EC933-G-AU INTERNATIONAL FINANCE – LECTURE 1

BASIC NOTIONS OF OPEN-ECONOMY MACROECONOMICS

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ABSTRACT. The *objective* of this first lecture is to revise in a more or less systematic way the basic notions of open-economy macroeconomics and to introduce some initial notation (maintained uniform throughout the course, as far as this proved possible). Its *structure* is organised as follows. Section 1 delimits the subject of our course and distinguishes between the main approaches to it. Key definitions and interpretations of the most essential concepts related to the exchange rate and the foreign exchange market are summarised in section 2; to the international interest-rate parity conditions in section 3; to the balance of payments and international reserves in section 4; and to the central bank's balance sheet and the mechanism of foreign exchange intervention in section 5. Finally, section 6 presents a synthetic approach to national accounting in the open economy, based on proposals from Gandolfo (2001).

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This set of lecture notes is preliminary and incomplete. It is based on parts of the four textbooks suggested as essential and supplementary reading for my graduate course in international finance at Essex as well as on the related literature (see the course outline and reading list at http://courses/essex.ac.uk/ec/ec933/). The notes are intended to be of some help to the students attending the course and, in this sense, many aspects of them will be clarified during lectures. The present second draft may be developed and completed in future revisions. The responsibility for any errors and misinterpretations is, of course, only mine. Comments are welcome, preferably by e-mail at mihailov@essex.ac.uk and/or a_mihailov@hotmail.com.

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1. Old and New Approaches to International Finance

International economics is generally regarded as consisting of (i) the (pure) theory of *international trade* and (ii) *international finance*. Traditionally, academic economists have tended to consider the two fields in separation, with international trade being modelled in *real* terms and international finance building on these real models by adding different *monetary* units, i.e. national currencies, and various financial instruments denominated in them. More recently, however, more and more people in the profession think that there is no good reason, or need, to divide trade from finance or real from monetary open-economy models. The separation has originated, it appears, mostly as the concepts and institutions of trade and finance have historically evolved to complement each other, as well as for analytical convenience and clarity.

Not so much because we would wish to remain faithful to the tradition but rather due to the limitations imposed when formulating the subject and content of the present graduate course, we shall deal here with issues pertaining to what may be called open-economy macroeconomics, that is, international finance rather than international trade (although trade will also be present). Anyway, *nuances* in the meaning of several labels that usually serve to designate a *similar* if not (always or necessarily) the same field of interest certainly exist. At least the following four (nuanced) synonyms are widely used as titles for courses (and textbooks) analogous to ours:

- international finance;
- international monetary economics;
- open-economy macroeconomics;
- international macroeconomics.

As mentioned, no matter certain nuances, the core of international finance, and hence of the present course, is delineated by this *common* field where the above labels overlap. Roughly, this common field focuses on the theories and policies of *balance-of-payments* and *exchange-rate* determination and adjustment.

One could distinguish two main methodological *approaches* to international finance. The *old /traditional/ approach* considers the balance of payments as a phenomenon to be studied as such, by exploring the specific *determinants* of trade and financial flows. It employs mostly *aggregative (ad-hoc)* partial equilibrium models, real or monetary. The approach has been widely used in older theory and is still a major (or preferred) analytical tool for policy makers. The *new /modern/ approach* views trade and financial flows as the *outcome* of intertemporally optimal saving-investment decisions by forward-looking agents. It constructs *optimising (microfounded)* monetary models, usually of the general equilibrium type. This is a recent approach, in fact, gaining more and more support since the mid-1990s.

Although we believe that future research will be guided by the modern approach, this is not for us a sufficient reason to neglect the traditional one. That is why we start this course by some basic theories framed in the old way, and later develop the newer models, which in certain aspects provide microfoundations for set-ups and results already known from the older aggregative frameworks. We also think that it is useful to have a historical and institutional perspective on how the traditional theories evolved, and to be able later to see in what sense the newer models revise, complement or enrich the older analytical settings and their policy implications.

We note as well that both approaches, the old and the new, have treated models of a *small open economy* (SOE) in *partial equilibrium* (PE) as well as models of a *two-country world economy* in *general equilibrium* (GE). This is another possible division – or, rather, classification – within the domain of international macromodelling, because some key assumptions and, hence, often (part of) the conclusions differ. Most importantly, SOE models assume that relative to the rest of the world (RoW), a particular domestic economy is sufficiently small, so that it cannot affect prices in world markets: it just takes them as given (or exogenous). By contrast, the alternative modelling strategy of having two large economies interact calls for a different set of assumptions and, correspondingly, general equilibrium (or even game-theoretic) approaches where each country influences world prices (or the strategies of other countries' authorities).

