Nominal exchange rate

- The nominal exchange rate between two currencies is the price of one currency in terms of the other. The nominal exchange rate (or, simply, exchange rate) will be denoted by the letter *e*.

- If e = 2 \$/€, then one euro can be traded for two dollars: the price in dollars of 1 euro is 2 dollars.

- The inverse e' = ½ €/\$ of e = 2 \$/€ shows how many euros can be traded for one dollar: the price in euros of 1 dollar is 0’5 euros. Accordingly, both e and e' express the same information.

Quotations

- The direct quotation of an exchange rate expresses the exchange rate as

$$\frac{\text{domestic (home) currency units}}{\text{foreign currency units}}\,.$$

- In <u>indirect quotation</u>, the exchange rate is quoted as

$$\frac{\text{foreign currency units}}{\text{domestic (home) currency units}}\,.$$

- If the euro is the home currency, $e = 2$ $/€ expresses the exchange rate using indirect quotation.

Currency appreciation

- A currency X appreciates with respect to another currency Y if the number of units of Y that one unit of X can buy is increased.
- If X appreciates with respect to Y, X becomes more valuable in terms of Y.
- Using <u>indirect</u> quotation, the home currency <u>appreciates</u> when the exchange rate <u>rises</u>.
- Using direct quotation, the home currency appreciates when the exchange rate falls.

Examples of appreciation

- In passing from e = 1 \$/€ to e' = 2 \$/€, the euro appreciates with respect to the dollar. Initially, 1 euro could be traded for only 1 dollar; after the exchange rate rises, 1 euro can be traded for 2 dollars, so the euro has increased its value.

- In passing from e = 2 €/¥ to e' = 1 €/¥, the euro appreciates with respect to the yen. Initially, 2 euros were needed to buy one yen; after the exchange rate falls, only 1 euro is required to buy a yen, so the euro has increased its value.

Currency depreciation

- A currency X depreciates with respect to another currency Y if the number of units of Y that one unit of X can buy is reduced.

- If X depreciates with respect to Y, currency X become less valuable in terms of Y.

- Using <u>indirect</u> quotation, the home currency <u>depreciates</u> when the exchange rate <u>falls</u>.

- Using direct quotation, the home currency depreciates when the exchange rate rises.

Examples of depreciation

- In passing from e = 2 \$/€ to e' = 1 \$/€, the euro depreciates with respect to the dollar. Initially, 1 euro could be traded for 2 dollars; after the exchange rate rises, 1 euro can only be traded for 1 dollar, so the euro has reduced its value.

- In passing from e = 1 €/¥ to e' = 2 €/¥, the euro depreciates with respect to the yen. Initially, 1 euro could buy 1 yen; after the exchange rate falls, 1 euro can only buy 0’5 yen, so the euro has lost value.

The currency (foreign exchange) market

- It is the market for the trading of currencies.
- It is the largest and more liquid financial market in the world (http://en.wikipedia.org/wiki/Currency_market).
- In April 2010, average daily turnover was almost 4 trillion dollars (4×10^{12} = 4,000,000,000,000 dollars). It is estimated that 70%-90% of all the transacctions are speculative.
- The main traders are banks. Inter-bank trading accounts for more of the 50% of all the transactions.

Facts about the currency market

Most traded currencies Source: Wikipedia

Currency	ISO 4217 code (Symbol)	% daily share (April 2010)
United States dollar	USD ($)	84.9%
Euro	EUR (€)	39.1%
Japanese yen	JPY (¥)	19.0%
Pound sterling	GBP (£)	12.9%
Australian dollar	AUD ($)	7.6%
Swiss franc	CHF (Fr)	6.4%
Canadian dollar	CAD ($)	5.3%
Hong Kong dollar	HKD ($)	2.4%
Swedish krona	SEK (kr)	2.2%
New Zealand dollar	NZD ($)	1.6%

Top 10 currency traders (May 2010)

Name	Market share
Deutsche Bank	18.06%
UBS AG	11.30%
Barclays Capital	11.08%
Citi	7.69%
Royal Bank of Scotland	6.50%
JPMorgan	6.35%
HSBC	4.55%
Credit Suisse	4.44%
Goldman Sachs	4.28%
Morgan Stanley	2.91%

A model of the foreign exchange market

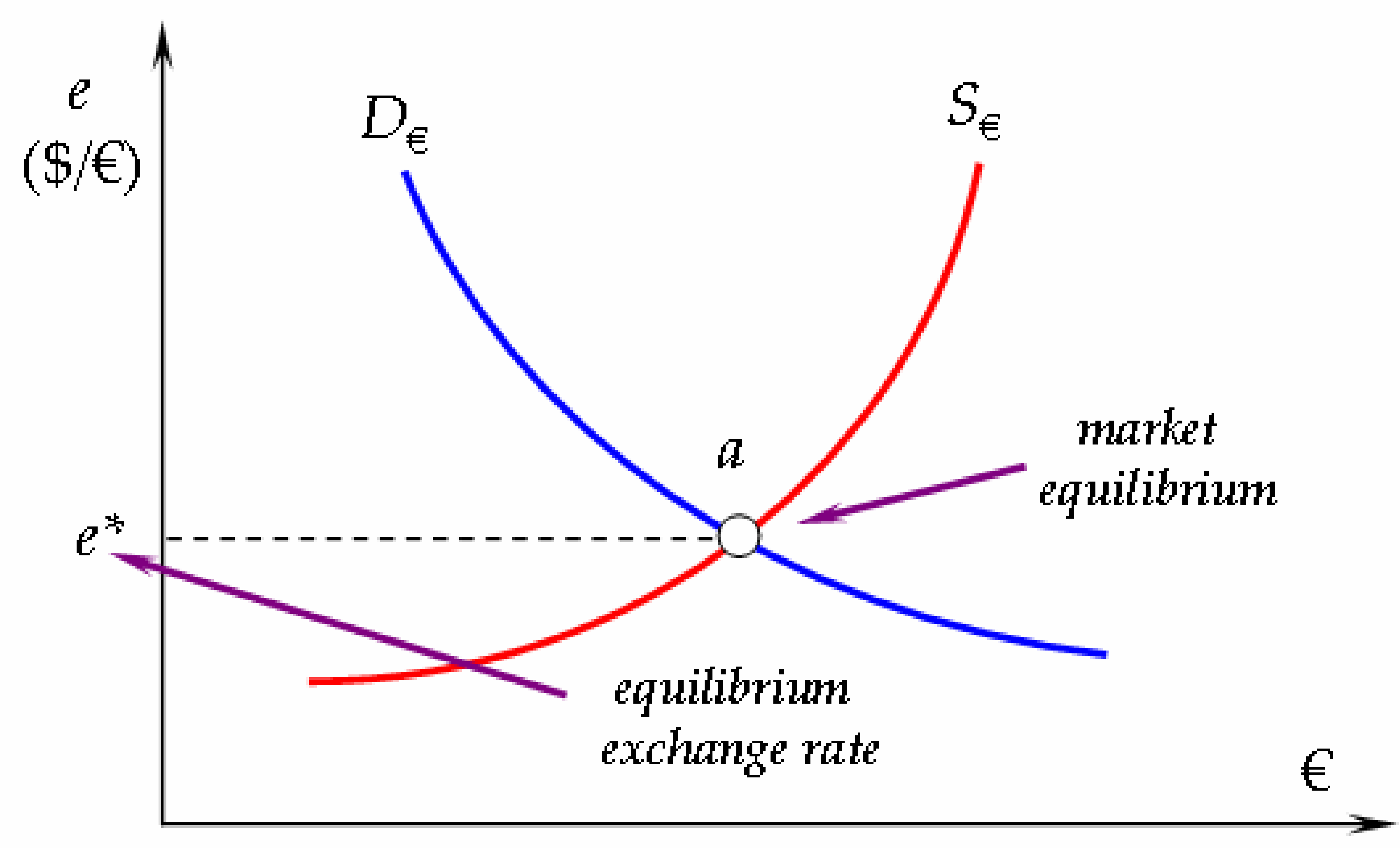
- Like the loan market, the currency market is modelled as a <u>competitive market</u>.

