Open Economy Macroeconomics
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The International Setting

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Course info

- Lecturer Jouko Vilmunen (jouko.vilmunen@bof.fi)
- Lectures 24h
- Excercises: 5-6 problem sets
- Lecture notes: course webpage and distribution through the email
- Book: *Exchange Rates and International Finance* (Pearson Education) 5^{th} edition by **Laurence Copeland**

Structure of the course

- The International Setting
- Exchange Rate Determination
- World of Uncertainty (if time allows)
- Fixed Exchange Rates (if time allows)

What is an Exchange Rate

- The importance of exchange rates have increased in recent times, why?
- Partly because of the internationalization of modern business
- Partly because exchange rates are highly volatile, not merely variable
- Copeland:
  - The attention given to exchange rates can be traced to the role they play as the joker in the pack: the unpredictable element in the calculation of that could turn a profitable deal into a disastrous lossmaker, or make an attractive investment project into the albatross on the company's balance sheet, or push the cost of your family holiday way beyond your budget

What is an Exchange Rate

- It is simply a *price*
- Actually prices as economists understand the term are exchange rates
  - exchange rate between a particular good and a particular currency: price of a book bought in Finland is the exchange rate between that book and euro
  - 'money can be bought'
    - eg. 30 euros per book, so from the bookseller's point of view the price of 1€ is $\left(\frac{1}{30}\right)$th of a copy of the book
    - if the price of the book went up to 31 euros, the price of 1€ would *fall* to $\left(\frac{1}{31}\right)$th of a copy of the book
  - ie. a rise in the price of the book is the same as a *fall* in the price of money

What is an Exchange Rate

- An exchange rate of £1 = €1.50: the price of a euro in UK currency is £(1/1.5) = £0.67
  - hence, to a Finn or, more generally, euroarea citizen, a pound costs €1.50
- In general, the exchange rate of currency A in terms of currency B is the number of units of B needed to buy a unit of A
- No normal way of expressing exchange rates: both £1 = €1.50 and €1=£0.67 are acceptable ways of expressing the same exchange rate
- In the following, S denotes the exchange rate.
  - and increase in S signifies depreciation, ie. the price of foreign currency has gone up
  - a fall in S then means appreciation, ie. the price of foreign currency has fallen or a rise in the relative value of the domestic currency

Bilateral versus Trade-weighted Exchange Rates

- Bilateral vs international value
  - euro has fallen relative to the US dollar: does it mean that the euro's international value has fallen too?
- For many purposes, the two-country perspective is too narrow
  - if we think that the US dollar has strenghened, we should look at the US economy for an underlying reason
  - if we think that the euro has weakened, we should look at the performance of the eurozone
- Compare with the price of a single good, say mobiles
  - has the *relative price* of mobiles increased $\longrightarrow$ check the markets for mobile for underlying reasons
  - has the price of goods *in general* increased $\longrightarrow$ search for a macroeconomic reason

Bilateral versus Trade-weighted Exchange Rates

- Note:
  - the price of a single good has risen, while the price of other goods has remained the same vs
  - the price of a single good has risen, at the same time as all other prices $\longrightarrow$ the value of money has fallen!
- Similarly:
  - the (euro) price of dollars has gone up, while the (euro) price of all other currencies has remained the same $\longrightarrow$ the US dollar has strenghened
  - if all currencies move against the euro, the euro has weakened
- This difference is by no means semantic: if the euro has lost value against all other currencies, we should definitely check the euroarea for an underlying reason!

Bilateral versus cntd

- **Bilateral** exchange rate between Finland and the US is the price of dollars in terms of euros
- A change in the bilateral Finland-US exchange rate indicative of either a change in the international value of the euro or a change in the international value of the US dollar - or both
- Which one? How to get indication of what has happened to the *overall* value of the euro or the US dollar?
- Check all the bilateral euro exchange rates
- Note that knowing all the euro exchange rates, we can calculate the *cross exchange rates*, ie. exchange rates between two currencies neither of which is the euro
  - 23.2.2015 the euro price (value) of the US dollar is €(1/1.1298) = €0.8851 and the euro price (value) of the UK pound sterling is €(1/0.7352) = €1.360
  - hence, the US dollar price (value) of the UK pound sterling is \$(1.360/0.8851) = \$1.5368 (see e.g.the BoF webpage for exchange rates)

Bilateral versus cntd

- Generally

$$= \frac{\text{US dollar price of UK Pound Sterling}}{\text{Euro price of the UK Pound Sterling}}$$

- Assume that the euro has depreciated against the US dollar, but appreciated against the japanese yen: what is the net effect?
- No completely adequate answer to this question
- Apply the logic of computing the domestic purchasing power of money: measure changes in the price of goods in general by computing a price index $\longrightarrow$ **effective or trade-weighted exchange rate** corresponds to the price index

Bilateral versus cntd

Definition

The effective or trade-weighted exchange rate of a currency A is a weighted average of its exchange rate against currencies B, C, D, E, ... The weights used are usually the proportions of country A's trade that involves B, C, D, E, ... respectively

- As a convention we refer to the euroarea or interchangeably Finland as the 'home country' and the US as the 'foreign country'

Spot versus Forward Rates

- All the forex transaction referred to above are conducted 'on the spot' - delivery of currency more or less immediately when the bargain is struck $\longrightarrow$ the corresponding exchange rates are called *spot rates*
- Not all deals in the forex markets involve immediate delivery
- Contracts may commit the parties involved to exchange currencies at some future date at a predeterminate price $\longrightarrow$ *forward or futures exchange rate*
- Forward exchange rates are often used for hedging purposes

Bid and Ask rate

- Forex markets involve intermediaries, who are temporary counterparties in individual forex trade
  - these agents are profit maximizers, not motivate purely by charity
    - fee for matching buyers and sellers
    - mostly, revenue from the gap between the price at which they buy and sell

Definition

The **bid rate** for currency A in terms of currency B is the rate at which dealers buy currency A (sell currency B) the **ask (or offer) rate** is the rate at which dealers sell currency A (buy currency B). The **(bid/ask) spread** is the gap between the ask and bid rates.

Bid and Ask rate

- See Table 1.2. in Copeland (pp. 10-11)
- Note: absent transaction costs the ask price for currency A (in terms of currency B) is the reciprocal of the bid price for currency B (in terms of currency A), **not** the ask price:

$$S(\text{£ per \$}) = 1/S(\text{\$ per £})$$

this is because one can only *buy* one currency by simultaneously *selling* another currency

- No longer true, once we allow for the spread between bid and ask rates
- Write: $S^b(A/B)$ for the bid price for currency B in terms of currency A, $S^a(A/B)$ for the ask price of B in terms of A and similarly for $S^b(B/A)$ and $S^a(B/A)$ for the bid and ask for A in terms of B; then

$$S^b(B/A) = 1/S^a(A/B) \text{ and } S^a(B/A) = 1/S^b(A/B)$$

Bid and Ask rate

- Implication: in practice the relationship between cross rates is more complicated than indicated above!
- Convention: all exchange rates will be henceforth understood as mid-market rates - averages of bid and ask (offer) rates
- The point is that buying and selling rates are important for the precise calculations of the profitability of forex deals, but not in principle for the conclusions regarding the basic mechanisms at work in currency markets. We will, if time allows, return to this issue later when discussing the way dealers set the spread

The Market for Foreign Currency (Forex market)

- Basic questions: what determines exchange rates? what factors explain the wild fluctuations (girations, volatility) in currency values so characteristic of the forex markets nowadays?
- This course is about trying to answer this question!
- For the moment: turn to basic microeconomics:
  - demand for currency
  - supply of currency
  - look for the price that equalizes the two, ie. forces excess demand/excess supply to zero (see Fig 1)