2. The Exchange Rate and the Forex Market

2.1. **The Exchange Rate or Exchange Rates?**

2.1.1. *Bilateral Exchange Rate(s).*
Nominal Exchange Rate(s): NER.
Definition(s). The exchange rate is the relative price between two national currencies. It can be expressed reciprocally:

$$\underbrace{S_t^{H/F} \equiv \frac{n \text{ units of domestic currency}}{1 \text{ unit of } \textit{foreign} \text{ currency}}}_{\textit{price} \text{ quotation system: } \textit{price of foreign currency} \text{ in terms of home currency}} \quad \text{or}$$

$$\underbrace{S_t^{F/H} \equiv \frac{n \text{ units of foreign currency}}{1 \text{ unit of } \textit{domestic} \text{ currency}}}_{\textit{volume} \text{ quotation system: } \textit{price of home currency} \text{ in terms of foreign currency}} . \tag{2.1}$$

The ratio in the superscripts in the notation[1] is a matter of convention. Distantly following Gandolfo's (2001) idea, we adopt the rule according to which the *denominator* of the superscript ratio[2] indicates the currency whose *price* (1 *unit*) is expressed in terms of (n units of) the other currency, in the superscript numerator.[3] More precisely, our notation should be interpreted in the following way. $S_t^{H/F}$ denotes the rate of exchange at time t (subscript) between the currencies of a fictitious country called $H(ome)$, also taken to be the domestic or national economy, and another imaginary country called $F(oreign)$, corresponding to some economy abroad or, in a general sense, "the rest of the world" (RoW). Our superscript is intended to show in which of the two possible reciprocal ways is the exchange rate defined: H/F says that what is expressed by the exchange rate is the (unit) price of the foreign currency in terms of (n units of) the home currency, as is the case in most countries, e.g. in the United States (US) or the European Monetary Union (EMU); by analogy, F/H denotes that what is expressed by the exchange rate is the (unit) price of the domestic or national currency in terms of (n units of) the foreign currency, as is the tradition notably in United Kingdom (UK). This will become clearer by some examples.

If we, like most textbooks, assume the US to be the *domestic* country in the present context, the bilateral exchange rates according to the *price* quotation system could be 1.069 (USD per 1 EUR) against the Eurozone (or Euroland, i.e. the EMU), 1.621 (USD per 1 GBP) against the UK or 0.00868 (USD per 1 JPY) against Japan. Reciprocally, according to the *volume* quotation system, the respective bilateral exchange rates will be $0.93545 = \frac{1}{1.069}$ (EUR per 1 USD) against the EMU, $0.6169 = \frac{1}{1.621}$ (GBP per 1 USD) against the UK or $115.20737 = \frac{1}{0.00868}$ (JPY per 1 USD) against Japan.

Depreciation of the domestic /national/ currency means that more units of the domestic /national/ currency buy 1 unit of the foreign currency with respect to some previous (e.g. $t-1$) period or, conversely, that less units of the foreign currency buy 1 unit of the domestic /national/ currency. Thus national currency depreciation is equivalent to an *increase* (↑) in the exchange rate according to the *price* quotation system, also sometimes termed the *academic* definition of the exchange rate (since usually found in the scientific journals) and a decrease (↓) in the exchange rate according to the volume quotation system, known as well as the policy-makers' definition of the exchange rate (since often implied by the IMF and national economic authorities).[4]

To define *appreciation* of the domestic /national/ currency, the *inverse* logic needs to be applied.

[1] Or the order of the two subscripts used in similar context in Gandolfo's (2001) textbook, chapter 2.

[2] The *first* subscript in Gandolfo (2001).

[3] The *second* subscript in Gandolfo (2001).

[4] In his textbook, chapter 1, Mark (2001) calls the price (or academic) quotation system "the exchange rate quoted in American terms" and the volume (or policy-makers') quotation system "the exchange rate quoted in European terms". But this reflects the viewpoint that the US dollar is (always) the domestic currency as well as the practice of quoting the USD in the US.