- In this market, the euro is the home currency and the dollar is the foreign currency.

- Quantity is the quantity of euros. Price is the exchange rate $/€ expressed in indirect quotation.

- The market demand function $D_€$ is the demand for euros and slopes downward. The upward sloping market supply function $S_€$ is the supply of euros.

Equilibrium exchange rate



Demand for euros

- The demand for euros is, at the same time, a supply of dollars.

- The agents demanding euros have dollars and want to buy European goods or financial assets.

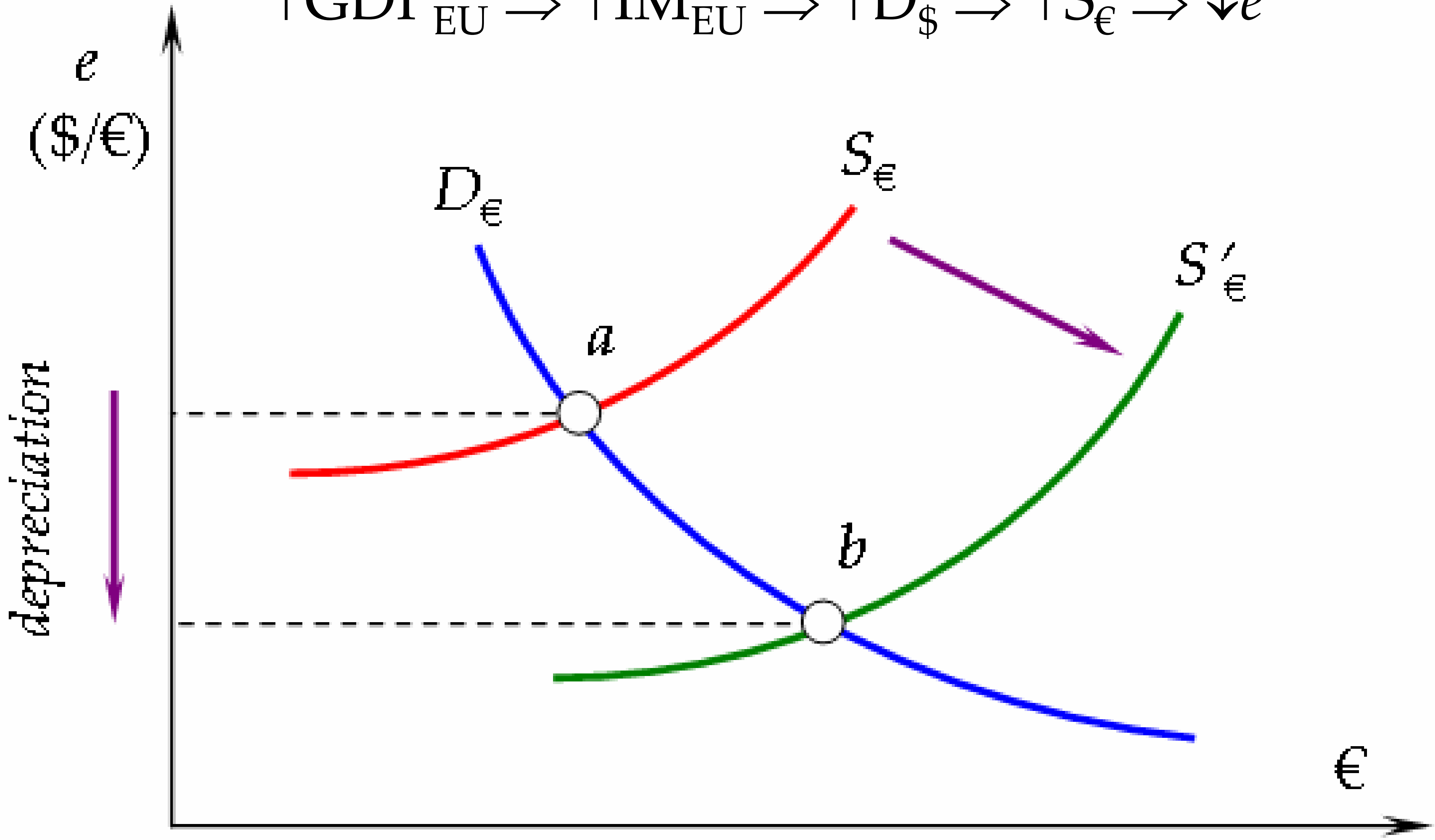
- The demand function slopes downward because a reduction in e means that fewer dollars are needed to purchase an euro. This makes European goods and financial assets comparatively cheaper. To buy more such goods and assets, more euros are demanded, so $\downarrow e \Rightarrow \uparrow$quantity demanded of €.