Forex market

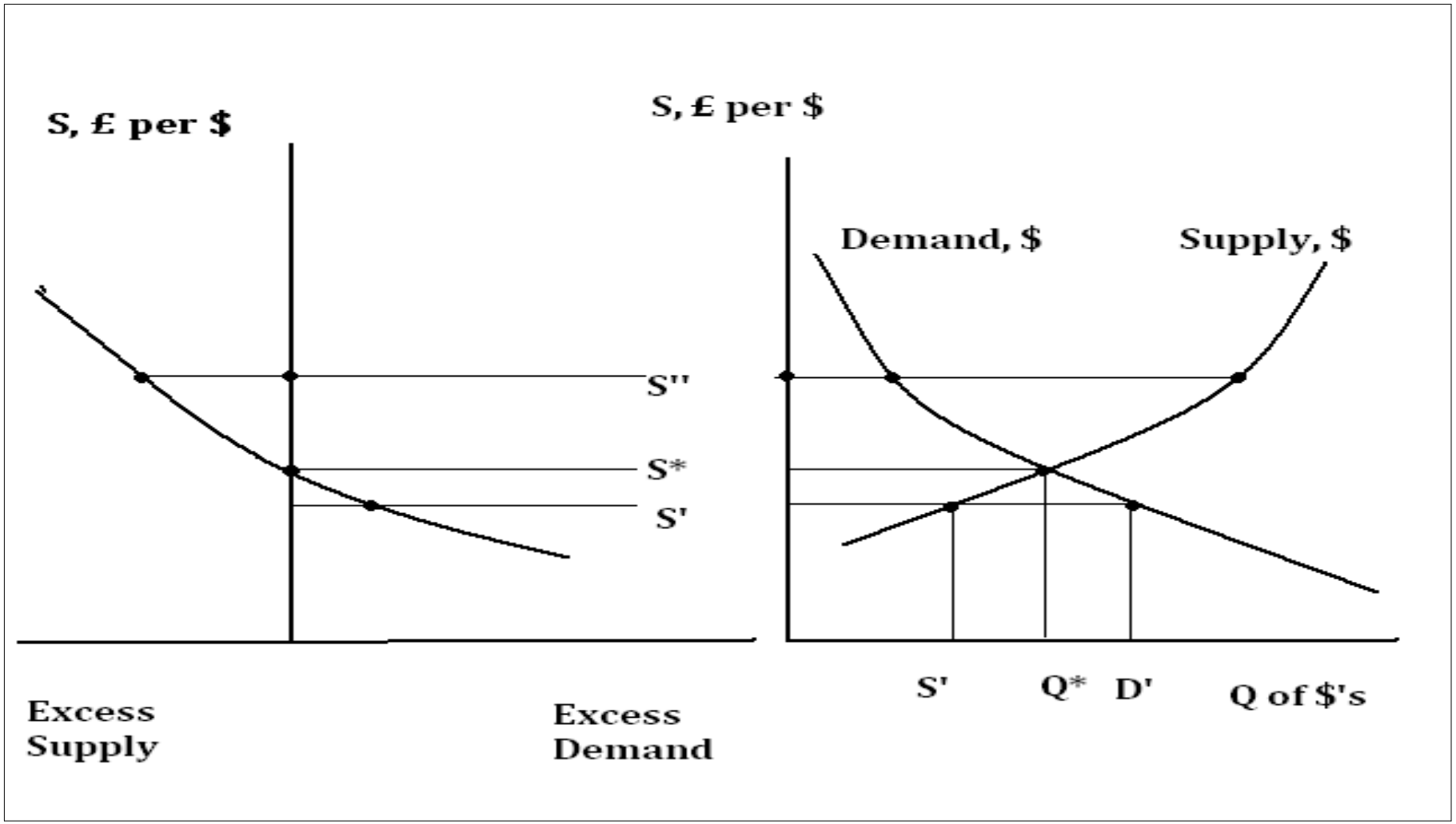


Figure: Equilibrium exchange rate

Forex market

- Where does supply and demand come from in the forex market?
  - exporters (trade in goods and services)
  - foreign and domestic investors (shares, estates etc.)
  - speculators (making a profit from buying and selling currencies, typically short-term assets, e.g. deposits)
- In practice difficult to tell part who's who
- Furthermore, demand for and supply of currencies often come from the same institutions

Floating (Interesting paper: P. Bergin et al (2016), NBER wp #21979)

- Think of the euro forex markets as being in equilibrium
- Then: for unspecified reasons the demand for euros rises
- At the prevailing dollar price of euro, there will be an excess demand for euros $\longrightarrow$ the dollar price of the euro has to increase, ie. euro has to strenghen
- In absence of impediments the euro has to strenghen as long as there is excess demand
- In this regime the (equilibrium) price of euro in terms of the dollar is determined by *market forces*

Definition

A completely flexible or (purely or freely) floating exchange rate is one whose level is determined exclusively by the underlying balance of supply and demand for the currencies involved, with no outside intervention

Fixed Exchange Rates

- We shall be mainly concerned with floating exchange rates
- A few words about fixed exchange rates
- It is not difficult to see that high volatility of floating exchange rates can adversely affect both individuals and the aggregate economy
  - volatility makes long-term commitment to trade at fixed prices set in advance difficult
  - the risk of unfavourable exchange rate movements can add to the uncertainties involved in international investment decisions (location decisions, market entry and entry decisions etc.)
- From aversion to exchange volatility it is only a short step to conclude that government has to do something - eg. fix the exchange rate
- But how is this done? Announce the fixed S and impose legal restrictions on forex dealings
  - foreign currency trade through the central bank
  - private holdings of foreign currency banned or permitted only with official consent

Fixed Rates cntd

- Even today such restrictions exist, particularly in emerging markets
- Their effect is to make it possible for authorities to peg S without operating through the market
  - currencies subject to such controls are said to be *incovertible* or *not fully convertible*
- How about adjustment in the forex market as market conditions change?
- Eg. an incraese in the demand for US dollars can create an excess demand for them in the forex market
  - authorities could supply the extra dollars to satisfy the increased demand and, hence, prevent S from depreciating
  - so things work as in any case where a price is fixed - somebody, not necessarily the government - must stand ready to enter the market and *neutralize* any shift in the demand for or supply of the good
  - requirement: a buffer stock or stocks - one for the good when excess demand and one for cash for excess supply!

Fixed Rates cntd

- All this may explain why governments decide to live with the vagaries of demand and supply, rather than try to fix the price?
  - cost of day-to-day managing of the stocks
  - what happens if there is an extended period of excess supply or demand, indicating a more or less permanent shift in demand of supply?
- This same problem occurs with fixed S
  - gold and foreign exchange reserves act as buffers
  - as long as periods of excess demand or supply are short-lived, the fixed S system can be sustained
    - foreign exchange reserves in the central bank increase (fall) due to excess demand for (supply of) the domestic currency
- During extended periods of forex market strain - like during persistent speculative periods - foreign exchange reserves will be subject to a sustained fall or rise

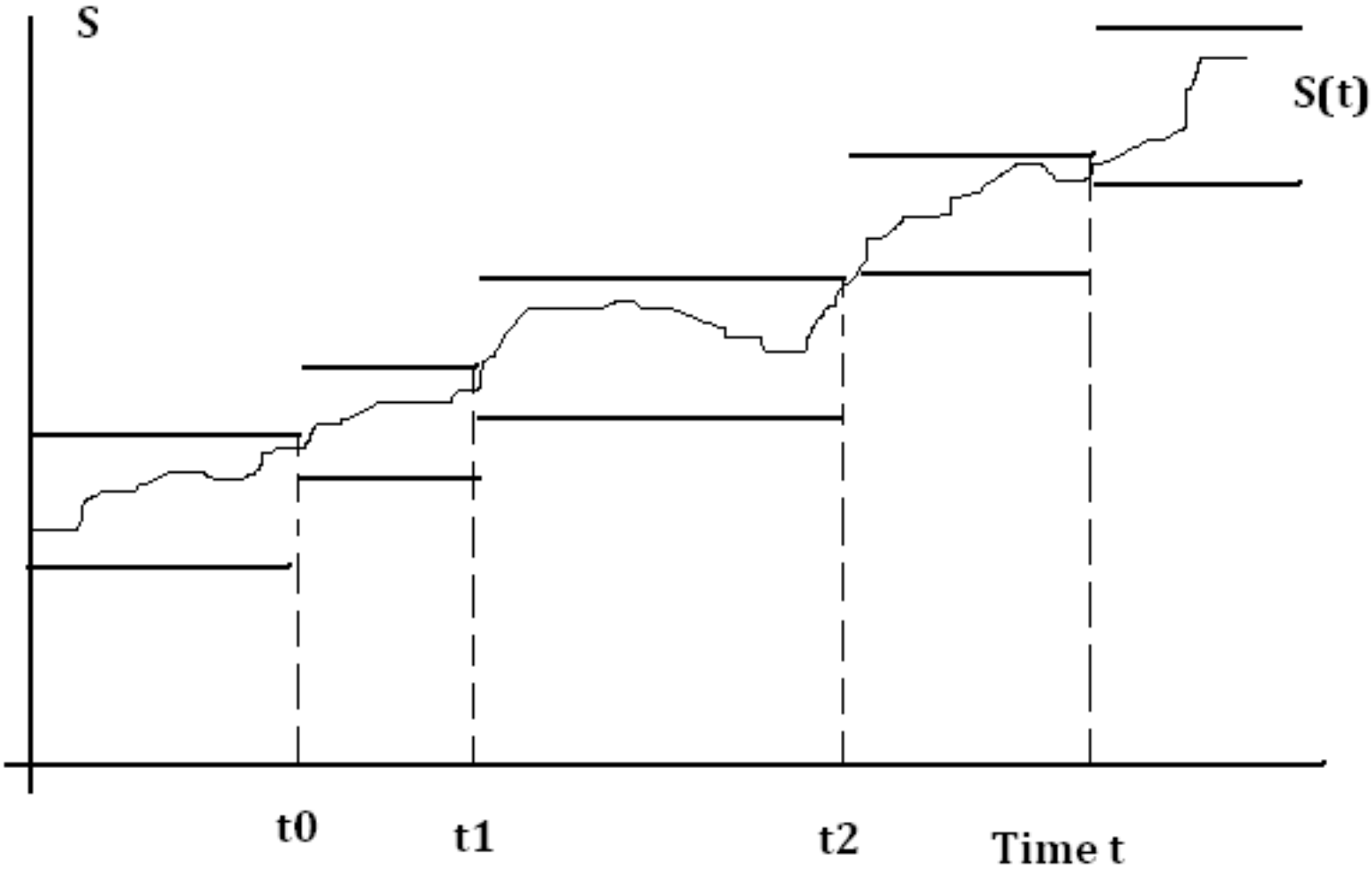
Fixed Rates cntd

- Hence an asymmetry: excess demand for foreign currency $\longrightarrow$ threat of running down foreign exchange reserve $\longrightarrow$ sustainability of the fixed S system at risk; excess supply of foreign currency $\longrightarrow$ print euros at zero marginal cost to satisfy the underlying excess demand for the domestic currency
  - prerequisite for the latter case: government has no other objectives for monetary policy, eg. constant money stock to prevent inflation
- Conjecture:
  - the authorities should not resist fundamental driven (long-term) changes in the equilibrium S, neutralize only *temporary* excess demands and supplies
- Difficult to distinguish temporary and permanent changes at the time they occur: what appears to be transitory to start with may turn out to be permanent
- Typically fixed S system in practice is one of a *target zone:* S is allowed to float within a prespecified range around a *central parity*

Managed Float

- Fixed rates with fluctuation bands, where the bands are adjusted every once and a while to suit the authorities' objectives $\longrightarrow$ *managed or dirty float* (Fig 2)
- In general S systems can be classified by their implications to the foreign exchange reserves
  - under pure float, the reserves are constant - there is actually no need for the monetary authority to hold foreign exchange reserves
  - under managed float, the reserves fluctuate on a day-to-day, month-to-month basis, but around a more or less constant level
  - under fixed rates, the reserves have to carry the full burden of adjustment to disequilibrium in the forex market and can be expected to be far more volatile, probably exhibiting long swings up and down (as they do in practice)