In line with the academic tradition, we shall also adopt the *price* quotation system in talking about "the exchange rate" further in this course. Hence, we shall avoid writing $S_t^{H/F}$ or $S_t^{F/H}$ (unless this is really required for the sake of clarity); but instead by just writing S_t we shall always understand $S_t^{H/F}$. For us, therefore, *depreciation* of the currency in consideration would coincide with an *increase* (↑) in its exchange rate whereas appreciation would signify a decrease (↓) in the exchange rate.

Arbitrage on (foreign) currencies can be defined as the simultaneous buying and selling of foreign currencies to profit from discrepancies between exchange rates of the *same* currencies existing at the *same* moment but in *different* financial centres, and with no transaction costs and no risks. To justify the latter two assumptions, Gandolfo notes that everything occurs almost instantaneously and simultaneously on the computer, telephone, telex or other such means of communication. Therefore such arbitrage does not tie up capital so that no cost of financing is involved and no exchange risk is incurred. The cost is just the fee for the use of the telephone lines or other communication systems.

Consistency /Neutrality/ Condition. Since $S_t^{H/F} = \frac{1}{S_t^{F/H}}$ and $S_t^{F/H} = \frac{1}{S_t^{H/F}}$, then

$$S_t^{H/F} S_t^{F/H} = S_t^{F/H} S_t^{H/F} = 1. \tag{2.2}$$

Two-Point Currency Arbitrage. It is implied by (2.2) above. Two-point arbitrage ensures that the exchange rate between any two currencies in any two financial centres is (or, more realistically, tends to be) the same. If this is not so, i.e. if the *actual* exchange rate between two given currencies does not coincide in two given financial centres and thus deviates from its *theoretical* equivalent level predicted by (2.2), arbitrageurs will start making profits until the law of demand and supply of the two currencies in each of the two financial centres does not equalise the diverging exchange rates.

Direct and Indirect /Cross/ Exchange Rate(s). More generally, for any three countries i, j and k

$$\underbrace{S_t^{i/j}}_{direct \text{ rate}} = \underbrace{S_t^{i/k} S_t^{k/j}}_{indirect \ /cross/ \text{ rate}} . \tag{2.3}$$

The cross /indirect/ (exchange) rate of currency i with respect to currency j indicates how many units of currency i exchange indirectly (i.e. through the purchase and sale of a third currency, k) for 1 unit of currency j.

Triangular /Three-Point/ Currency Arbitrage. It is seen from the formula just above that the cross rate between two currencies i and j, $S_t^{i/k} S_t^{k/j}$, should always coincide with their direct rate, $S_t^{i/j}$. This is due to the elimination – through *triangular arbitrage*, i.e. when three currencies and three financial centres are involved – of any unexploited costless profit opportunities to engage in currency exchange. Since $S_t^{i/j} = \frac{1}{S_t^{j/i}}$, $S_t^{i/k} = \frac{1}{S_t^{k/i}}$ and $S_t^{k/j} = \frac{1}{S_t^{j/k}}$, then – by moving terms across the equality sign in (2.3) – one obtains

$$S_t^{i/j} S_t^{j/k} S_t^{k/i} = 1 \text{ or } S_t^{j/i} S_t^{i/k} S_t^{k/j} = 1. \tag{2.4}$$

Real Exchange Rate(s): RER. The real exchange rate (RER) is a key variable for the open economy. But its concept has not been uniquely defined in the literature, theoretical as well as empirical.

PPP-related definition. Perhaps the most frequent – if not the oldest, as suggested by Gandolfo, but conceptually problematic, as argued by Edwards,[5] among others – definition of the RER is the one that relates it to the Purchasing Power Parity (PPP) theory. It defines the (bilateral) RER as the (bilateral) NER adjusted (or corrected) for differences in the general price levels in two compared countries:

[5] We explain in what sense below.

$$q_t^{PPP} \equiv \frac{S_t P_t^*}{P_t} = \frac{P_t^*}{\frac{P_t}{S_t}} \text{ or, reciprocally, } \frac{1}{q_t^{PPP}} \equiv \frac{P_t}{S_t P_t^*} = \frac{\frac{P_t}{S_t}}{P_t^*}, \tag{2.5}$$

with P_t and P_t^* – the superscript asterisk $(*)$, as is conventional in international economics, denoting foreign variables – both usually measured /approximated/ by the respective consumer price indexes (CPIs) (or retail price indexes (RPIs)) but also, alternatively, by the producer price indexes (PPIs) (or wholesale price indexes (WPIs)) or, still, by the gross domestic product (GDP) deflators.