Supply of euros

- The supply of euros is, at the same time, a demand for dollars.
- The agents supplying euros want dollars to buy American goods or financial assets.
- The supply function slopes upward because a rise in e means that more \$ are given in exchange for one €, making American goods and financial assets comparatively cheaper. To buy more such goods and assets, more dollars are needed, so more euros are supplied. In sum, $\uparrow e \Rightarrow \uparrow$quantity supplied of €.

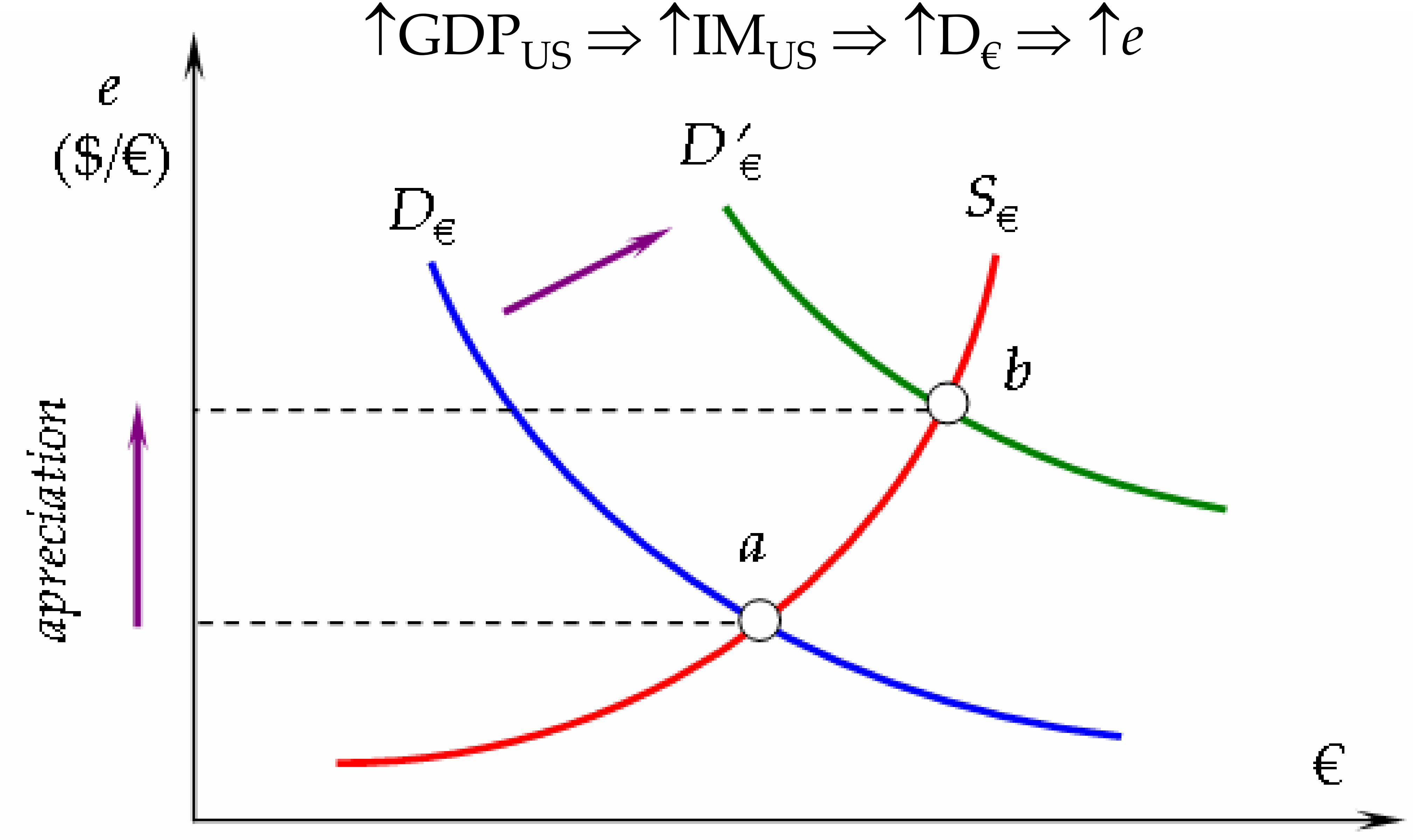
Effect of a GDP increase in Euroland

$$\uparrow \text{GDP}_{EU} \Rightarrow \uparrow \text{IM}_{EU} \Rightarrow \uparrow \text{D}_{\$} \Rightarrow \uparrow \text{S}_{€} \Rightarrow \downarrow e$$