Managed Float cntd



Balance of Payments

- Drawing up an account of all the transactions conducted between Finland and the ROW would serve as a kind of index of the flow of demand for and supply of the euro over any period $\rightarrow$ purpose of the Balance of Payment (BoP)
- The BoP involves the Current Account (CA) and the Capital Account (CapA)
- As the name suggests, the CA covers all transactions that create *NO* future claim in either direction, involving simply an exchange 'here and now'
- The CA itself is divided into sections or sub-accounts in order to give a broad indication of the contribution of different types of transactions involved

Goods and Services - Trade Balance (TB)

- The goods account covers all transactions between Finland and the ROW involving trade in goods for current purposes
- In 2015 Finland exported goods exceeded imported goods
  - hence, the surplus in goods account was 2113 M€
  - at the same time the services account was in deficit by 1312 M€
- Which is more important, trade in goods or services?
- There is no economically meaningful answer to this question!
  - the only valid reason for distinguishing the two is the frequency (accurary too?) with which the two items are measured
  - whether it is services or goods, the Finnish importer from the US has to buy US dollars with euros and an American importer from Finland has to buy euros with US dollars to trade
- Trade in services include various items like
  - production licences (eg. assembly line in Finland), tourism, insurance, shipping and banking

Services of Factors of Production

- Other ways than trading goods and services of earning flows of foreign currency without changing countries' net capital position
  - both involve services of factors of production - labour and capital
- Current labour transactions: occur every time Finnish citizens sell their labour to foreign-based companies, or conversely Finnish companies pay salaries to foreigners
- In many countries a larger item is generated by capital as investment income, sometimes known as 'capital service':
  - insofar as Finnish capital is employed by foreigners, payments made for its use are earnings of the Finnish economy, and vice versa
    - eg. if Microsoft rents a house in Finland to accommodate its executives, the the rent payment to the Finnish landlord represents the export from Finland of housing services, and furthermore serves to swell the demand to exchange dollars for euros
    - interest earned by a Finnish company on its deposit in a New York bank amounts to a payment by Americans for the use of Finnish-owned funds - again an export of capital services

Factors of Production

- - similarly profits or dividends earned by Finnish residents or Finnish registered companies from their holdings of shares in US companies count as exports from Finland and imports by the USA and vice versa
- BoP aggregates these income items as 'Primary Income'
- Other things equal, the balance on capital services will be greater (= more positive) the larger the domestic capital stock
- The latter, in the *international context*, is the country's net asset position vis-à-vis the ROW
  - the more the country has accumulated (net) claims on foreigners, the greater is likely to be the (net) flow of income it receives from overseas as payment for the use of its assets
- The third component in the CA is 'transfers' which is nowadays called 'Secondary Income'
- Transfers consists of unrequited payments made to the Finland by foreigners and vice versa - ie. payments made without any specific offsetting transfer of goods or services

Transfers

- Governments make these kinds of unilateral transfers to cover the country's subscriptions to international 'clubs' like EU, IMF, UN agencies etc and its bilateral aid donations
- Private agents make transfers as gifts of one kind or another to foreigners
  - most private transfers involve remittances by people working to families overseas
- Finland 2015: (net) transfers add up to -2234 M€
- The overall CA surplus or deficit is for many purposes the most important single figure in the BoP
- There are a number of ways of expressing what it signifies

Current Account Balance

- Perspective on CA balance:
  - indicator of the balance of demand and supply within the domestic economy
    - Finland 2015: CA surplus of 250 M€ indicates the scale of excess supply of goods and services in the Finnish economy
  - CA deficit or surplus is identically equal to the total saving net of investment in the economy
    - public + private sector saving - investment balance
    - hence, in the same way as an individual who saves over any period adds to his/her net worth, a country running a CA surplus (deficit) accumulates (reduces) net assets
- Is the CA deficit/surplus large?
  - Finland 2015: CA surplus of 250 M€ $\rightarrow$ roughly 0,12 % of 2015 GDP; exports + imports of goods hover around 60 % of GDP

CA Balance

- So what looks like a dramatic change in the CA balance can in fact result from marginal change in the credit or debit side of the account, or from one of the frequent revisions of the data that sometimes occurs years later!
  - statitistics people are well aware of this data revision problem
  - modern computerized record-keeping, statistics on exports and imports should in principle be accurate and available without little or no delay
  - the same may be true for government transfers
  - all other categories in the BoP: only rough estimates?
  - this last one is not only a matter of incomplete data collection, but may involve questions of principle that cannot be answered straightforwardly
- All these problems withe the interpretation of the BoP statistics have existed ever since the start of publishing them, but globalization has made them far more acute
- Technology in collecting and processing the data has advance by leaps and bounds, but the figures produced are arguably less irrelevant that ever before

Capital Account

- How far does the reduction in a country's net (external) assets take the form of an increase in the debts owed by the country's public sector to the ROW?
- Does it mainly take the form of an increase in private sector liabilities?
- To what extent does it involve the running down of the country's assets overseas?
- Are the assets involved short-term or long-term? Financial or non-financial? Portfolio assets or direct holdings?
- In principle, the Capital Account (CapA) and Financial Account (FinA) give the answer to all of these questions
- In practice the data are grossly inaccurate and difficult to interpret $\rightarrow$ use of net amounts are more often than not used instead
- Finland 2015: CapA = 225 M€ and FinA = 920 M€

Capital Account

- Negative CapA (FinA) balance means an increase in a country's net (external) assets, ie. a reduction in international indebtedness
- Why? Because underlyng this negative balance is an excess of import of (foreign) assets over export of (domestic) assets!
- Categories of CapA:
  - direct and portfolio investment
    - the latter refers to assets purchased purely as additions to international portfolios of equities, property, bonds etc - mainly held by financial institutions of different kinds
  - financial derivatives reflects the change in the value of the positions held by the country's institutions in the derivative markets (ie. futures and forwards, swaps and options)
    - can be a large component, too large to be ignored (not necessarily in Finland)
  - other investment consists of net lending by agencies other than the government (ie. banks, non-bank institutions and individuals)
  - reserve change: under a pure float this item $= 0$ identically, but if S is fixed then the burden of adjustment must fall on the official reserves

Capital Account

- Last item, 'errors and omissions' is a balancing item
- Can be a large one: Finland 11/2015 -7579; however, Finland 2015 423 M€!
- It arises, because by definition the BoP must balance (sum to zero: measured deficit (in the CA) must be equal to net asset sales during a given period)
  - compare to individuals: his/her spending in excess of income must be identically equal to the increase in his/her liabilities or decrease in his/her assets
- However, BoP data are collected from independent sources so that any inaccuracies show up in a non-zero overall balance
- Note also, that non-zero 'errors and omissions' is typically not a one-off situation: eg. in Finland the BoP error has been substantial for some time now
  - actually statistics people (at least in the BoF) are trying hard to figure out ways to reduce this item by improving the quality and accuracy of the data

Prices in the Open Economy: PPP

- Purchasing Power Parity (PPP) is a very old doctrine - almost as old as paper money itself
  - it can be traced all the way to sixteenth-century Spain
- Revivial in modern times: Gustav Cassel in the period between the two WW's
- Understanding of the PPP is essential if one wants to get a grip with more sophisticated models of S determination
- PPP is based on the generalization of the notion of the **Law of One Price (LOP)**
  - *arbitrage and transaction costs* and related concepts are tightly related to LOP
- Empirical evidence does not uniformly favour the validity of PPP
  - rejections of PPP occur frequently in empirical literature, puzzles keep emerging etc

The LOP in the Domestic Economy

- In the context of the domestic economy, LOP states:

Definition

If two goods are identical, they must sell for the same price

- Looks harmless, almost blindedly obvious statement
- Has far reaching implications though

Example

All tickets to Robin Williams's concert in London have been sold at face value through the usual distribution channels across the UK, but excess demand has created a black market operating outside ticket agencies, in pubs, on street corners, in discos, in the classified ads columns of local newspapers and, of course, in the Internet. Assume you're told that tickets for particular seats are on offer in the black market in Birmingham for £50.

LOP

Example

(Cntd) What would you expect and identical ticket to cost in, say, Manchester? By the LOP: most likely £50. This is what you would find in practice.Why? Ask yourself what would happen if this was not the case. If, say, the price of a ticket were £5 lower in Manchester, then everyone in Birmingham (and Manchester) wanting to go to the concert would buy the ticket in Manchester. So sellers in Birmingham would be unable to sell the tickets as long as there were any on sale at a cheaper price in Manchester.

- You might object: Robin Williams fans in Birmingham would never find out that there were tickets on offer at a lower price on a street corner in Manchester, in the small ads pages of Manchester newspaper etc
- Could be but: it is well known that there are people who make a living out of exploiting such price differences!

LOP

- - buying as many tickets as they could in the cheaper location in Manchester and sell them immediately in the dear location in Birmingham
- Such **arbitrageurs** would at the same time do 3 things:
  - make tidy profits; drive up prices in Manchester; drive down prices in Birmingham
  - on each ticket they trade, a profit is made that is equal to the price differential; the larger the price differential the larger the profit and, hence, the greater the incentive to trade
  - as they bid up the price in Manchester and push it down in Birmingham, the gap narrows and their profit fall from £5 per ticket to virtually nothing; the incentive to trade is progressively reduced
  - the process tails off and stops altogether when prices in the two cities are brought into equality at some price between £45 and $50, say £47; at this point *profit opportunities have been exhausted*

Arbitrage

Definition

Arbitrage is the process of buying or selling something in order to exploit price differentials so as to make riskless profits

- Note: 'something' is intentionally vague; can refer to
  - goods and services or securities
- See e.g. H. Varian (1987, *Arbitrage Principle in Financial Economics,* The Journal of Economic Perspectives, Vol. 1, No 2, 55-72)
- Wikipedia has a good review of arbitrage
- Completely general concept and is frequently encountered in markets for equities, commodities and currencies themselves
- Given the existence of arbitrageurs, are there any factors that could prevent the LOP prevailing?
- Lack of information not plausible since arbitrageurs make it in their business to know about price differentials
- Transaction costs? The costs of actually transacting can be non-trivial; define

Transaction costs

Definition

Transaction costs are all the costs associated with a transaction, over and above the cost of the item that actually changes hands