Tradables-nontradables-related definition. Another common definition of the RER (at some moment/period t) originates in models with tradable and nontradable goods (or sectors). It states that the (bilateral) RER is the relative price of nontradables in terms of tradables (the *numéraire* good or sector), or vice versa:

$$q_t^{T/N} \equiv \frac{S_t P_{Tt}^*}{P_{Nt}} \text{ or, reciprocally, } q_t^{N/T} \equiv \frac{1}{q_t^{T/N}} \equiv \frac{P_{Nt}}{S_t P_{Tt}^*}, \tag{2.6}$$

where the price of tradables (usually expressed in *world* currency), P_{Tt}^*, is some composite /index/ of the prices of exportables, P_{EXt}^*, and importables, P_{IMt}^*, and P_{Nt} denotes the price of nontradables (expressed in *home* currency).

As clear from this definition, the real exchange rate summarises the incentives faced by domestic producers to engage in the production of tradable goods. If it is high, or increases, there are incentives to shift to the tradable sector; if the RER is low, or decreases, there are incentives to produce (more) nontradables. In the latter case, a producer exporting his output will get in exchange very few units of national currency, so the existing incentive structure is such that makes him rather shift to production of nontradables. The RER is also often considered as a measure of external competitiveness (of a country with respect to another, or more generally the rest of the world).

ToT-related definition. A third definition has emerged from simple exportables-importables models of trade. It is, in fact, identical to the standard definition in international trade theory of the *terms of trade (ToT)* of a given country with another country (or all other countries, in a multilateral sense), q_t^{ToT}. q_t^{ToT} can be defined as either $q_t^{IM/EX}$ or $q_t^{EX/IM}$, as below:

$$q_t^{IM/EX} \equiv \frac{S_t P_{IMt}^*}{P_{EXt}} = \frac{P_{IMt}^*}{\frac{P_{EXt}}{S_t}} \text{ or, reciprocally, } q_t^{EX/IM} \equiv \frac{1}{q_t^{IM/EX}} \equiv \frac{P_{EXt}}{S_t P_{IMt}^*} = \frac{\frac{P_{EXt}}{S_t}}{P_{IMt}^*}. \tag{2.7}$$

Unit labour costs related definition. A fourth definition relates the RER to the relative *unit labour costs (ULC)* in two compared countries, expressed in the same national currency. We thus now have W_t and W_t^* denoting ULC (as some approximation of average wage costs or wages) and replacing the respective aggregate price levels in the PPP-related RER definition:

$$q_t^{ULC} \equiv \frac{S_t W_t^*}{W_t} = \frac{W_t^*}{\frac{W_t}{S_t}} \text{ or, reciprocally, } \frac{1}{q_t^{ULC}} \equiv \frac{W_t}{S_t W_t^*} = \frac{\frac{W_t}{S_t}}{W_t^*}. \tag{2.8}$$

A refinement on (empirical) RER definition(s)[6]. Although one of the theoretical concepts of the RER defines it as the relative price of nontradables in terms of tradables, the empirical measurement of the prices of both these classes of goods on an *aggregate* level poses a number of problems. Indeed, it is very difficult to find a proxy for the price level of nontradables, i.e. of domestically produced and consumed goods (which do not compete with goods produced abroad). Choosing a proxy for the price level of tradables is usually not straightforward either. In applied work, the RER is therefore most frequently approximated by selecting some foreign (or RoW) wholesale price index (WPI) or producer price index (PPI) as representative for the price level of tradables and the domestic consumer price index (CPI) or retail price index (RPI) as a proxy for the national price level. Since the WPI or PPI in the (rest of the) world is,

[6]Sebastian Edwards, one of the leading researchers in the field of real exchange rates, particularly insists on this point.

by definition, calculated using some RoW (or foreign) currency, this index will also have to be multiplied by the nominal exchange rate in the definition of the RER, so that the analytical concept in (2.6) above finds an empirical measurement as:

$$q_t^{Emp} \approx \frac{S_t P_t^{*PPI}}{P_t^{CPI}} = \frac{P_t^{*PPI}}{\frac{P_t^{CPI}}{S_t}} \text{ or, reciprocally, } \frac{1}{q_t^{Emp}} \approx \frac{P_t^{PPI}}{S_t P_t^{*CPI}} = \frac{\frac{P_t^{CPI}}{S_t}}{P_t^{*PPI}}. \tag{2.9}$$

