

# The Foreign Exchange Market

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- Hours and liquidity

  - Open almost around the clock

  - Most liquid in the European afternoon

  - Least liquid in the West Coast evening

- Functions

  - Transfer of Purchasing Power

  - Provision of Credit: BA's, LoC's

  - Risk Management, Hedging

- Participants

  - Dealers (mostly banks); act as market makers

  - Individuals and firms conducting commercial and investment transactions

  - Speculators and arbitrageurs

  - Central Banks and Treasuries

  - F/x Brokers (facilitate trading between dealers, who remain anonymous)

- Size

  - Almost US\$ 1200 bn. per day!

# F/X Transactions and Quotations

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**Spot transaction** = current transaction, with settlement normally two business days later

**Outright forward** requires delivery at a certain future date for a price set today; usually quoted for value dates (settlement dates) of 1, 2, 3, 6, and 12 months ahead

**F/X Swaps** simultaneous spot and forward transactions or simultaneous forwards with different value dates; used to arbitrage price differences between f/x quotes and interest rates

## Quotation

European terms = €1.12/\$ (Direct quote in Europe, indirect quote in the USA)

American terms = \$0.8929/€ (Indirect quote in Europe, direct quote in the USA)

**Bid and offer quotations** are the prices that dealers are prepared to buy or sell a currency for

## Forward quotations

Outright quotation €1.115/\$

Points basis: -50 (€1.115 forward rate minus €1.12 spot rate = -50 points)

Percentage terms: -1.79% ( $[-50 \text{ points} / \text{€}1.12 \text{ spot rate}] * [360 \text{ days} / 90 \text{ days}]$ )

# Cross Rates and Arbitrage

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## Cross Rates

Korean Won	W808.80/US\$
Danish Krone	DKr5.8705/US\$
Implies	W137.7736/DKr (= W808.80 / DKr 5.8705)

## Intermarket arbitrage

**You want to buy Canadian dollars with Dutch guilders and observe**

Bank of America	Buys Dutch guilder at fl 1.9025 / US\$
Dominion Bank	Buys US\$ at C\$ 1.2646 / US\$
ABN Amro Bank	Buys Dutch guilder at fl 1.5214 / C\$
BA/Dominion cross rate = fl 1.5044 / C\$, which is lower than ABN Amro's quotation	

## Triangular arbitrage:

Sell fl1,000,000 to BA = US\$525,624  
Sell on to Dominion to buy C\$664,704  
Sell on to ABN Amro to buy fl1,011,281 for a **risk-less profit of fl11,281**

# Cross Rates and Arbitrage

Benchmark Currency Rates								
	USD	EUR	JPY	GBP	CHF	CAD	AUD	HKD
HKD	7.7504	10.2212	0.0773	11.3717	6.7117	6.3214	5.5779	
AUD	1.3895	1.8324	0.0139	2.0387	1.2033	1.1333		0.1793
CAD	1.226	1.6169	0.0122	1.7989	1.0617		0.8824	0.1582
CHF	1.1548	1.5229	0.0115	1.6943		0.9418	0.8311	0.149
GBP	0.6815	0.8988	0.0068		0.5902	0.5559	0.4905	0.0879
JPY	100.23	132.1833		147.0625	86.798	81.7503	72.1355	12.9323
EUR	0.7583		0.0076	1.1126	0.6566	0.6185	0.5457	0.0978
USD		1.3188	0.01	1.4672	0.866	0.8156	0.7197	0.129

# International Parity Conditions

## Absolute Purchasing Power Parity

Law of one Price:

$$p^{\$} * S = p^{\text{DM}} \text{ or } S^{\text{DM}/\$} = p^{\text{DM}} / p^{\$}$$

### The Big Mac Index

Country	Big Mac Price	F/X Rate	Big Mac Price	Implied PPP	Local currency under-
		<b>07.04.97</b>	<b>in \$</b>	<b>of the dollar</b>	<b>or overvaluation</b>
USA	\$ 2,42		2,42		
Argentina	Peso 2,50	1,00	2,50	1,03	3
Austria	Sch 34,00	12,00	2,82	14,00	17
China	Yuan 9,70	8,33	1,16	4,01	-52
Denmark	DKr 25,75	6,52	3,95	10,60	63
Germany	DM 4,90	1,71	2,86	2,02	18
HongKong	HK\$ 9,90	7,75	1,28	4,09	-47
Japan	Yen 294	126,00	2,34	121,00	-3
Poland	Zloty 4,30	3,10	1,39	1,78	-43
SouthKorea	Won 2300	894,00	2,57	950,00	6
Switzerland	SFr 5,90	1,47	4,02	2,44	66

# International Parity Conditions

## Relative Purchasing Power Parity

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It is unrealistic to expect prices across national borders to be equal. However, different changes in the price levels across countries should be reflected in the exchange rates: **relative PPP**.