Arbitrageurs profits from ticket sales

Costs	
Buy 100 tickets in M @£45 each	£4500
Transaction Costs	£10
Total Costs	£4510
Revenue	
Sell 100 tickets in Birmingham@£50 each	£5000
Profit = Revenue less total costs	£490

Profit

- Profits per ticket have fallen from £5 to £4.90, because all-inclusive cost of the average ticket has risen by the amount of the transaction cost per ticket
- The arbitrage process will come to a halt when the price differential has narrowed to £0.10 (transaction cost per ticket)
- When the price differential has narrowed down to £0.10, arbitrage profits has been driven down to zero: this is an **equilibrium**
- Describe this equilibrium in symbols as follows

$$P^B = P^M + C$$

  where P^B, P^M, C is, respectively the price in Birmingham, the price in Manchester and the transaction cost
- Any other factors that could conceivably prevent arbitrage from imposing LOP on trade?
  - legal barriers to arbitrage
    - note that our formulation in the above equation at least partially takes into account legal restrictions on trade $\leftarrow$ *transaction cost!*

Risklessness

- Risk of violating the law is the *only* risk involved in arbitrage: in a pure arbitrage transaction, there are no trading risks in the normal sense, as the arbitrageur takes the opportunity of a near-riskless profit
- The absence of risk is a distinguishing feature of arbitrage
- Since arbitrage activity involves no risk, one would expect a ready supply of both arbitrageurs and of funds to finance their operations?
- Funds to finance arbitrage activity may not, however, be easily available and legal issues may not be the only, perhaps not even the main reason
- Hence, the possibility arises that the LOP may fail simply because the supply of arbitrage funds is too small to eliminate price differentials
- In relation to borrowing and lending, should there be an interest charge included in the transaction cost term C?
    - the answer has nothing to do with the question of whether an arbitrageur borrows or uses his/her own funds as working capital
        - use of own funds has an opportunity cost!

Speculation

- There is no interest cost to pure arbitrage for the same reason that there is no risk:
  - if buying and selling are instantaneous, then the working capital needed is nil
  - too large a difference between buying and selling may indicate something else than arbitrage activity
- Other buyers and sellers in the market are not irrelevant for equilibrium prices: these traders set the "playfield" for arbitrageurs and without them there's nothing for arbitrageurs to arbitrage on!
- One should, then, not confuse arbitrage with **speculation**

Definition

Speculation is the activity of holding a good or security in the hope of profiting from a future rise in price

- Speculation $\longleftrightarrow$ *expectation of a higher price in the future* $\longrightarrow$ willingness to *take risk* for this reason

Speculation

- Speculation is inherently risky, since the price he/she speculates on fluctuates randomly, ie. its exact value is not known in advance at the time a speculative position is taken
- In any market, then, there can potentially be three different kinds of agents or market participants:
  - traders - setting the underlying "fundamental" demand and supply
  - arbitrageurs - exploiting local price differentials
  - speculators - taking risky positions on the future path of prices
- Theoretically, the distinction between the activities of trading, arbitraging and speculating is clear, but
  - in practice it is often virtually impossible to separate the different classes of transactors
- This latter point is especially important in the context of policy measures
- Also, legally convincing distinction may be elusive, which is precisely the problem faced by law enforcement agencies

Examples

Example

Could the price of potatoes in Helsinki deviate from the price in eg. Tampere? You can apply the modified LOP directly to argue that transaction costs C can generate a price differential between the two locations. Transaction costs can be quite substantial in this case, since potatoes are costly to move from one location to another. However, provided we allow for the transaction costs and make sure that we are looking at the same quality of potato in each case, we are likely to find that prices in the two cities are very close to each other. Note that the question of where the potatoes have been grown is irrelevant. Also, we do not rely on the existence of arbitrageurs. As long as retailers are competitive, they are likely to keep the price deviations within the range set by the transaction costs, ie. genuinely competitive distributors (wholesalers or retailers) will themselves act as arbitrageurs.

Examples

Example

Take a typical manufactured good, say, a folding umbrella made in China. Can we be sure that its price is uniform across Finland? First guess: no, the price even varies from shop to shop in the same town; that's why we shop around, n'est pas? Not really, we tend to shop, because we want to compare different makes of goods and to compare different models produced by the same manufacturer. But the LOP relates ONLY to identical goods. Even so, don't prices vary even for genuinely identical goods? Yes, they do, if we look in different shops. The reason lies in large part in the fact that a shopper buys not the umbrella, but also the services of the retailer that sells it. We can, then, include the costs due to these services under transaction costs without destroying the content of the concept itself.

Examples

Example

Compare the price of houses in the north of Finland (Rovaniemi) and south (Helsinki). How can we find genuinely identical houses in the two different locations? A house in Rovaniemi is simply NOT the same as a house in Helsinki. The difference is attributable in the first instance to local market conditions. However, it is sustained by one obvious fact : houses cannot be moved (really?) from one end of the country to another. The transaction costs are not only high, they are infinite, at least in the short-run. Since arbitrage have to be ruled out in this case, does it follow that the price of houses in the two locations can diverge without limit? There is no clear answer to this quesiton, but it is certainly possible that there are forces that prevent prices diverging indefinitely (eg. prices in Rovaniemi may fall so much to justify flying to work to Helsinki from Rovaniemi on a daily basis, or builders may divert resources to Helsinki to increase the supply of houses). Over the long-run then, there could be such forces acting to prevent prices diverging without limit.

Examples

Example

A haircut. To avoid problems of comparability, assume we are talking about a standard haircut, "of the kind favoured by old-fashioned men (like the author)" (Copeland, p. 54). Note first that nothing in the economy relies on a distinction between the market for goods and the market for services. So, can the price of a haircut in Helsinki deviate from the one in Rovaniemi? Plainly the answer is yes, and substantially so. Even under similar demand conditions, the cost of the main hairdressing inputs (wages, rents and so on) is greater in Helsinki than in Rovaniemi, so the supply curve is in Helsinki further to the left. Arbitrage in the normal sense is rule out, so that in the short-run price differentials can be substantial. For this reason, we can describe services such as hairdressing, motor vehicle repairing, plumbing, medical services (video surgery!) and so on as well as some goods (houses!) as **non-traded**.

LOP in the Open Economy: non traded goods

Definition

Non-traded goods (non-tradeables) are items (usually services) for which interregional price differentials cannot be eliminated by arbitrage

- Note: no reference is made to goods for which price differential can never be eliminated
- Essential: goods that cannot be moved between locations to exploit price differentials
- Now, what if the two locations lie in different side of the country's border? $\longrightarrow$ LOP in open economies
- How do we need to change our conclusions?
- One significant change is required: take the following example

LOP in the Open Economy

Example

An travel agency in NY also sells tickets to Robin Williams's concert in London. If you make him/her an offer, he/she will sell the concert separately. How will the price that he/she can get for them compare with the price of £50 in London? First of all, prices in NY are quoted in US $'s, not in UK £'s so we cannot directly compare prices in NY and London in the same way we compare prices in London and Manchester. So, we need to transform US $'s into UK £'s using the official US-UK **exchange rate** (= the price of a unit of foreign currency in terms of domestic currency). Suppose that the exchange rate is $1\$ = 0.80£$

$$£ \text{ price of a dollar} \times \$ \text{ price of a ticket} = £ \text{ price of a ticket}$$

LOP in the Open Economy

Example

(cntd) So, since we use the letter S to denote the (nominal) exchange rate, SP^{NY} is the overall price to a Londoner for the ticket, where P^{NY} denotes the US \$ price of the ticket. Similarly, if you start from the UK £ price of the ticket of £50 and you know that the official US \$ price of the UK £ sterling is $1/S = 1/0.80 = 1.25$ US \$ per UK £, then the US \$ price of the ticket is $1.25 \times 50 = 62.50\$$. So if the travel agency in NY wants to sell tickets at 100 \$, everybody is adviced not to call to order tickets in NY. If there are competitors to the NY travel agency in selling tickets to the concert, the can **undercut** NY competition by 37.50\$!

- Let us represent the equilibrium in formal terms: previously we introduced an equation relating prices in Birmingham and Londom; the open economy version of this equation is

LOP in the Open Economy

$$P^L = SP^{NY} + C$$

- That is: London price for the ticket ($\$50$) is equal to the (current) US-UK exchange rate ($1\$ = 0.80\$$) times the NY price for the ticke ($62.50) plus possible transaction costs
- All the other points made in the context of the closed economy LOP follow in an obvious fashion
- London speculators face and additional risk, however:
  - given ticket sales in NY, they speculate on the underlying demand for tickets AND also on the exchange rate
- What about other closed economy examples, eg. potatoes and umbrellas?
  - transaction costs are even higher in the international than in the interregional context
- Another difference between open and closed economy: government made barriers to the cross-border trade

LOP in the Open Economy

Definition

A **tariff** is a tax levied on goods crossing an international border

- Impact of tariffs in open economies?
- Vast literature, one conclusion stands out:
  - it represent another factor likely to drive a wedge between foreign and domestic prices
  - can be levied at a flat rate per unit $\longrightarrow$ inflating the value of the transaction portmanteau term C
  - more frequently, it consists of a more or less ad valorem tax - one levied in proportion to the price per unit
- Quotas - often used in the context of agricultural products - represent yet another form of barriers to intl trade
- Note also other non-tariff barriers, like prohibitions concerning import of certain agricultural products, manufactured products (dangerous toys, weapons etc)

LOP in the Open Economy: non-tradables vs tradable

- In the case of non-tradeables, man made (government made) barriers to intl trade are often fewer than for **tradeables**
- More often than not, the only obstacles in this case are usually physical ones that apply equally in a closed economy
  - hence the price of a service like haircut in Helsinki may turn out to be almost as close to the price in Stockholm as it is to the price in Jyväskylä
- In the end, the question of how closely the intl LOP fits the facts cannot be settled by theory
  - need empirical evidence
  - need to compare prices of individual goods and services carefully across different countries
- A warning concerning a fallacy:
  - fact: a tiny percentage of sales of this type of a good (or service) involves exports (or imports)
  - so without arbitrage between the domestic and foreign markets, there can be very little relationship between prices at home and abroad