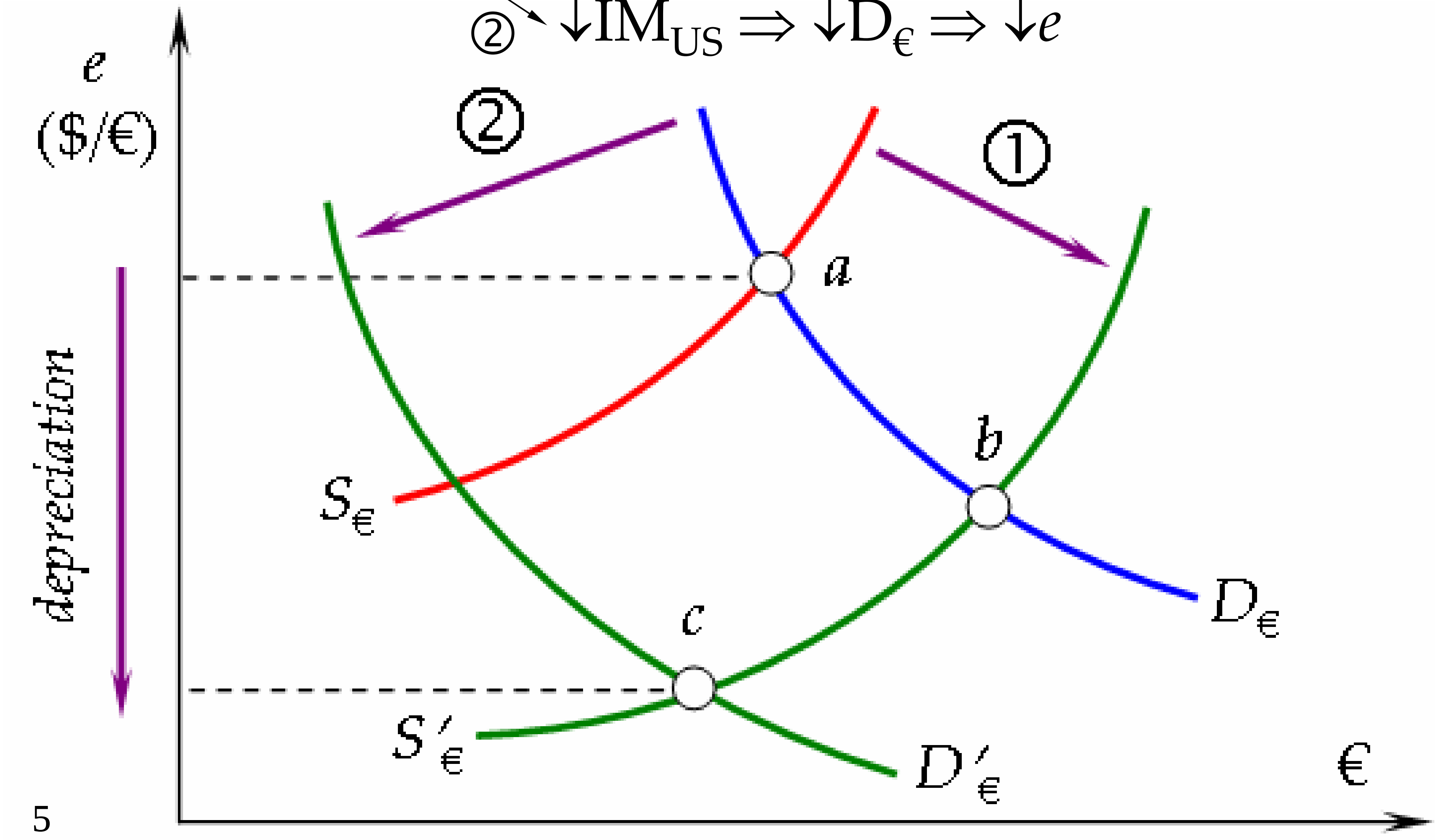
Effect of a GDP increase in the US

$\uparrow GDP_{US} \Rightarrow \uparrow IM_{US} \Rightarrow \uparrow D_{€} \Rightarrow \uparrow e$



Effect of a rise in Euroland's inflation

$$\uparrow \pi_{EU} \Rightarrow \begin{cases} ① \ \uparrow IM_{EU} \Rightarrow \uparrow D_{\$} \Rightarrow \uparrow S_{€} \Rightarrow \downarrow e \\ ② \ \downarrow IM_{US} \Rightarrow \downarrow D_{€} \Rightarrow \downarrow e \end{cases}$$

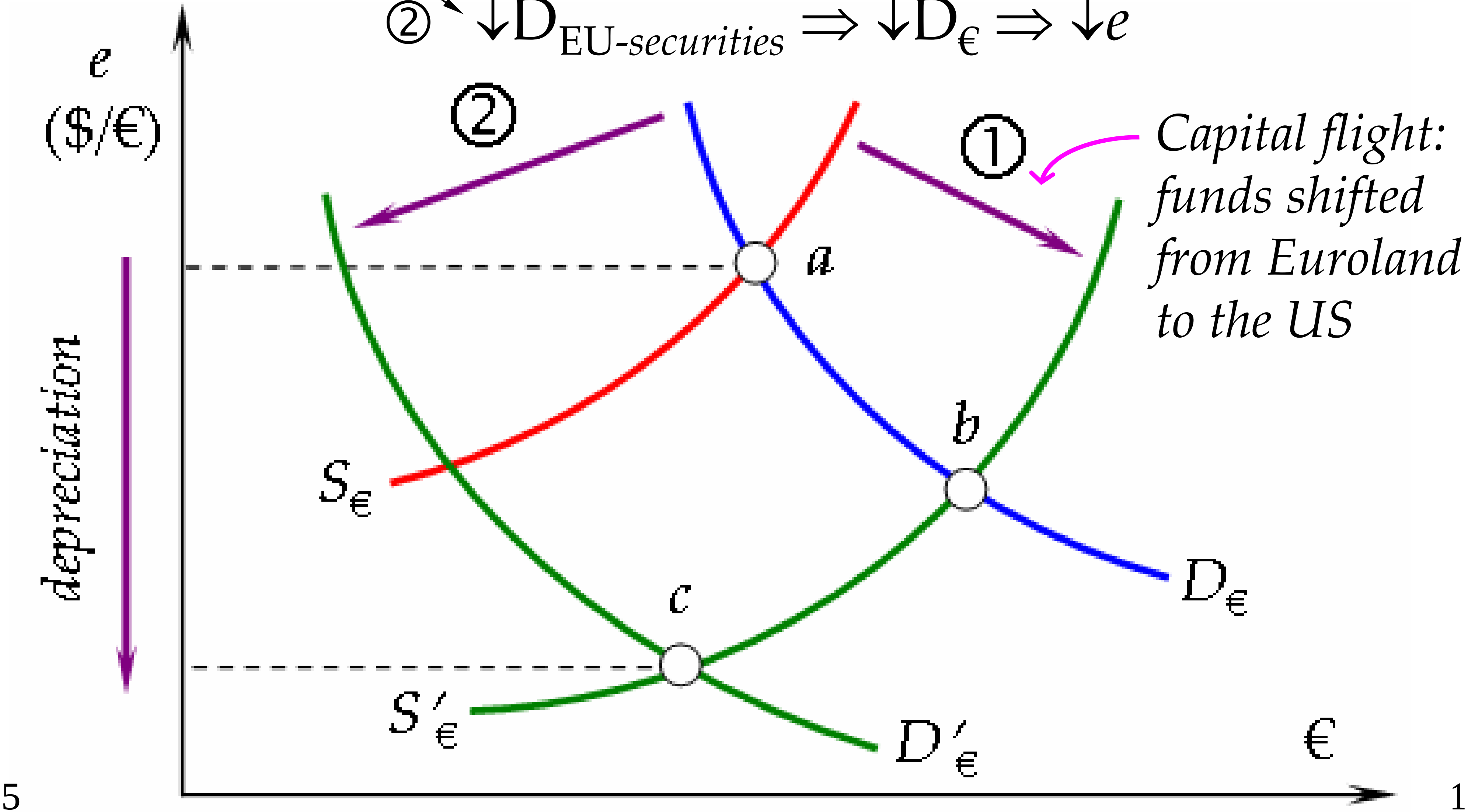


Effect of a rise in the US interest rate

$\uparrow i_{EU} \Rightarrow$

① $\uparrow D^{\text{BY EUROPEANS}}_{\text{US-}securities} \Rightarrow \uparrow D_{\$} \Rightarrow \uparrow S_{€} \Rightarrow \downarrow e$