2.1.2. *Multilateral (or Effective) Exchange Rate(s).*
NEER ≡ MNER. Definition:

$$NEER_{it} \equiv MNER_{it} \equiv \sum_{j=1, j\neq i}^{n} \omega_j S_t^{i/j}, \qquad \sum_{j=1, j\neq i}^{n} \omega_j = 1. \tag{2.10}$$

The multilateral nominal exchange rate (MNER) or – as more frequently termed – the nominal effective exchange rate (NEER) of a given country i is an index number expressed with a base of 100 (or 1) corresponding to its value at a given point in time t (theoretically, this should be a period when the economy in question has been in, or close to, external and internal equilibrium). Unfortunately, it is not possible to determine the weights ω_j entering into the construction of the index unambiguously. The habitual way to get around such a problem is to relate them to the respective share of the foreign trade (exports + imports) value of country i with country j in the total foreign trade value of country i. Therefore *multilateral* or *effective* practically means *trade-weighted*.
REER ≡ MRER. Definition:

$$REER_{it} \equiv MRER_{it} \equiv \sum_{j=1, j\neq i}^{n} \omega_j q_t^{i/j}, \qquad \sum_{j=1, j\neq i}^{n} \omega_j = 1. \tag{2.11}$$

To construct the multilateral real exchange rate (MRER) or – as it is more commonly known – the real effective exchange rate (REER) index, the same methodology is used as in the NEER case but this time (some measure of) bilateral *real* exchange rates $q_t^{i/j}$ replace(s) their nominal counterparts $S_t^{i/j}$. Of course, the REER could have also been reciprocally defined, with $q_t^{j/i}$ instead of $q_t^{i/j}$ in (2.11), as, for example, it is presented by the International Monetary Fund (IMF) in its "International Financial Statistics" monthly, quarterly and yearly databank, in such a way that an increase (decrease) in it means an appreciation (depreciation) of the national currency under consideration with respect to the other currencies (in the trade basket) as a whole. For comparability reasons with our definition of the nominal exchange rate, and correspondingly of the NEER – although it could have been, in principle, also defined the other way round, i.e. with $S_t^{j/i}$ instead of $S_t^{i/j}$ in (2.10) – we shall stick in this course to the REER definition (2.11) and the corresponding RER definitions as q_t (and not $\frac{1}{q_t}$) above, implying that an increase in the R(E)ER, similarly to an increase in the N(E)ER, means a depreciation of the national currency (in real or nominal terms, respectively).

Despite that the nominal and real *effective* exchange rates (NEER and REER) are commonly used terms, the name "effective" appears not very precise. The principal reason is that in earlier international trade theory, e.g. in many of the works of Anne Krueger and Jagdish Bhagwati, this word was applied in another sense. It meant, in particular, the exchange rate effect on imports or exports under different degrees of tariff protection and/or subsidy provision once the impact of duties, quotas, incentive packages and other trade policy measures has been accounted for (and isolated). That is why some authors – such as, for instance, Sebastian Edwards – are of the opinion that the NEER and REER terminology should not be preferred to the equivalent notions of *multilateral* nominal and real exchange rates (MNER and MRER).

As already noted, in the context of applied studies, the (rest of the) world (or foreign) PPI is as close as possible to $P_{T,t}^*$, and the domestic CPI as close as possible to $P_{N,t}$.

A theoretical point to make in our present setting is that exportables and importables should be considered together as a *Hicksian composite tradable good*. This is because, in order to aggregate goods, we need the relative price to be constant.[7]

Another thing to mention is that it may be conceptually wrong to use CPIs in both the numerator and denominator of the R(E)ER empirical definition above. If this is done, such a "R(E)ER" will be measuring the differences in *cost of living* indices rather than the incentives to engage in the production of tradables, which are at the heart of the rationale to define, measure and talk about the real exchange rate.