LOP in the Open Economy

- Why a fallacy? The fact that there has been a death penalty for drunken driving and that an assumption that one year we do not observe executions does not imply that the tough policy has failed in that year!
- Ie. the threat of losing markets to foreign competition, particularly when enterprising arbitrageurs are around, may well have a decisive impact on prices *without any trade taking place at all*!
  - contestability!
  - better to talk about 'non-tradeables' and 'tradeables' rather than 'non-traded' and 'traded' goods
- So far, we have talked about prices of individual, identical goods
- Need to turn our attention to the price of goods in general - general price level
  - to measure the general price level, we need a price index or price indices

Price Indices

Definition

A **(consumer) price index** is a weighted average of individual product prices, with weights determined by expenditure shares

- Once prices of individual goods have risen, people want to know how these affect the cost of living
- So, if, for example, the price of salt has doubled and petrol has gone up by 3 %, we would like to know how our cost of living has been affected
- Assume, for the sake of argument, that the expenditure share of salt is 0.1% and that of petrol 5%, then the overall effect on the general price level is

$$(0.001 \times 100\%) + (0.05 \times 3\%) = 0.1\% + 0.15\% = 0.25\%$$

- Note that there is the hidden term corresponding to those prices that have remained constant

Price Indices

$$(0.949 \times 0.0\%) = 0.0\%$$

- The weights in the price index sum to unity, hence $0.949 = 1 - 0.001 - 0.05$
- Note: when you compare the effect of an increase in the price of an individual good on the general price level, it is important to bear in mind the expenditure shares need not stay constant as in the above calculations
  - for small price changes we, to a first approximation, assume constant expenditure shares
  - for large price changes, we can get a totally misleading picture of the effect of an increase in the price of a single good on the general price level
    - think of the price of petrol rising overnight by 200%; if we assume a constant expenditure share, this implies an effect on the consumer price index of $0.05 \times 200 = 10\%$!; we never observed such effects back in time

Price Indices

- ← microeconomics of consumer demand at play here; in particular, the budget line and changes thereof once individual prices change
- Note further that the general price level, ie. weighted average of individual prices is unit-dependent
  - due caution in comparing price levels then
  - construct a time series for the price index by choosing the base year, when the price index has the value of 1 (100)
    - this time series gives us information about the cumulative change in the price level (index) relative to the base year
- Compare only **changes** in the general price level
  - gives you percentage increase in the price level - inflation - but since when?
  - choice of base year almost always arbitrary

Purchasing Power Parity (PPP)

- Compare prices in Finland and the USA
- Assume neglible transaction costs, so that LOP holds for all prices of domestic and foreign goods, P_i and P_i^f, $i = 1, 2, ..., N$
  - hence N goods in each country, f signifies 'foreign'
- Since transaction costs C are assumed to be zero, we can write our LOP equation as

$$P_i = SP_i^f, \quad i = 1, \ldots, N$$

- What about the price indices in the two country?
- If the expenditure weights are equal in the two countries, we can be sure that the LOP holds for price levels too:

$$P = SP^f$$

- This is the simplest version of the **Purchasing Power Parity (PPP)**

Absolute PPP: microeconomic background

- Since the above refers to price *levels*, the version of PPP has come to be called the **absolute** PPP doctrine, which amounts to the following proposition:

The general level of prices, when converted to a common currency, will be the same in every country

- PPP predicts equality of price levels when converted to a common currency; it says nothing about the mechanism that brings about and sustains the equality
- One possibility: microeconomics
  - LOP at the level of individual prices holds, so arbitrageurs or competitive forces will ensure equality of price levels too

Absolute PPP: macroeconomics

- Want a *macroeconomic* explanation
- Look how price level is determined in a closed economy ← macroeconomic policy (monetary policy in particular)
- The exchange rate moves appropriately to secure equality of two country's price levels
- Three points about the macroeconomic view of the PPP are worth mentioning:
  - the macroeconomic view interpretes the above PPP equation as determining the exchange rate ← monetary model of the exchange rate
  - the above scenario presupposes floating exchange rates
    - under fixed exchange rates, PPP fails or is supposed to work differently ← monetary model of the BoP
  - macroeconomic approach does not rely on the LOP
    - PPP may still apply, even under wide divergence of individual prices; eg. price of haircut not equalized, but PPP - equality of cost of living - may still broadly hold

PPP: robust to small deviations at the level of individual goods

- Note that since an aggregate price level is an average of individual prices, LOP need not hold for all prices in order for PPP to hold: positive deviation offset by negative ones (from LOP) sufficient to sustain PPP
- Note also that expenditure shares need not be equal: one good with a weight of 1% is overpriced by 50%, so that its contribution to the price level is $(0.001 \times 50) = 0.5\%$ has to be matched by a good (goods) with a weight of eg. 5% and underpricing of 10%, ie. $(0.05 \times (-10)) = -0.5\%$
  - may seem unlikely, but the validity of PPP can only be settled by empirical evidence
    - "the proof of the pudding is in the eating"
- Price indices are not perfect measures of the underlying general price levels; problems are more acute in an open economy context
  - the usual problems with the quality of goods and services, prices actually paid vs listed prices

PPP: testability

- Given the problems listed above, PPP is a dead duck, no need to consult data?
- Premature, misguided conclusion!
  - even if the data does not favour PPP, it may hold in reality, but poor quality of the measured data does not allow us to confirm this
    - ie. PPP may hold for the true, *unobservable* price level variables that are only very weakly related to observable, measured price level variables
- So, PPP is *untestable*?
  - not necessarily: if the true price level variables are related to other observables, then PPP hypothesis becomes fully operational
- In any case, PPP is an important benchmark for the analysis of exchange rate movements in so far as they impinge on international competitiveness
  - general price level a reasonable measure of cost of production in a country $\longrightarrow$ the ratio of price levels in two countries will serve as a measure of relative competitiveness

Real Exchange Rate

- If PPP works this way, competitiveness should not only be constant, but equalized across countries!
- Data: international competitiveness has varied a lot in the post WWII period $\longrightarrow$ use **real exchange rate** as a measure of deviations from PPP

Definition

The **real exchange rate** is the price of foreign relative to domestic goods and services

- Formally

$$Q = \frac{SP^f}{P}$$

- "Nominal exchange rate S **corrected for relative prices** $\frac{P^f}{P}$"
- PPP $\longrightarrow Q = 1$
- Q is a problematic measure: its values will change once we change the base year of the price indices; hence work with changes in Q

Q2: inflation differentials and the nominal exchange rate

- Take logs of the PPP relation and denote log variables by small letters, $x = \ln X$

$$p = p^f + s$$

- Let dx signify change

$$dp = dp^f + ds$$

ie. domestic *inflation (log-change!) is equal to the sum of foreign inflation and rate of currency depreciation*

- Re-write the last equation as

$$dp - dp^f = ds$$

- This is interesting: domestic country can run higher inflation than the foreign country only if its exchange rate falls pro rata

Q3: relative PPP

- Interpretation: as prices rise the value of money falls
- In an open economy context prices rise relative to the ROW, so "money loses value" has to be interpreted in the intl context as domestic currency depreciating
- Expressing PPP in terms of rates of changes puts the emphasis on **relative** PPP instead of the absolute PPP encountered previously
- In the context of the LOP we emphasized the need for pay attention to transaction costs (transportation costs, tariffs, non-tariff barriers); what about PPP, surely all the problems are present here too.
- Economics literature has dealt with this problem in two ways:
  - transaction costs are generally small, so we can continue to work with absolute or relative PPP in problems under considerations
  - if not negligible, most of the main elements of total costs vary in proportion to the value of the goods in question; if these costs are proportional to the price then they would not appear in the relative PPP model, but to see this more clearly, start with the absolute PPP

Q4: transaction costs again

$$P = K\left(SP^f\right)$$

- K is a constant larger than one; take logs

$$p = k + s + p^f$$

and deriving the underlying rates of changes

$$dp = ds + dp^f$$

- If neither of the above is correct, then one alternative is to derive the equilbrium real exchange rate (from an appropriate model) that obtains only in the long-run: ie. relative PPP holds in the long-run with short-run deviations allowed for
- Also, one could use the distinction between non-tradeables and tradeables and argue that PPP holds only for tradeables
  - possible problem (already alluded to): rigid division of the economy into non-traded and traded sector may not, in the end, be more realistic than assuming all goods are traded goods!

PPP and Facts

- PPP CAN break down among industrialized countries, see the figures from Copeland (p. 69-70)
- Figure 2.1-2.2.
  - Q has varied a lot for the five countries relative to the USA (France, Germany, Japan, Switzerland, UK)
  - towards late 1970's all these five appreciated against the US $ and depreciated sharply towards the mid 1980's
  - 1990's is more stable, helped by the convergence among European economies
  - developments specific to each country can also affect the value of the US $
- Note: amplitude of the fluctuations - they should be flat under (relative) PPP
- Actually, data can be provided to sustain the claim that real exchante rates track the movements in *nominal* exchange rates!

