound 9.09	1.60	2.82	5.70	-50
Estonia	Kroon 30	2.49	9.32	12.0	-23
Euro area§	€2.94	3.82	1.10**	1.30**	+19
Hong Kong	HK$12.0	1.54	3.73	7.81	-52
Hungary	Forint 590	3.00	183	197	-7
Iceland	Kronur 509	7.44	158	68.4	+131
Indonesia	Rupiah 15,900	1.75	4,938	9,100	-46
Japan	¥280	2.31	87.0	121	-28
Latvia	Lats 1.35	2.52	0.42	0.54	-22
Lithuania	Litas 6.50	2.45	2.02	2.66	-24
Malaysia	Ringgit 5.50	1.57	1.71	3.50	-51
Mexico	Peso 29.0	2.66	9.01	10.9	-17
New Zealand	NZ$4.60	3.16	1.43	1.45	-2
Norway	Kroner 41.5	6.63	12.9	6.26	+106
Pakistan	Rupee 140	2.31	43.5	60.7	-28
Paraguay	Guarani 10,000	1.90	3,106	5,250	-41
Peru	New Sol 9.50	2.97	2.95	3.20	-8
Philippines	Peso 85.0	1.74	26.4	48.9	-46
Poland	Zloty 6.90	2.29	2.14	3.01	-29
Russia	Rouble 49.0	1.85	15.2	26.5	-43
Saudi Arabia	Riyal 9.00	2.40	2.80	3.75	-25
Singapore	S$ 3.60	2.34	1.12	1.54	-27
Slovakia	Crown 57.98	2.13	18.0	27.2	-34
South Africa	Rand 15.5	2.14	4.81	7.25	-34
South Korea	Won 2,900	3.08	901	942	-4
Sri Lanka	Rupee 190	1.75	59.0	109	-46
Sweden	SKr32.0	4.59	9.94	6.97	+43
Switzerland	SFr6.30	5.05	1.96	1.25	+57
Taiwan	NT$75.0	2.28	23.3	32.9	-29
Thailand	Baht 62.0	1.78	19.3	34.7	-45
Turkey	Lire 4.55	3.22	1.41	1.41	nil
UAE	Dirhams 10.0	2.72	3.11	3.67	-15
Ukraine	Hryvnia 9.00	1.71	2.80	5.27	-47
Uruguay	Peso 55.0	2.17	17.1	25.3	-33
Venezuela	Bolivar 6,800	1.58	2,112	4,307	-51

Sources: McDonald's; *The Economist*

*Purchasing-power parity: local price divided by price in United States
†Average of New York, Atlanta, Chicago and San Francisco ‡Dollars per pound
§Weighted average of prices in euro area **Dollars per euro

To put it into practice III

Based on the LoP and considering the table above...

1. Which is the most overvalued currency? Why?
2. Which is the most undervalued currency? Why?

To put it into practice IV

Assume that the inflation rate in Brazil is expected to increase substantially.

How will this affect Brazil's nominal interest rates and the value of its currency?

If the IFE holds, how will the nominal return to U.S. investors who invest in Brazil be affected by the higher inflation in Brazil? **Justify your claims**.

To put it into practice V

Assume the following information is available for the United States and Europe:

	USA	Europe
Nominal interest rate	4%	6%
Expected inflation	2%	5%
Spot rate		USD/EUR 1.13
One-year forward rate		USD/EUR 1.10

a. Does CIRP hold?
b. According to PPP, what is the expected spot rate of the euro in one year?
c. According to the UIRP, what is the expected spot rate of the euro in one year?