2.1.3. *(Nominal) Exchange-Rate Regimes.* We shall not say much now on this interesting and controversial topic, but it will often recur throughout the course. Just for a background synthesis we would recall that the two extremes of exchange-rate regimes possible in theory are the perfectly (or freely) *flexible* exchange rate, or *float*, when the monetary authorities do not intervene in the foreign exchange market, and the perfectly *fixed* exchange rate, or *peg*, when the monetary authorities maintain the exchange rate level unchanged by foreign exchange (shortly, forex) intervention. In practice, governments have applied various exchange-rate arrangements, from the mentioned extremes to a number of "middle ground" choices, regularly accounted for by the IMF in a special-purpose annual report entitled "Exchange Arrangements and Exchange Restrictions". For a brief descriptive overview on exchange-rate regimes, see chapter 3 in Gandolfo's textbook. For a more detailed literature survey, with emphasis on emerging economies, see Edwards and Savastano (1999). More recent papers include Frankel (1999), Calvo and Reinhart (2002) and Reinhart and Rogoff (2004).

2.2. **The Forex Market(s).** Foreign currencies are traded *over-the-counter* (OTC), that is 24 hours a day, through a spatially decentralised *dealer* network. Most dealers are housed in large *banks* located around the world. Foreign exchange dealers quote two prices, a low(er) and a high(er) one. The low(er) price is called the bid, or *bid* price, and the dealer (or the bank) stands ready to buy at this price foreign currencies (or assets) from the nonbank public (i.e. an individual could sell to a bank at the bid price). The high(er) price is known as the ask, or *offer /ask/* price, and it is the price at which the dealer (or the bank) stands ready to sell foreign currencies (or assets) to the nonbank sector (i.e. an individual could buy from a bank at the ask price). The difference between the ask and the bid price is termed *bid-ask spread*. In addition, a *brokerage fee* will usually be associated with each transaction.

The foreign exchange (or forex) market encompasses four traditional *types* of transactions: spot, forward, swap and eurocurrency operations. In addition, transactions in currency derivatives (such as futures and options) have recently become more important and could therefore be classified in a separate fifth category. A good source of information on the volume of forex operations throughout the world by type and financial centre is the periodic publication of the Bank for International Settlements (BIS) in Basel entitled "Triennial Central Bank Survey of Foreign Exchange and Derivatives Market Activity".

2.2.1. *Spot Market.* Spot transactions, to which spot exchange rates apply, are for *immediate* delivery. But in practice "immediate" means "in two working dates".

2.2.2. *Forward Market and Hedging.* A second type are the outright forward transactions, to which forward exchange rates apply. The main function of such operations – and of the markets where they are contracted – is to allow economic agents to cover against /hedge/ exchange-rate risk, deriving from possible future variations in the spot exchange rate S_t. Forward contracts specify the price and quantity of a given currency for delivery on some *future* date (called maturity). The forward (exchange) rate, F_t, is the price stipulated in the contract, so it is prefixed and cannot change, no matter whether the actual future exchange rate deviates or not from it. Standard maturities for forward contracts do not normally exceed one year: they are 1 or 2 weeks, 1, 3, 6, and 12 months. Some terminology in the present context seems worth reminding.

A forward *premium* denotes that the (domestic) currency under consideration is more expensive (with respect to some foreign currency) for future delivery than for immediate delivery,

[7]Otherwise aggregation like the one implicitly assumed in the use of PPIs and CPIs is not possible.

i.e. it is *more expensive* forward than spot. A forward *discount* denotes the opposite situation, i.e. the given currency is *cheaper* forward than spot. The higher or lower value of the currency forward than spot is usually measured as deviation of the forward exchange rate with respect to the spot exchange rate. The measure could be absolute, $F_t - S_t$, but more frequently it is proportional, in which case it is called a forward margin:

$$\text{forward margin} \equiv \frac{F_t - S_t}{S_t}. \tag{2.12}$$

The latter is also known as the *implicit* interest rate in a forward forex transaction, for reasons related to deriving the covered interest parity condition (which we summarise below). The forward margin can be either a forward *premium* if *negative*, under the *price* quotation system we use in this course, or a forward discount if positive, under the same exchange rate quoting convention.

In general, hedging against an asset means making sure to have a *zero net position* in that asset. The zero net position is also known as *closed* position, that is, neither a net asset position nor a net liability position is allowed in the financial instrument considered, e.g. in a given foreign currency in our context. An *open* position, by contrast, is a situation where there is no exact balance between the assets and liabilities in a financial instrument, e.g. in a particular foreign currency. The open position can be *long* whenever more assets than liabilities are held (i.e. *net creditor* or *net lending* position) in a foreign currency at a particular moment in time or *short* whenever more liabilities than assets are held (i.e. *net debtor* or *net borrowing* position) in that currency. That is why in financial jargon "to short" or "going short" is equivalent to (net) borrowing in a given currency or asset.