② $\downarrow D^{\text{BY AMERICANS}}_{\text{EU-}securities} \Rightarrow \downarrow D_{€} \Rightarrow \downarrow e$



Arbitrage vs speculation

- Arbitrage refers to transactions that, taking advantage of price differences, generate a sure profit.
- Speculation is the same as arbitrage with the only different that transactions do not guarantee a sure profit: whereas a speculator is taking a risk, an arbitrageur obtains a risk-free profit.
- Almost nothing lies outside the scope of arbitration and speculation: commodities, bonds, currencies, shares, options, real estate, derivatives, futures contracts...

Spatial arbitrage (I)

- Spatial arbitrage exploits price differences in different locations.
- Suppose e_L = 2 \$/€ in London and e_N = 3 \$/€ in New York. An arbitrageur would buy euros where they are “cheap” (in London, where buying 1€ just takes 2\$) to sell them were they are “expensive” (in NY, where you need 3\$ to get 1€).
- The sequence 1€ $\rightarrow^{\text{sold in NY}}$ 3\$ $\rightarrow^{\text{sold in L}}$ 1.5€ generates a sure profit of 0.5€ per euro (50% profit rate). It may be continued: 1€ → 3\$ → 1.5\$ → 4.5€ → 2.25€ → 6.75\$ → 3.375€ → …

Spatial arbitrage (II)

- Those transactions eventually alter prices. By buying € in London, $D_€$ shifts to the right and ↑e in London: the € appreciates where it is "cheap".

- By selling € in NY, arbitrageurs shift $S_€$ to the right in NY, so ↓e in NY: the € depreciates where it is "expensive".

- So e_L = 2 $/€ rises and e_{NY} = 3 $/€ falls. Eventually (may in a matter of minutes), both prices will converge to some value between 2 and 3. Reached that point, spatial arbitrage is no longer possible.

Triangular (or triangle) arbitrage (I)

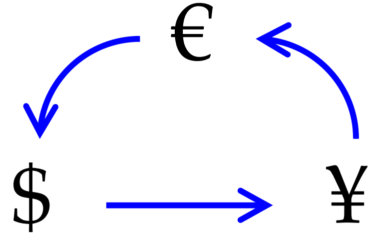
- Based on the idea of taking advantage of price imbalances involving at least three currencies.

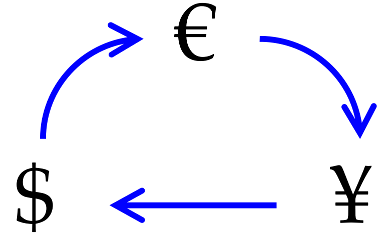
- Let exchange rates be 2 \$/€, 3 ¥/\$, and 4 ¥/€. Triangular arbitrage can only occur if the product of two rates is not equal to the third one (in making the product one of the currencies should cancel out).

- The 2n and 3r cannot be meaningfully multiplied, as no currency cancels out in 3 ¥/\$ · 4 ¥/€. By taking the inverse 1/3 \$/¥ of 3 ¥/\$ a meaningful product obtains: 1/3 \$/¥ · 4 ¥/€ = 4/3 \$/€ ≠ 2 \$/€. This means that there are arbitrage opportunities.

Triangular (or triangle) arbitrage (II)

- There are six exchange sequences: € → $ → ¥, € → ¥ → $, $ → € → ¥, $ → ¥ → €, ¥ → $ → €, ¥ → € → $.
- But the 1st is equivalent to both the 3r and the 5th because all generate the same cycle € → $ → ¥ → €.
- And the 2nd, 4th, and 5th are equivalent because all generate the same cycle € → ¥ → $ → €. So there are two ways of trying to exploit price differences, represented by these two exchange cycles.





Triangular (or triangle) arbitrage (III)

- One the cycles generates profits; the other, losses.
- The right-hand cycle yields losses: 1 € → 4 ¥ → 4/3 $ → 2/3 €. The left-hand one produces profits: 1 € → 2 $ → 6 ¥ → 1.5 €.
- As noticed, $\frac{\$}{¥} \frac{¥}{€} < \frac{\$}{€}$: going directly from $ to € is better than going indirectly through ¥. The step "1€ → 2$" makes the dollar appreciate, so $/€ falls. The step "2$ → 6¥" makes the yen appreciate, so $/¥ raises. And the step "6¥ → 1.5€" makes the euro appreciate, so ¥/€ raises. Hence, the gap between going directly or indirectly is being closed.

How to become a millionaire in a day /1

- Let e = 2 \$/€ today and suppose I expect e = 1.9 \$/€ tomorrow. Imagine that the daily interest rate is 3‰. If my expectation is correct, I can become a millionaire tomorrow. This is the recipe.

- I ask for a loan of, say, 100 million €. Tomorrow I will have to return this amount plus 300,000 €. With my 100 million €, and given the rate e = 2 \$/€, I purchase 200 million \$. I could lend those dollars for a day, but the day has been hard enough. So I just wait for tomorrow.

How to become a millionaire in a day /2

- Tomorrow comes and I am right. I then sell my 100 million \$ at the rate e = 1.9 \$/€ and get 105,263,157 € (the almost 90 additional cents, left as a tip).
- I next repay my 100 million € debt plus the loan interest of 300,000 €.
- And I finally search for a fiscal paradise that would welcome my remaining 4,963,157 €…
- What if I am wrong and, for instance, e = 2.1 \$/€. Then I have a little problem, since, at that rate, I can only obtain 95,238,095.23 € from my 100 million \$.