Define:  $\text{inf}$  = inflation rate                       $P$  = Prices                       $P_1 = P_0 * (1 + \text{inf})$

$$P_1^{\$} = P_0^{\$} * (1 + \text{inf}^{\$}) \qquad P_1^{\text{€}} = P_0^{\text{€}} * (1 + \text{inf}^{\text{€}})$$

Assume that the current exchange rate has found some kind of equilibrium

$$P_0^{\text{€}} = S_0^{\text{€\$}} * P_0^{\$}$$

The new exchange rate  $S_1^{\text{€\$}}$  has to reflect the different inflation experiences

$$\begin{aligned} P_1^{\text{€}} &= S_1^{\text{€\$}} * P_1^{\$} \\ P_0^{\text{€}} * (1 + \text{inf}^{\text{€}}) &= S_1^{\text{€\$}} * P_0^{\$} * (1 + \text{inf}^{\$}) \\ S_0^{\text{€\$}} * P_0^{\$} * (1 + \text{inf}^{\text{€}}) &= S_1^{\text{€\$}} * P_0^{\$} * (1 + \text{inf}^{\$}) \\ S_1^{\text{€\$}} &= S_0^{\text{€\$}} * (1 + \text{inf}^{\text{€}}) / (1 + \text{inf}^{\$}) \end{aligned}$$

# International Parity Conditions

## Covered Interest Parity

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Define:  $i$  = interest rates

$F$  = forward exchange rate

With the help of a forward contract, market participants can lock in a certain f/x position of the following kind:

Borrow local currency for local interest rate

Convert at current exchange rate to foreign currency

Invest at foreign interest rate

Reconvert to local currency at the end of period with forward rate known today

Repay local currency debt with interest

**No arbitrage condition:** The forward rate must be valued such that this strategy yields no profits:

$$S_0^{\$/\text{€}} * (1+i^{\text{US}}) * F_1^{\text{€}\$} = (1+i^{\text{€}})$$

This implies:  $F_1^{\text{€}\$} = S_0^{\text{€}\$} * (1+i^{\text{€}}) / (1+i^{\text{US}})$

# International Parity Conditions

## Uncovered Interest Parity and International Fisher Effect

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The question is: Is the forward rate the best predictor for the future spot exchange rate?

$$F_1^{\text{€\$}} = E(S_1^{\text{€\$}})$$

If this equation holds, we speak of **uncovered interest parity**. Then, the forward rate is an *unbiased* predictor of the future spot rate.

Assume UIP and relative PPP both hold. Then:

$$S_0^{\text{€\$}} * (1+i^{\text{€}}) / (1+i^{\text{US}}) = S_0^{\text{€\$}} * (1+\text{inf}^{\text{€}}) / (1+\text{inf}^{\text{\$}})$$

or

$$(1+i^{\text{€}}) / (1+\text{inf}^{\text{€}}) = (1+i^{\text{US}}) / (1+\text{inf}^{\text{\$}})$$

hence

$$(1+r^{\text{€}}) = (1+r^{\text{US}})$$

where  $r$  is the real interest rate, i.e. the nominal rate after adjusting for inflation. The alignment of real interest rates across nations is called the **International Fisher Effect**.

# The Real Exchange Rate Index

The inflation experience and the movement of the currency's exchange rate vis-a-vis other currencies together imply the shift of the competitiveness of a nation's products relative to those of its trading partners.

The change in competitiveness is quantified with the help of the real exchange rate index:

$$RE_1^{\text{€\$}} = RE_0^{\text{€\$}} * (S_0^{\text{€\$}} / S_1^{\text{€\$}}) * ((1 + \text{inf}_e) / (1 + \text{inf}_{\text{US}}))$$

Example from the Economist, July 4<sup>th</sup> 1998:

Country	Inflation Rate	Interest Rate	Currency 1 year ago	Currency today	Real interest rate	Real exchange rate index vs US\$
Austria	1,00%	3,62%	12,30	12,8	2,62%	0,9543
Germany	1,30%	3,56%	1,75	1,82	2,26%	0,9578
Indonesia	52,00%	47,95%	2435	14500	-4,05%	0,2510
Russia	6,50%	80,00%	5,78	6	73,50%	1,0088
Turkey	91,40%	75,93%	149280	267530	-15,47%	1,0501
USA	1,70%	5,47%	1	1	3,77%	n/a

# The Real Exchange Rate Index

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Example from the Economist, November 16<sup>th</sup> 2005:

	<b>Inflation</b>	<b>Interest</b>	<b>Currency yr. ago</b>	<b>Currency today</b>	<b>Real Interest</b>	<b>RERI</b>
<b>Denmark</b>	2,00%	2,35%	5,71	6,39	0,35%	0,91
<b>Germany</b>	2,30%	2,35%	0,77	0,86	0,05%	0,91
<b>Japan</b>	-0,30%	0,02%	104	119	0,32%	0,91
<b>Indonesia</b>	17,90%	14,45%	9003	10010	-3,45%	0,80
<b>Russia</b>	11,80%	13%	28,6	28,9	1,20%	0,92
<b>USA</b>	4,30%	4,21%	1	1	-0,09%	1,00
<b>Switzerland</b>	1,30%	0,95%	1,17	1,33	-0,35%	0,91