2.2.3. *Swap Market.* Swap transactions are repurchase (or resale) agreements which combine features of spot and forward transactions. A *swap* is a contract whereby a currency bought (sold) today is to be resold (repurchased) at a specified future date, with the price of both the current and the future transaction (pre)set. The *swap rate* is thus the difference between the repurchase (resale) price and the original sale (purchase) price.

2.2.4. *Derivative Market.* The enormous growth of trading in what has become known as derivative instruments or derivatives – mostly, futures and options contracts – has partly been due to forex transactions. It is not the purpose here to go into the details of such operations. For a quick revision of the basic types of currency derivatives, see Gandolfo's textbook, section 2.7; Mark, pp. 9-11, also summarises how a futures contract works; for data and more institutional context, refer to the website of the BIS, in particular to the above-cited triennial publication as well as to the annual reports of this bank, specialised in the field of foreign exchange trading.

Spot transactions account for the majority of forex trading, most of which is interdealer trading. About $\frac{1}{3}$ of the volume of the market are swaps. Outright forward operations are of a minor relative importance, but derivative trading, as mentioned, has much increased.

2.2.5. *Eurocurrency Market.* A final variety of the forex market one should not fail to consider is its segment where *eurocurrencies* (also sometimes called *xenocurrencies*) are traded. A eurocurrency is a foreign currency deposit at a bank located outside the country where the currency is issued as legal tender. The bank itself which holds the deposit as well as the financial centre where it is situated define what is known as an *offshore* bank or financial centre. No matter the name, a deposit needs not be at a European bank (in Europe) to count as eurocurrency: it could be, for instance, a yen deposit at a US bank. That is why the name xenocurrency (from the Greek "xenos" meaning foreigner) has been suggested[8] as a more general name. An equivalent notion also used is *cross-border bank assets and liabilities*. In fact, the name eurocurrencies evolved from *eurodollars*. The latter term originated in the late 1950s when substantial amounts of US dollars were deposited in Europe, initially in London banks and mostly by official agencies of the Soviet Union. The eurodollar market thus developed from a combination of Soviet fears during the Korean war that the US government might freeze US dollar deposits with US banks and the initiative of London banks to avoid the restrictions on credit to foreign trade imposed in

[8]By Fritz Machlup in the early 1970s (according to Gandolfo, p. 28).

the UK in 1957. Because banks in Europe also began accepting yen and other foreign currency deposits, the eurodollar market was gradually renamed eurocurrency market. Most eurocurrency deposits are fixed-interest time deposits, with maturities matching those of the usual forward contracts (see above).

London Inter-Bank Offer Rate (LIBOR) is the rate at which banks are willing to lend to the most creditworthy banks participating in the London interbank market. Loans to less creditworthy banks and/or companies are often quoted in terms of a premium to LIBOR.

3. International Interest(-Rate) Parity Conditions

3.1. **Covered Interest Parity.** Spot, forward and eurocurrency rates are mutually dependent through the *covered* interest(-rate) parity (CIP) condition. From the perspective of a US resident (individual, company or bank), let ι_t be the date t interest rate[9] on a 1-period eurodollar deposit and ι_t^* be the date t interest rate on a 1-period euroeuro[10] deposit at the *same* bank. As until now, S_t denotes the spot exchange rate (dollars per euro, according to the price quotation system we adopted) and F_t is the 1-period forward rate. Because both deposits are held in the same bank (and country), they have identical default (and political) risk, and thus differ only by their currency of denomination. CIP then states that (under no transaction costs) the risk-free dollar returns from the eurodollar and the euroeuro deposits are equal:

$$1+\iota_t = (1+\iota_t^*)\,\frac{F_t}{S_t}. \tag{3.1}$$

If (3.1) is violated, riskless arbitrage profit opportunities are available, which bring back the eurocurrency market to the equilibrium condition embodied in CIP. Using a logarithmic approximation, (3.1) is also often written as

$$\iota_t \approx \iota_t^* + f_t - s_t \tag{3.2}$$

from

$$\iota_t \approx \iota_t^* + \underbrace{\ln F_t}_{\equiv f_t} - \underbrace{\ln S_t}_{\equiv s_t} \qquad \Leftrightarrow \qquad \underbrace{\ln\left(1+\iota_t\right)}_{\approx \iota_t} = \ln\left[(1+\iota_t^*)\,\frac{F_t}{S_t}\right].$$

Many papers have tested CIP. For two good methodological summaries, namely of Frenkel and Levich (1977) and M. Taylor (1989), see Mark's textbook, pp. 4-7. Overall, the empirical evidence confirms CIP to perform pretty well. Occasional violations occur after accounting for transaction costs, but they are short-lived and typical for periods of high market volatility.