Short selling (shorting, going short)

- Wikipedia: “Short-selling […] is the practice of selling assets, usually securities, that have been borrowed from a third party […] with the intention of buying identical assets back at a later date to return to the lender” and make a profit.
- “The short seller hopes to profit from a decline in the price of the assets between the sale and the repurchase, as the seller will pay less to buy the assets than the seller received on selling them. Conversely, the short seller will incur a loss if the price of the assets rises.”

Going short vs going long

- Going long is the opposite strategy: an asset is bought expecting that its price will raise.
- The millionaire example is an instance of short selling: I assumed a debt in € because I expected a depreciation of the €. Hence, by purchasing $, I expected to next obtain more € for the same dollars, so that the debt could be repaid with cheaper €.
- To limit market volatility, some restrictions to short selling were imposed in September 2008. Short selling typically triggers currency crises.

Fixed vs floating exchange rates

- There are two basic exchange rate regimes.
- In a fixed exchange rate regime, the government picks an official value of the exchange rate between the domestic currency and some foreign currency (or group of them) and assumes the compromise of defending that value in the foreign exchange market by buying or selling the domestic currency.
- In a floating exchange rate regime, the government lets the market determine the exchange rate. The rest of regimes combine these two (for instance, a floating rate within a fixed fluctuation band).

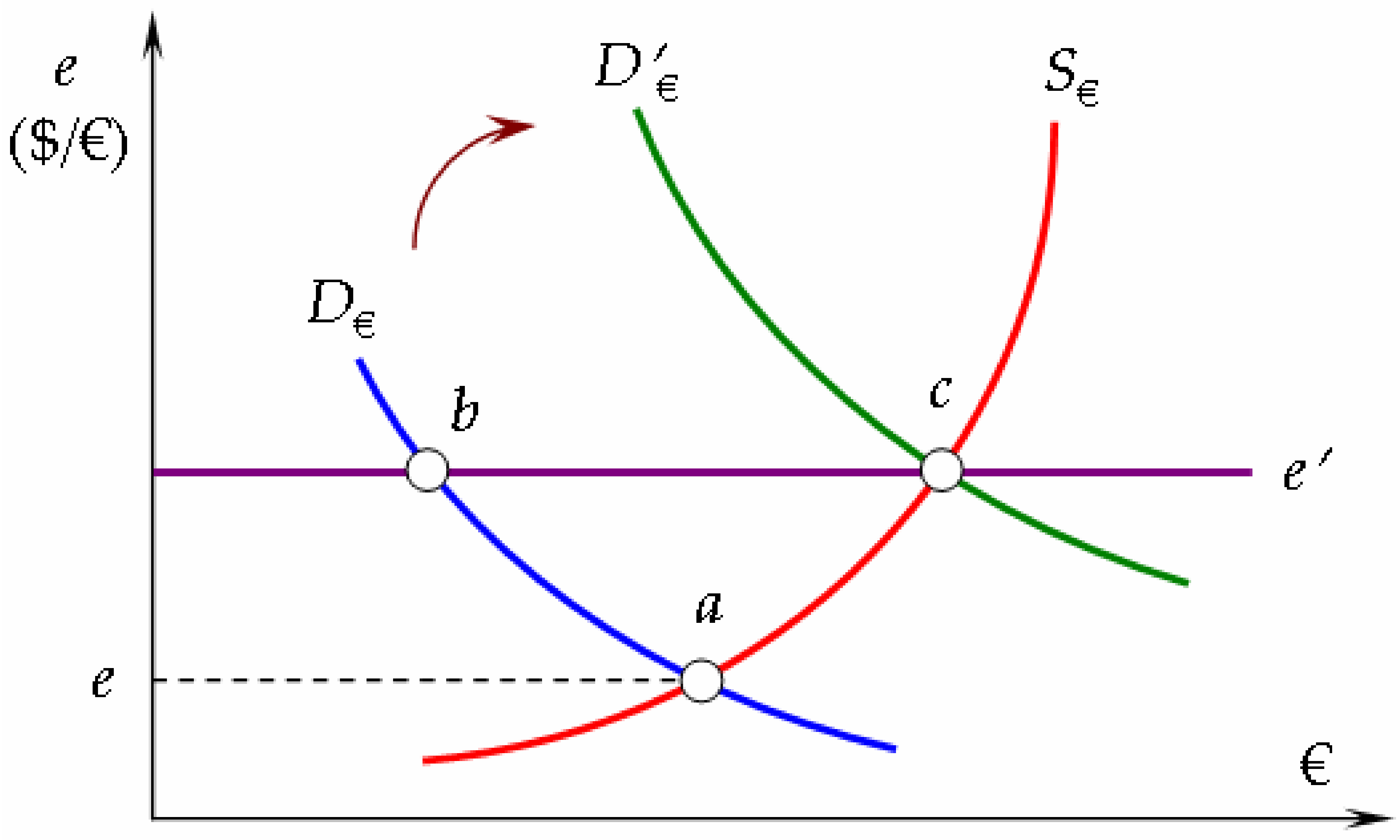
Currency market intervention (I)

- Let e' be the fixed exchange rate, with the central bank instructed by the govt. to sustain that value.

- Imagine that, for some reason, the exchange rate in the market is $e < e'$ (point *a* in the graph on slide 29). Having e' as fixed exchange rate means that the central bank must intervene to place the market equilibrium along the horizontal line with value e'.

- It may appear that the central bank may either shift $S_€$ to reach point *b* or shift $D_€$ to reach point *c*. The first option is not available, since the bank cannot force a reduction in the supply of €.

Currency market intervention (II)



Currency market intervention (III)

- What the central bank can do is to increase the demand for €. Hence, to reach value e' from point *a*, the central bank must demand enough € to shift the market demand function from $D_€$ to $D'_€$.

- The problem is that, at point *a*, the market does not value the euro as the government intends. The solution is to demand more € to raise its value.

- But the purchase of € to raise the value from e to e' must be paid in $. Thus, in passing from *a* to *c*, the central bank is spending dollars. Obviously, to sell $ the central bank must have them.