# The Real Exchange Rate Index

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Example from the Economist, March 29<sup>th</sup>, 2006:

	<b>Inflation</b>	<b>Interest</b>	<b>Curr yr. Ago</b>	<b>Curr today</b>	<b>Real Interest</b>	<b>RERI</b>
<b>Denmark</b>	2,10%	2,80%	5,75	6,22	0,70%	0,94
<b>Germany</b>	1,90%	2,80%	0,77	0,83	0,90%	0,94
<b>Japan</b>	0,50%	0,04%	107,00	118,00	-0,46%	0,93
<b>Indonesia</b>	17,90%	13,65%	9505,00	9150,00	-4,25%	0,91
<b>Russia</b>	11,10%	12,00%	27,90	27,80	0,90%	0,94
<b>USA</b>	3,60%	4,77%	1,00	1,00	1,17%	1,00
<b>Switzerland</b>	1,40%	1,25%	1,20	1,31	-0,15%	0,94
<b>Iceland</b>	4,50%	11,25%	61,42	72,42	6,75%	0,84

# The Real Exchange Rate Index

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Example from the Economist, November 3<sup>rd</sup> 2007:

	Inflation	Interest	Curr yr. Ago	Curr today	Real Interest	RERI
Denmark	1,20%	4,80%	5,84	5,15	3,60%	1,15
Germany	2,40%	4,60%	0,78	0,69	2,20%	1,13
Japan	-0,20%	0,73%	117,00	115,00	0,93%	1,05
Indonesia	6,90%	8,09%	9103,00	9097,00	1,19%	0,96
Russia	9,50%	10,00%	26,70	24,70	0,50%	1,01
USA	2,80%	4,51%	1,00	1,00	1,71%	1,00
Switzerland	0,70%	2,75%	1,24	1,16	2,05%	1,09
Iceland	4,50%	13,75%	67,68	58,99	9,25%	1,13

# The Real Exchange Rate Index

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Example from the Economist, November 10<sup>th</sup> 2008:

	<b>Inflation</b>	<b>Interest</b>	<b>Curr yr. Ago</b>	<b>Curr today</b>	<b>Real Interest</b>	<b>RERI</b>
<b>Denmark</b>	4,20%	7,30%	5,08	5,70	3,10%	0,90
<b>Germany</b>	2,40%	4,66%	0,68	0,77	2,26%	0,90
<b>Japan</b>	-0,20%	0,64%	113,00	99,40	0,84%	1,19
<b>Indonesia</b>	11,80%	12,38%	9120,00	10900,00	0,58%	0,79
<b>Russia</b>	16,10%	11,00%	24,50	26,70	-5,10%	0,83
<b>USA</b>	4,90%	1,95%	1,00	1,00	-2,95%	1,00
<b>Switzerland</b>	2,60%	2,60%	1,13	1,16	0,00%	1,00
<b>Iceland</b>	15,90%	18,33%	59,00	128,78	2,43%	0,41

# The Real Exchange Rate Index

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Example from the Economist, April 14<sup>th</sup> 2009:

	Inflation	Interest	Curr yr. Ago	Curr today	Real Interest	RERI
Denmark	1,90%	4,50%	4,75	5,61	2,60%	0,83
Germany	0,50%	1,45%	0,64	0,75	0,95%	0,85
Japan	-0,10%	0,54%	103	101	0,64%	1,02
Indonesia	7,90%	9,27%	9195	11320	1,37%	0,75
Russia	14,00%	13,00%	23,6	33,6	-1,00%	0,62
USA	0,20%	0,50%	1	1	0,30%	1,00
Switzerland	-0,40%	0,40%	1,01	1,14	0,80%	0,89

# The \$/€ exchange rate since inception

Change from 4 January 1999 to 14 April 2009:  $\uparrow +0.1487$  (+12.61%)

Minimum (26 October 2000): 0.8252 - Maximum (15 July 2008): 1.5990



# The Yen/€exchange rate since inception

Change from 4 January 1999 to 14 April 2009:  $\downarrow -1.16$  (-0.87%)

Minimum (26 October 2000): 89.30 - Maximum (23 July 2008): 169.75



# Exchange Rate Forecasting

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Does it pay?

Efficient Markets Paradigm (*Informational* Efficiency)

Prices contain all publicly known information

Inefficient markets

Trading on publicly available information can generate profits

Fundamental analysis

BoP analysis

Asset markets (stock markets, interest rates)

Technical analysis

Why can we make money from publicly available information? **GOVERNMENTS!**

Fiscal deficits; inflation pressures; desire to maintain “stable” value of currency