PPP and Facts

- Figure 2.3-2.4
  - facts in a different form: nominal exchange rate against the US $ required to preserve the same real exchange rate as in 1980
    - ie. nominal exchange rate in 1980 adjusted for change in the price ratio
    - in the figures it is the average spot rate actually observed over the year in question (multiplied by 100), so when this ratio is above 100 the exchange rate is overvalued relative to the US $
- Figures confirm protracted convergence to long-run PPP?
  - problems: an optical illusion, since if we change the base year a different picture emerges; no guarantee that fluctuations in these currencies will not take them far in the coming years
- Note finally, exchange rates have varied much more than price levels

Non-traded vs traded goods: Balassa-Samuelson

- Main observation: productivity rises more rapidly in the traded goods sector than in the non-traded goods sector
  - a fact in the industrialized world?
- Implication: wages will tend to rise more rapidly in the traded goods sector than in the non-traded goods sector, as employers compete more fiercely for labour thus bidding up wages
- Integrated, national labour markets - free labour mobility across sectors - will then imply that wages will be uniform in the economy
  - this despite lower productivity growth in the non-traded goods sector
- Hence, prices in the non-traded goods sector will have to rise relative to traded goods sector to maintain profitability in the former

Trade Costs and Adjustment to PPP

- International trade involves trade costs
- In many cases these costs are unrelated to the value of goods being shipped (e.g. fixed costs)
- Implies a neutral zone for intl price differentials, within which deviations from the LOP can persist more or less indefinitely
  - only when deviations are large enough, exceeding a threshold do prices finally react
- Researchers have tested a model for the real exchange rate under adustment costs

$$q_t - \widetilde{q}_{t-1} = f\left[\left(q_{t-1} - \widetilde{q}_{t-1}\right), z_{t-1}\right] \varphi\left(\widetilde{q}_{t-1} - q_{t-1}\right), \ 0 < f_1 < 1$$

where q_{t-1} is the log of the period t-1 real exchange rate, while $\widetilde{q}_{t-1}$ denotes the corresponding equilibrium real exchange rate

Adjustment to PPP

- The function f takes values between 0 and 1; f_1 denotes partial derivative w.r.t. the first argument $\frac{\partial f}{\partial(q_{t-1}-\widetilde{q}_{t-1})}$; z summarizes the list of other factors that may affect the real exchange rate
- The real exchange rate thus adjusts less rapidly to smaller shocks, which is consistent with empirical evidence from high and low inflation countries
- In the **Iceberg Model** transaction costs are linearly related to the value of goods shipped
- If importers pay for all the costs due to transportation, insurance, wastage etc, then by assuming that a proportion τ of every unit of goods shipped internationally is lost or consumed in the form of shipping costs, then the importer receives only the remaining $1-\tau$ that survives the voyage
- Goods will thus set for different prices depending where they originate

Iceberg Model

- If a foreign good j is imported to Finland, then the relationship between the price of the good in its country of origin, P_j^f, and home P_j is given by

$$P_j = \frac{P_j^f}{1-\tau}$$

- Why? To import one unit of the good to Finland the Finnish importer has to buy $\frac{1}{1-\tau}$ units of the good, since only $1-\tau$ units will survive the voyage
- If the foreign importer also has to suffer similar costs of wastage, then the price of a Finnish export good k is lower in Finland than in the corresponding foreign country

$$P_k = (1-\tau)\, P_k^f$$

- Hence

$$\frac{P_k}{P_j} = (1-\tau)^2 \frac{P_k^f}{P_j^f}$$

Incomplete Pass-Through

- The type of costs alluded to above are, according to authors like Obstfeld and Rogoff, important sources of distortions to relative prices
  - these distortions could explain some of the apparent anomalies in the pattern of international payments
  - these distortion have important implications for open economy macroeconomics
  - for us: yet another possible explanation for the failure of PPP
- A 10% devaluation will not, according to evidence at least, cause exporters to cut their prices by 10%.
- If so, **the pass-through** from exchange rate movements to prices is **incomplete**, ie. less than 100%. Why?
- Currency is a cost item to importers no matter what type of an importer we are talking about
- Hence, the question is: how does a typical importer, buying from an exporter, deal with an increase in costs?

Pass-Through

- Obvious: in order to keep its profit margin constant, a US firm exporting to Finland only needs to adjust its export price in proportion to the *net* impact of an exchange rate change
- Currency content of costs: US exporter uses inputs priced in different currencies; e.g. 75% of its inputs are priced in the US $, and 25% in euros (and/or currencies related to the euro)
- Hence, a 10% appreciation of the foreign currency will lead "only" to 7.5% increase in the no-arbitrage PPP home currency price of the good supplied by the US exporter
  - the remaining 2.5% is accounted for by a fall in the euro price
- Many reasons why firms are reluctant, starting form the fact that exchange rate movements are typically *high frequency movements*
  - changes in costs are of lower frequency; from this perspective then, much noise in exchange rate movement

Empirical Research

- Furthermore: *long-term contracts and menu costs*
  - long-term contracts: supply at fixed prices, implying that suppliers absorb volatility in S in their profits unless positions are hedged in e.g. forward markets
  - menu costs: costs of actually publicizing price changes - costs of printing, advertising, informing customers etc
- Costs from market entry or establishing the presence in markets - sunk costs and irreversible investment whose payoff is the flow of future profits
- Important: for all the above to be valid, we need to assume that the relevant firms are able to sustain a policy of *price discrimination*
  - essentially: set a different price in home and foreign markets
- **Empirical evidence?** PPP is one of the most researched topics in economics

Random Walk

- Evidence from simple univariate time series regression have not been encouraging: in fact, the so called *random walk* appears to be most successful in explaining observed (short-term) changes in real exchange rates

$$q_t = q_{t-1} + u_t$$

where the error term u_t is zero mean random shock unrelated to any previous history

Fact

This is the so called pure random walk or driftless random walk. If we add a constant to the r.h.s. of the above equation, we have a random walk with drift

- Implications:
  1. Future changes in the real exchange rate are unpredictable with current information

$$\mathbb{E}_t \left(q_{t+k} - q_{t+k-1} \right) = \mathbb{E}_t \left(u_{t+k} \right) = 0, \quad k > 0$$

Random Walk

- 2. The best predictor of the value of the future real exchange rate is the current value of the real exchange rate

$$\begin{aligned} q_{t+k} &= q_{t+k-1} + u_{t+k} \\ &= q_{t+k-2} + u_{t+k-1} + u_{t+k} \\ &= \dots \\ &= q_t + u_{t+1} + u_{t+2} + \dots + u_{t+k} \Longrightarrow \\ \mathbb{E}_t\left(q_{t+k}\right) &= \mathbb{E}_t\left(q_t + u_{t+1} + u_{t+2} + \dots + u_{t+k}\right) = q_t, \quad k > 0 \end{aligned}$$

Random Walk

- The first implication resembles the one of the efficient market hypothesis: future changes in asset prices are unpredictable with current information
- The second implication says that a shock to the real exchange rate, say $u_t = 10\%$ has a **permanent** effect on the real exchange rate: if the current real exchange rate weakens by 10% (q_t increases by 10%), then we expect the future real exchange rate, no matter how far into the future, to be at the level where it is this period after the shock!
- Hence, there's no **mean reversion** in the real exchange rate if it is generated by a random walk: mean reversion would imply that for a given positive shock today, say $u_t = 10\%$, one would *expect* the real exchange rate to fall from tomorrow onwards (e.g. negative future shocks on average more likely)
- Application of new econometric techniques, e.g. those for *panel data* have produced results more favourable to PPP

Distance Matters

- Current evidence suggests that deviations from PPP have a *half life* of 3.5-5 years depending on the currency pair, price indices, sample period etc
  - painfully long still?
- New approaches to PPP have also served to refocus the attention of the research community to the LOP
- Already in 1970's researchers found evidence on the substantial deviations based on the simple regression test

$$p_i^f + s = a + bp_i + u$$

- LOP $\Longrightarrow (a, b) = (0, 1)$; this condition was mostly not satisfied
- Recent research has tended to confirm this negative conclusion

Distance Matters

- In particular: compare deviations within states and regions of the USA and Canada with deviations between North America and other countries
- Under fully integrated intl goods market deviations from LOP would be attributable to the distance goods have to travel
- Once allowance is made for distance, deviations should not on average be greater between countries than between regions and cities in the same country
- Authors have found: an intl border has the same effect as would an additional 75 000 miles between cities in the same country!

45 Degree Rule

- Detour: P. Krugman and the 45 degree rule

Intro

- Focus will now be shifted to financial assets and the relationships one would expect to find between domestic and foreign asset prices
- We shall concentrate on a conventional asset, ie. a single, standard security and stick to it throughtout the next few slides
- More specifically: think of a 12-month time deposit, ie. a deposit for a fixed term of one year, paying an annual interest rate at maturity and nothing before
- We shall focus on investment alternatives open to a representative investor with a large stock of wealth in liquid form
  - could also be an intl bank or company with a large stock of liquid funds
- Two identical deposits, one in a Finnish bank and one in a US bank, with the only difference being the currency
- Assumption: no barriers to intl transfer of funds
  - fairly realistic assumption nowadays
- Also, abstract from taxes that would affect the choice of where to deposit

Uncovered Interest Parity (UIP)

- You have €1; invest either domestically or internationally in the US markets
- **Investing domestically**: assume the domestic interest rate is r (expressed as a decimal)
  - after 12 months your payoff is $€(1 + r)$
- **Investing internationally in the US market**: assume US interest rate is r^f
  - change your euro into dollars using the official S: $€1 = \$\left(\frac{1}{S}\right)$
  - after 12 months your payoff in \$'s is $\$\left(1 + r^f\right)\left(\frac{1}{s}\right)$
  - you expect that the euro price of the US dollar will be S^e (e = expected) in 12 months
  - your expected payoff in euros will then be $\left(1 + r^f\right)\left(\frac{S^e}{S}\right)$

Equilibrium

- Compare the strategies: same type of deposits, same period, same kind of banks; hence, can we use the LOP to argue that the payoffs of the two strategies should be the same?
- Not quite, as the payoff of the foreign strategy involves expectations or a forecast of the end of the 12 month period exchange rate (S^e), while the domestic strategy is riskless!
- **Risk premium** is the concept we need here

Definition

Risk premium is the reward, usually in the form of anticipated excess return, that an economic agent gets in order to persuade him/her to bear risk

- Guess(?): people usually prefer riskless to risky investments, which explains why risky investments usually yield higher returns than riskless ones

Preferences

- More generally, agents' **attitudes towards risk** is determined by their preferences

Definition

Risk averters require a positive risk premium in order to persuade them to hold risky assets. **Risk lovers**, on the other hand, are willing to pay a premium for the privilege of bearing risk, while **risk neutral** agents are willing to do so in return for a zero-risk premium

- Assume for the moment that agents are broadly risk neutral
- Hence, there are no risk averters or risk lovers; agents are indifferent between an investment yielding a completely secure return and one offering the prospect of an identical return on average, but with the possibility of a much higher or lower return
  - agents are only concerned with average returns