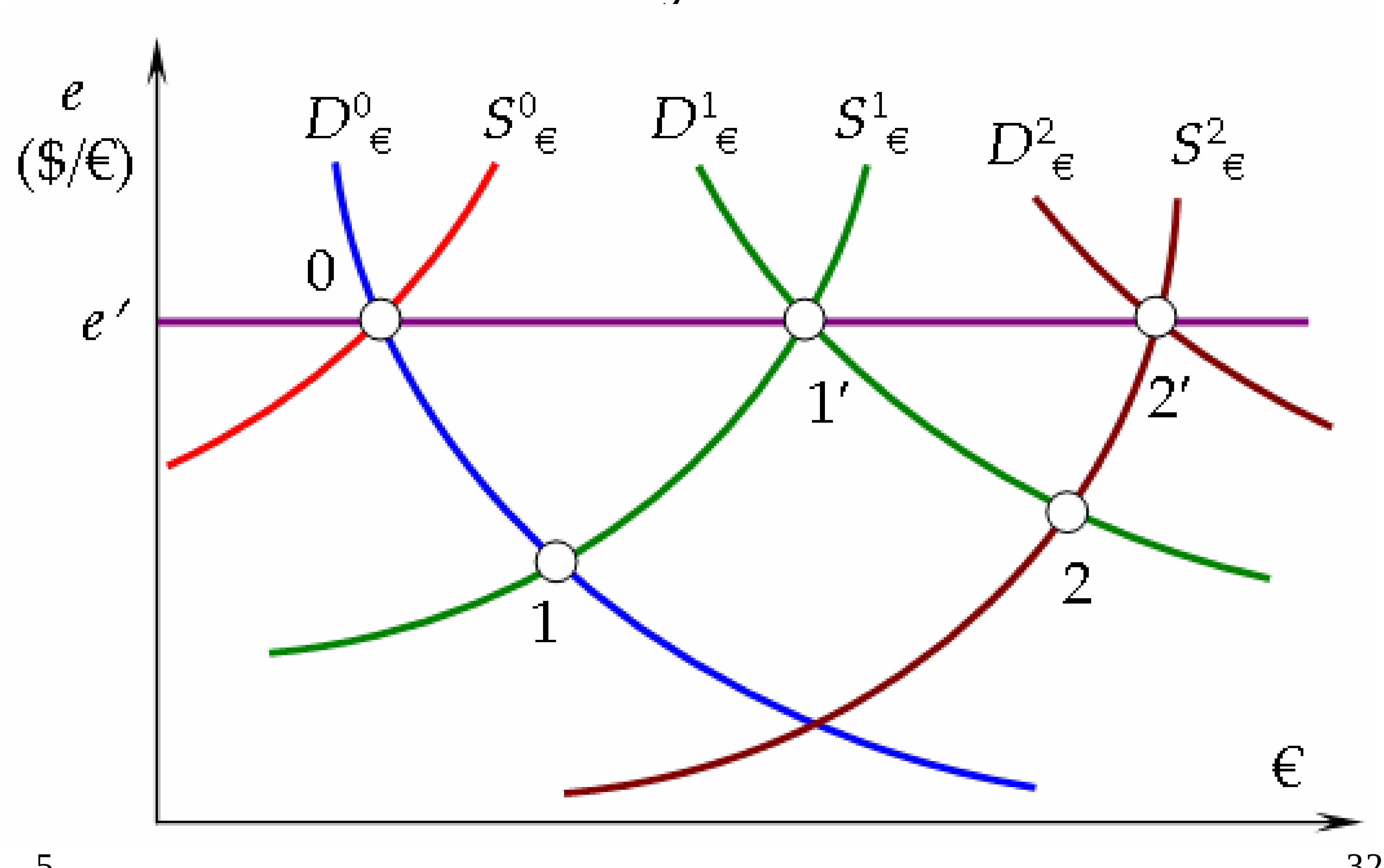
Currency crises (I)

- A currency crises occurs when a fixed exchange rate cannot be defended (achieved through the intervention of the central bank).

- What if market participants believe that a given rate cannot be defended? They will engage in short-selling: expecting the € to lose value, they will ask for loans in €, and convert the € in $.

- That behaviour shifts $S_€$ to the right, so the € loses value. And a self-fulfilling prophecy emerges: <u>what agents do in response to what they expect to occur contributes to cause what they expect to occur</u>.

Currency crises (II)



Currency crises (III)

- On slide 32, the market is initially at 0. A <u>speculative attack</u> unfolds through a massive selling of € (to repurchase them later at a smaller rate). This attack shifts $S_€$ from $S^0_€$ to $S^1_€$, moving market equilibrium from point 0 to point 1.

- The central bank reacts by selling \$, shifting $D_€$ from $D^0_€$ to $D^1_€$. Equilibrium moves from 1 to 1′.

- A second attack shifts $S_€$ from $S^1_€$ to $S^2_€$, reaching 2. If the central bank still has enough \$ reserves, equilibrium may be moved to 2′. If not, the attack is successful and market equilibrium remains at 2.

Revaluation and devaluation

- A devaluation is a reduction of the fixed exchange rate. It occurs when the government accepts that the former fixed rate cannot be upheld.

- In the previous example, if market participants believe the "right" value to be the one associated with point 2 and the central bank has not enough $ to sustain any other higher value, declaring the market value to be the new fixed exchange rate means devaluating the exchange rate.

- A revaluation is the opposite of a devaluation: an increase of the fixed exchange rate.

A famous successful speculative attack

- Took place on the 16th of September, 1992: the Black Wednesday.
- On that date, George Soros became famous for forcing the British government to withdraw from the European Exchange Rate Mechanism (a fixed exchange rate agreement), predecessor of the €.
- Soros made over 1 billion $ by short selling pound sterlings. Newspapers revealed that the British Treasury spent 27 billion £ trying to sustain the value of the pound.

The impossible trinity (I)

- Due to R. Mundell, it is the trilemma according to which it is not possible to simultaneously have
  - a fixed exchange rate,
  - an independent monetary policy, and
  - free international capital mobility=no capital control.
- If a fixed change rate is adopted and an independent monetary policy chosen, capital controls must be imposed (restrictions to buy and sell the domestic currency in currency markets). This was the case of China until recently.

The impossible trinity (II)

- If an independent monetary policy is followed and no capital control is applied, then the exchange rate must be allowed to fluctuate (UK, Canada).