Equal euro returns

- Under risk neutrality, the returns to the two strategies outlined above have to be equal:

Corollary

In equilibrium, the domestic and foreign strategies will have to yield the same euro returns

- In equilibrium agents (investors) have to be indifferent between the two deposits: otherwise a representative investor faces a 'one-way bet'
  - given our investor's expectations, ie. market expectations ($\Longleftarrow$ representative agent!) if euro returns are not equal (under these expectations) there will be a flood of investment either in or out of Finland
- Hence, we can formalize the equilibrium relationship between the returns as

$$1 + r = \left(1 + r^f\right)\left(\frac{S^e}{S}\right)$$

UIP

- A little bit of math: take (natural) logs of the both sides of the above equation (NB! $S^e = \mathbb{E}S'$, prime ' denotes future value, 12 months into the future)

$$\begin{aligned}
\ln(1+r) &= \ln\left(1+r^f\right) + \ln\left(\frac{S^e}{S}\right) \\
&= \ln\left(1+r^f\right) + \ln(S^e) - \ln(S) \\
&= \ln\left(1+r^f\right) + \ln(\mathbb{E}S') - \ln(S) \\
&\approx \ln\left(1+r^f\right) + \mathbb{E}\ln(S') - \ln(S)
\end{aligned}$$

- Also, for small $\ln(1+x) \approx x$, for small x; hence

$$r = r^f + s^e - s$$

UIP

- Above: $s^e = \mathbb{E}s' = \mathbb{E}\ln(S')$; define $\Delta s^e = s^e - s$, ie. **expected rate of change of the domestic currency** (expected depreciation); then

$$r = r^f + \Delta s^e$$

- This is the (approximate) **Uncovered Interest Rate Parity, UIP (or UIRP** as Copeland shortenes it); it requires that

The difference between the domestic and foreign interest rate has to be equal to the expected rate of change of the domestic currency

- The reasoning underlying UIP should be clear
  - if $r - r^f > \Delta s^e$ no investor would deposit money in US banks; US interest rates would have increase to strenghen the incentive of intl investors to deposit in US banks
  - if $r - r^f < \Delta s^e$ no investor would deposit money in Finnish banks; interest rates in Finland would have increase to strenghen the incentive of intl investors to deposit in Finnish banks

Covered Interest Rate Parity

- UIP has important implication in itself
  - looking at its defining equation, one has ask which of the variables are **endogenous** and which **exogenous**? Or what causes what?
- Depends on the structure of the model we choose to believe, but
  - in a small open economy context, foreign interest rates can be taken by domestic agents as given (ie. not influenced by the actions of domestic agents)
  - forex operators may have their own view of where exhange rates are going in the future or they consult sources like professional forecasters
    - it may be difficult for authorities to affect these predictions or views (?)
- Hence, as a first guess, the variables in the r.h.s. of the UIP equation may be taken as given; hence, the l.h.s. also has to be taken as given
  - small open economy cannot affect or control its interest rates then!

Covered Interest Parity

- If agents make intl investment decision based on UIP, then they in general assume risk - taking forex positions is based on UIP is more like speculation rather than arbitrage
- Under risk neutrality, the underlying exchange rate risk is of no consequence to the decision of risk neutral agents
- If, on the other hand, agents (markets) are risk averse, they are willing to pay for not having to bear the risk
- Entering into a **forward contract** with another agent also willing to trade risk - mutual benefits from sharing risk!

Definition

The **spot (exchange) rate** is the rate figuring in agreements to exchange one currency for another more or less immediately ("simulataneous change of cash")

CIP

Definition

The **t period (e.g. 1-,3- or 12-month) forward (exchange) rate** is the rate that appears in contracts to exchange one currency to another t periods (e.g. 1-, 3- or 12- months) in advance of the actual transaction

- So: you go to a local Finnish bank, explain there that you will receive US dollars in 12 months and ask there what is the current price for those dollars delivered in 12 months
- Note: no currency actually changes hands between the parties to a forward contract at the time it is signed
  - parties just contract to exchange currency for another, at the specified forward rate, at some point in the future (called the **maturity date**)
- The advantage of the forward contract to an agent making a deposit to a foreign country is that he/she is *guaranteed* a prespecified return on his/her intl deposit

CIP

- That is the transaction (intl deposit) can be made riskless; the depositor can sell the risk using forward contracts and it is for this reason that the investor is 'covered' or insured against the risk in the interest rate arbitrage process
- Now that we are dealing with riskless transactions (arbitrage in the proper sense of the word), we can invoke the LOP to argue that the returns of the two strategies, the foreign being one where the depositor can sell the exchange rate risk using a forward contract, have to be equal

$$1 + r = \left(1 + r^f\right)\left(\frac{F}{S}\right)$$

where F denote the (12-month) forward exchange rate for US dollars; this is the (exact) CIP

- Now, a little bit of math (again!)

$$\frac{F}{S} = \frac{S + F - S}{S} = 1 + \underbrace{\frac{F - S}{S}}_{} = 1 + fp$$

CIP

- This gives rise to the following definition

Definition

The **forward premium (discount)** is the proportion by which a country's forward exchange rate exceeds (fall below) its spot rate

Example

If the current euro price of the US dollar is \$1 = €0.74 ($=S$) and the 12-month forward rate for the US \$ is \$1=€0.80 ($=F$), then the forward premium for the US \$ (the forward discount for the euro) is $fp = \frac{F}{S} - 1 = \frac{0.80}{0.74} - 1 = 1.08 - 1 = 0.08$ or 8%.

- Taking (natural) logs of the CIP and using the properties of the 'ln' -function, we can derive the approximate CIP

$$r = r^f + fp$$

Borrowing and lending1

- Hence: *the difference between domestic and foreign interest rate has to be equal to the forward premium (discount) on the domestic currency*
- Hitherto we have assumed that the investor has funds of his/her own to invest internationally
  - this does not reflect the power of arbitrage in its full, however
- Now, assume the investor does not have own funds, but instead borrows them to invest internationally
- Assume a Finnish investor borrows €1 from a bank; assume domestic 12-month interest rate of 5% applicable to borrowing and lending
  - **domestic strategy**
    - borrow €1 at 5% for 12 months,
    - deposit €1 at 5% for 12 months, liquidate deposit after 12 months at a gross return of €1.05
    - repay loan: €1.05; net position = 0

Borrowing and lending2

- - **foreign strategy** (assuming euro expected to depreciate €0.75 $\Longrightarrow$ €0.80 per US $)
    - borrow €1 at 5% for 12 months, buy US dollars @€0.75 each
    - deposit $1.33 at 6% for 12 months in a US bank, liquidate deposit after 12 months at a gross return of $1.41
    - convert back to euros; sell $ @ €0.80 each = €1.28
    - repay loan: €1.05; net position = 1.28 - 1.05 = €0.23
- Making a deposit to the USA generates a profit of €0.23 per €1 borrowed

Borrowing and lending3

- Domestic deposit breaks even (we are ignoring transaction costs both for borrowing and lending and for currency conversion)
- To look closer to the steps taken above, start with the following definition:

Definition

An investor who has a **liability (an asset)** denominated in a specific currency is said to have a **short (long) position** in that currency

- So, the investor starts by taking a short position in euro
- In the domestic strategy, the next step is to take a long position in euro of exactly €1 (via the deposit in the domestic bank)
- The net effect is to leave the investor in a balanced position in euros
- In the foreign strategy, the investor, after taking a short position in euro, takes a long position in dollars (converts borrowed euros into dollars)

Borrowing and Lending4

- Fluctuations in the € value of the $ during the investment period will alter the net foreign position which, initially, was balanced
  - this is the source of the exchange rate risk associated with the uncovered arbitrage transaction
- Here we assume that the $ appreciates during the investment period from $1=€0.74 to $1=€0.80, so the value of the long position in dollars appreciates to €1.28 by the time it is liquidated while the short position has risen as a result of accumulated interest on borrowing to only €1.05, leaving a net profit of €0.23
- Lessons to be drawn
  - be short in a depreciating currency; long in an appreciating currency
  - since speculation can be achieved by an agent who actually owns euros UIP does not need to rely on the existence of depositors living in the euroarea
  - currency risk arises whenever an investor's net position in a currency is non-zero; otherwise an investor has a hedged or covered position in the currency

Borrowing and Lending5

- Consider hedging the arbitrage in the previous example; hedging is achieved by selling the $ proceed on the forward market at the (initial) time the agent makes the deposit decision
- The unbalanced position at the start of the investment period that was the source of risk now disappears, because the investor who covers in the forward market has a zero net exposure throughout the investment period
- This outcome is achieved because the forward contract can be viewed as involving two simultaneous transactions:
  - a claim against the counterparty to collect € (hence a long position in €)
  - a commitment to deliver $ (a short position in $)
- Together the two transactions undertaken in signing the forward contract offset precisely the initial short position in € and long position in $ that arose when the investor borrowed € to deposit in the USA

Borrowing and Lending6

Fact

A forward sell of x dollars against y euros (a forward purchase of y euros with x dollars) is equivalent to lending (being long in) the present value of y euros and borrowing (being short in) the present value of x dollars

- The commitment to exchanging future claims (borrowing and lending) in the two currencies via the forward market must result in the same payoff as exchanging current claims in the spot market; hence, any difference in the exchange rate at which the two transactions occur must reflect differences in the interest rate on the two currencies

Borrowing and Lending7

- In hedging terms:
  - the proceeds from the $ deposit could be hedged without recourse to the forward market by borrowing $1.33 at the start of the investment period, converting to € on the spot and leaving the €1 on deposit for 12 months
  - after 12 months the gross payoff of the € deposit is €1.05 - just enough to pay the initial €1 loan and interest
  - the $1.33 borrowing on which $1.41 will be owed can be repaid from the original deposit in the USA
- Hence: the original borrowing/lending mix is put into reverse, thereby *unwinding* the original position

CIP - Facts

- Unwinding is common in currency markets, under the following guise:

Definition

A **(plain) currency swap deal** involves two parties in the exchange of principal and interest payments on a loan in one currency for principal and interest payments in another currency

- Compare now UIP and CIP
  - CIP does not make any assumptions about the behaviour or tastes, expectations formation or attitudes towards risk of agents operating in the market; CIP requires three conditions

1. a. there must be sufficient speculation funds available - free funds for arbitrageurs in the sense of liquid funds and unconstrained by restrictions on intl capital movements
   b. forex markets (spot or forward) have to be well organized - well-defined and well-publicized rates freely available to a group of informed traders committed to exploiting any profit opportunities that crop up

CIP - Facts

- c. transaction costs have to be sufficiently low to be negligible - otherwise we could observe deviations from CIP to the full extent of trading costs
- When taking the CIP and UIP to the data, we cannot neglect the issue of transaction costs altogether
- Hence the relevant question is:
  - has the gap between intl interest rate differentials and the respective forward premium been within the bounds one would expect to find, given the size of dealing costs?
- Ie. is the gap between the l.h.s. and r.h.s. of the CIP equation too small to represent an unexploited profit opportunity, after allowing for transaction costs? Formally, is the following inequality satisfied

$$\left|(1+r)-\left(1+r^{f}\right)\left(\frac{F}{S}\right)\right|<c$$

where c denotes the cost of carrying out the transaction?

Efficient Markets

- Estimating these costs in practice is non-trivial, however, e.g. do we restrict ourselves to arbitrage using only own funds, or should we consider also costs of borrowed funds
- The evidence, on balance, suggests *there are few unexploited opportunities for riskless profit in covered interest arbitrage*
- **How is with the UIP then?** What does the evidence say?
- First problem: not all of the variable in the UIP condition are directly observable - exchange rate expectations!
- We could try different assumption here and the general idea would be to exploit any assumption that allows us to substitute an observable, quantifiable data series for the term Δs^e in the UIP equation
- One major drawback here however: **the joint hypothesis problem (JHP)**

Efficient Markets

- JHP implies that a rejection of UIP can either be due to the assumption concerning expectations formation or to UIP not being supported by the data
- Since the empirical validity of the UIP involves deep questions/problems related to market expectations, we will return to this issue later
- Relationship between CIP and UIP? If $F = S^e$ or $fp = \Delta s^e$, then CIP and UIP are equal: anyway, CIP still continue to apply even if this equality does not hold
- Equality of the forward rate and expected spot rate (at the corresponding maturity) is by no means trivial! Anyway, if we continue to assume risk neutrality, then any difference between the forward rate and expected spot rate means that investors can profit by backing their views - ie. by speculating!

Efficient Markets

- Generalizing to market level: treating the market as a single individual, then equilibrium would entail a forward rate equal to the consensus view of the future spot rate: otherwise there would be excess demand/supply of forward exchange, which would itself tend to move the rate towards its equilibrium level
- This leads to the following definition:

Definition

Unbiasedness applies when the k-period (e.g. 3-, 6- or 12-month) forward rate is equal to the spot rate that the market expects to see prevailing when the contract in question matures

- This is a particular example of a very general concept: market efficiency
- **Efficient markets** can be characterized as ones where prices fully reflect all the available information; there are therefore, no unexploited opportunities for profits

Risk Premium

- Unbiasedness on the other hand is a very clearly defined state and therefore a special case of market efficiency
- Unbiasedness implicitly assumes a particular market model, where the following conditions apply:
  - adequate number of well-funded and well-informed agents in the currency market, with broadly similar views about the likely future developments; market prices are well-defined
  - no barriers to trade in the markets (no exchange controls) and no costs to dealing (no transaction costs)
  - investors are risk neutral
- Note that we can decompose the forward premium as follows

$$\begin{aligned} \left(\frac{F}{S}\right) &= \left(\frac{F}{S^e}\frac{S^e}{S}\right) \Longrightarrow \\ fp &= f - s^e + \Delta s^e \end{aligned}$$

Risk Premium

Definition

$f - s^e = rp$ is the risk premium on foreign currency

- Consequently (from CIP)

$$r = r^f + fp = r^f + \Delta s^e + rp$$

ie. it is the risk premium that has the potential to drive a wedge between CIP and UIP

- Now, what is the link between **Interest Rate Parity and PPP?**
- Start by asking the standard question in intertemporal consumption allocation, ie. savings decisions: how much does an individual want to consume this period ('now') and how much consumption should he/she be willing to defer to the next period ('tomorrow')?

PPP Revisited

- This choice, ie. the intertemporal structure of consumption, depends on the **real interest rate**
- Real interest rate is the relative price of consumption between today and tomorrow:
  - denoting by P and P' the price of a unit of consumption today and tomorrow respectively (ie. price level today and tomorrow)
  - reduce consumption today by one unit $\Longrightarrow$ save $€P$ $\Longrightarrow$ invest at (nominal) interest rate r
  - tomorrow: gross payoff to your investment $€P(1+r)$; you can by $(1+r)\left(\frac{P}{P'}\right)$ units of consumption
- $(1+r)\frac{P}{P'} = 1+R$, where R is the real interest rate

PPP Revisited

- $\frac{P'}{P} = 1 + \frac{P'-P}{P} = 1 + \pi'$, ie. the ratio of tomorrow's price level to today's price level is the **gross rate of inflation,** ie. $1 +$ rate of inflation (expected) between today and tomorrow
- Hence,

$$\begin{aligned} 1 + R &= (1 + r)\left(\frac{P}{P'}\right) = \frac{1 + r}{P'/P} \\ &= \frac{1 + r}{1 + \pi'} \end{aligned}$$

or

$$\begin{aligned} (1 + R)\left(1 + \pi'\right) &= 1 + r \\ r &\approx R + \pi' \end{aligned}$$

which holds for low and stable inflation rates (ie. to a first order of approximation)

PPP Revisited

- What actually matters about real interest rates for intertemporal consumption choices (savings decisions) is the **expected rate of inflation** instead of the actual realized inflation rate between today and tomorrow, so we should write the (approximate) **Fisher equation** as

$$r = R + \pi^e$$

  where π^e is the expected rate of (consumer price) inflation between today and tomorrow $(= \mathbb{E}\pi')$
- Now, $R = r - \pi^e$ is called the **ex ante** real interest rate and it emphasizes the perceived real interest rate at the time agents make intertemporal consumption, ie. savings decisions (the realize real interest rate $R' = r - \pi'$ is, for good reasons, called the **ex post** real interest rate)

PPP in Expectations

- Fisher equation is difficult to validate on observable data $\Longleftarrow$ joint hypothesis problem
- More often than not, it tends to be accepted by default in economics
- Now, let us tie everything together: suppose Fisher equation holds in the domestic as well as in the foreign economy

$$\begin{aligned} r &= R + \pi^e \\ r^f &= R^f + \pi^{fe} \end{aligned}$$

which imply

$$r - r^f = \left(R - R^f\right) + \left(\pi^e - \pi^{fe}\right)$$

PPP in Expectations

- If UIP holds, the l.h.s. of the above equation equals the expected rate of depreciation of the domestic currency, Δs^e

$$\Delta s^e = \left(R - R^f\right) + \left(\pi^e - \pi^{fe}\right)$$

- Hence: expected rate of depreciation reflects a) real interest rate differential between the domestic and foreign economy and b) expected inflation rate differential between the domestic and foreign economy
- Given the expected inflation differential, if the real interest rates are not equal capital will flow out of the country with the lower real interest rate
  - note: real interest rate is the key variable from the point of view of providing incentives to save, ie. shift consumption through time
- Hence, if $R - R^f = 0$

$$\Delta s^e = \pi^e - \pi^{fe}$$

$\Longleftarrow$ (relative) *PPP in expectations*

PPP in Expectations

- Point: PPP does not hold in observables, but does hold in unobservables
- Since the real exchange is defined by $Q = \frac{SP^f}{P}$ or $q = \ln(Q) = \ln(S) + \ln(P^f) - \ln(P) = s + p^f - p$, so that $\Delta q = \Delta s + \Delta p^f - \Delta p = \Delta s + \pi^f - \pi$, PPP in expectations asserts that

$$\Delta q^e = 0$$

  ie. the real exchange rate is not expected to change
- What does this mean? In time series terms $\Delta q^e = \mathbb{E}_t q_{t+1} - \mathbb{E}_t q_t = q^e_{t+1} - q_t = 0$ or

$$q^e_{t+1} = q_t$$

PPP in Expectations

- So, a typical agent in the market expects tomorrow's real exchange rate to be the same as today's
- In terms of time series statistics (models), there is a whole class of models consistent with the above equation, one of them being the simple random walk process
- Apparently random nature of the observed real exchange rate movements is actually not a gloomy conclusion at all, but a consequence of UIP and the equality of real interest rates across countries!
- Or: if trade in goods takes time, arbitrageurs will operate not on the basis of actual price differentials, but on the basis of their forecasts of price differentials when they complete trades?
- Two weaknesses in this argument
  - deviations from PPP (3-4 year half lives!) have far too long a life to be rationalized in this way
  - other factors (productivity related) than consumer preferences likely to affect real interest rates

PPP in Expectations

- **Relationship between interest rate parity (IRP), PPP and Fisher equation**: if UIP holds, we know that

$$\Delta s^e = \left(R - R^f\right) + \left(\pi^e - \pi^{fe}\right)$$

or

$$\Delta q^e = R - R^f$$

- In the most unlikely case where agents know the future paths for the domestic and foreign inflation rate as well as the future path for the rate of depreciation of the domestic currency

$$\Delta s^e = \Delta s, \pi^e = \pi, \ \pi^{fe} = \pi^f \Longrightarrow \Delta q^e = \Delta q$$

so that

$$\Delta q = R - R^f$$

- In this case, then movements in the real exchange rate reflects movements in the (real) interest rate differential

PPP in Expectations

- If real interest rates are driven to equality, the real exchange rates have to be constant, ie. PPP must hold; hence

Theorem

In a world where a) expectations are always correct, b) each country has the same real interest rate and c) agents are risk neutral, any two of the following relationships implies the third: the Fisher equation, UIP and PPP

- Meaning: in this particular case PPP, UIP and the Fisher equation are not independent relationships