- Under fixed exchange rates and free mobility of capital, the independence of monetary policy must be given up (the countries of the Eurozone).

- The logic behind the impossibility: if e is fixed and a monetary policy that expands M1 is applied, then domestic i lowers, implying a reduction of e. To defend e, domestic currency must be bough in the currency market, so M1 is reduced.

The real exchange rate

- The real exchange rate e_r is the nominal exchange rate expressed in terms of goods.

- Interpreting "goods" as the basket of goods in the CPI, e_r is the price of the basket in one economy in terms of the basket of the other. Specifically:

$$e_r = e\frac{P}{P^*}$$

were e is quoted indirectly, P is the domestic CPI, and P^* is the foreign CPI. So e_r is e adjusted by the price indices of the two economies. Note that e_r is measured in foreign baskets/domestic basket.

The real exchange rate: an example

- Suppose e = 4 \$/€, P = 100 €/basket$_{EU}$, and P^* = 200 \$/basket$_{US}$. With these values, how many baskets$_{US}$ could be obtained from 1 basket$_{EU}$?

- As P = 100, 1 basket$_{EU}$ could be sold for 100 €. At the rate e = 4 \$/€, 100 € exchange for 400 \$. With 400 \$ and P^* = 200, 2 baskets$_{US}$ can be purchased.

- This says that the purchasing power of 1 basket$_{EU}$ is 2 baskets$_{US}$. That is, e_r = 2 baskets$_{US}$/baskets$_{EU}$.

- Applying the formula, $e_r = 4 \cdot 100/200 = 2$ (observe that $4 \cdot 100$ is the cost in \$ of the basket$_{EU}$).

Competitiveness of an economy

- The real exchange real is a measure of the competitiveness: the smaller e_r, the higher the competitiveness of the domestic economy

- For instance, in passing from $e_r = 1$ to $e_r = 2$ domestic competitiveness is eroded: with $e_r = 1$, foreigners could obtain a domestic basket with just one of their baskets; with $e_r = 2$, they must deliver 2 of their baskets to get a domestic basket.

- Going from $e_r = 1$ to $e_r = 2$ means that it is more expensive for foreigners to purchase our basket, so we become less competitive.

Real appreciation & real depreciation

- A real appreciation is an increase of e_r (a loss of domestic competitiveness).
- A real appreciation of the exchange rate means that the domestic basket can buy more foreign baskets: the purchasing power of the domestic basket raises.
- A real depreciation is a decrease of e_r (an improvement in domestic competitiveness).
- A real depreciation of the exchange rate means that the domestic basket can buy fewer foreign baskets: the purchasing power of the domestic basket falls.

Purchasing power parity

- PPP is the theory that, in the long run, <u>e moves to make e_r equal to 1</u>, so 1 domestic basket exchanged for 1 foreign basket (same purchase power).
- The value of e making $e_r = 1$ is $e_{\text{PPP}} = P^*/P$.
- Letting domestic and foreign baskets be the same, <u>PPP holds that the price of the basket should be the same in both economies when expressed in the same currency</u>: $eP = P^*$, which is achieved if $e = e_{\text{PPP}}$.
- If $e > e_{\text{PPP}}$, then domestic currency is said to be <u>overvalued</u> (with respect to its parity value). If $e < e_{\text{PPP}}$, it is said to be <u>undervalued</u>.

PPP and commercial arbitrage (I)

- In the absence of transportation costs, PPP can be justified by commercial arbitrage (buy goods where cheap and sell them where expensive).
- To illustrate the idea with a simple example, suppose that only one good can be traded between Euroland and the US: Macroeconomic textbooks.
- The price of a textbook in the US is p^* = 100 $; in Euroland, p = 50 €. Imagine that e = 4 $/€. Hence, the price in $ of a Euroland textbook is 4·50 = 200 $.
- This suggests that textbooks are cheap in the US.

PPP and commercial arbitrage (II)

- Commercial arbitrageurs would buy textbooks in the US to subsequently ship them to Euroland. Once sold there, euros are converted into dollars.
- Those activities produce the following changes. The purchase of books in the US tends to raise p^*. The sale of those books in Euroland make p fall. And the demand for $ induces a reduction of e.
- Initially, $ep > p^*$. Thanks to the arbitrage, ep tends to fall and p^* tends to raise. Eventually, $ep = p^*$. This condition stops arbitrage.

Over and undervaluation: an example

- With $p^* = 100$ \$, $p = 50$ €, and $e = 4$ \$/€, the € is overvalued with respect to the \$. In fact, $e_{PPP} = p^*/p$ = 100/50 = 2 \$/€. This is reasonable: since the price of a book in the US doubles the price of a book in Euroland, purchasing power parity demands that 1 € be capable of purchasing 2 \$.
- Having $e = 4$ instead of $e = 2$ implies that the € has more purchasing power than it should have: with 50 €, one book can be bought in Euroland; given $e = 4$, those 50 € can buy 2 books in the US. So the € is a 100% overvalued: $(e - e_{PPP})/e_{PPP} = (4 - 2)/2 = 1 = 100\%$.

Big Mac index

- It is an index set by *The Economist* to test PPP.
- The basket chosen is the Big Mac.
- The chart shows the last data published (14th October, 2010).

Interpreting the Big Mac index data

- According to the chart, at the market exchange rates on the 13th of October, the price in $ of a Big Mac in China was 2.18. Since the price of the Big Mac in the US was 3.71 $ (in fact, a weighted average of the price in several cities), the yuan was undervalued a 41.23% with respect to the $. PPP predicts that the yuan will eventually appreciate.
- In the Eurozone, the Big Mac is priced at 4.79 $ (given market exchange rates). If parity between the € and the $ held, it should had been 3.71 $ (its price in the US). Thus, the € is overvalued a 29.11%.

Market exchange rates, 11th Feb 2011

	USD	GBP	CAD	EUR	AUD
USD	1	1.59914	1.00445	1.3524	0.998522
GBP	0.625333	1	0.628119	0.8457	0.624408
CAD	0.995563	1.59205	1	1.34639	0.994091
EUR	0.739426	1.18245	0.742721	1	0.738333
AUD	1.00147	1.60151	1.00594	1.3544	1

Friday, February 11, 2011

Source: x-rates.com

This says that 1 € exchanges for 1.3524 $
and that 1 $ exchanges for 0.739426 €.