3.2. **Uncovered Interest Parity and Risk Premia.**

3.2.1. *Uncovered Interest Parity.* If foreign exchange market participants are risk-*neutral* (and not risk-*averse*), they care only about the mean value of asset returns (and not about the variance of these returns, i.e. about risk). Risk-neutral individuals are also willing to take unboundedly large positions on bets that have a positive expected value. Since $F_t - S_{t+1}$ is the profit from taking a position in forward foreign exchange, under risk neutrality expected forward speculation profits are driven to zero, and the forward rate must, in equilibrium, be market participants' expected future spot exchange rate:

$$F_t = E_t\left[S_{t+1}\right]. \tag{3.3}$$

Substituting (3.3) into (3.1) gives the uncovered interest-(rate) parity condition (UIP):

$$1+\iota_t = (1+\iota_t^*)\,\frac{E_t\left[S_{t+1}\right]}{S_t}. \tag{3.4}$$

[9] ι is the lowercase Greek letter *iota*.

[10] This strange word is intended to mean a deposit in *euro*, the common EMU currency, held in some European (or, again, more precicesly EMU member country) bank.

However, violations of UIP are common in the data, and they present one of the empirical puzzles for international economists.

3.2.2. *The Two-Period Partial Equilibrium Portfolio Problem.* Why UIP does not hold? One possible answer is that market participants are risk-*averse*, not risk-neutral, and therefore require compensation, known as *risk premium*, to bear the exchange-rate risk involved in an *uncovered* foreign currency investment. The relation between risk aversion and UIP stands out clearly in the standard two-period partial equilibrium portfolio problem. This set-up is encountered in many related models, and we shall see a particular application later on in this course in the noise trading paper by Jeanne and Rose (2002). For these reasons, we now make a digression into the analytics of the portfolio problem invoked.

In it, agents take interest rate and exchange rate dynamics as given and invest a fraction ω of their current wealth $\mathcal{W}_t$ in a nominally safe domestic bond with next-period payoff $\omega\left(1+\iota_t\right)\mathcal{W}_t$. The remaining $1-\omega$ of wealth can be invested uncovered in a foreign bond with future home-currency payoff $\left(1-\omega\right)\left(1+\iota_t^*\right)\frac{S_{t+1}}{S_t}\mathcal{W}_t$. CIP is assumed to hold, so that a covered investment in the foreign bond is equivalent to the investment in the domestic bond. The next-period nominal wealth is the payoff from the bond portfolio:

$$\mathcal{W}_{t+1}=\left[\omega\left(1+\iota_t\right)+\left(1-\omega\right)\left(1+\iota_t^*\right)\frac{S_{t+1}}{S_t}\right]\mathcal{W}_t. \tag{3.5}$$

Domestic market participants have constant absolute risk aversion (CARA) utility defined over wealth:

$$\mathcal{U}\left(\mathcal{W}\right)\equiv -e^{-\gamma\mathcal{W}},\qquad \gamma\geq 0. \tag{3.6}$$

The domestic agent's problem is to choose the investment share ω to maximise expected utility:

$$E_t\left[\mathcal{U}\left(\mathcal{W}_{t+1}\right)\right]=E_t\left[-e^{-\gamma\mathcal{W}_{t+1}}\right]. \tag{3.7}$$

The RHS of (3.7) coincides, by definition, with what is known as the moment generating function of next-period wealth.[11]

If people believe that $\mathcal{W}_{t+1}$ is *normally* distributed conditional on currently available information, with conditional mean

$$E_t\left[\mathcal{W}_{t+1}\right]=\left\{\omega\left(1+\iota_t\right)+\left(1-\omega\right)\left(1+\iota_t^*\right)\frac{E_t\left[S_{t+1}\right]}{S_t}\right\}\mathcal{W}_t$$

and conditional variance

$$Var_t\left[\mathcal{W}_{t+1}\right]=\frac{\left(1-\omega\right)^2\left(1+\iota_t^*\right)^2 Var_t\left[S_{t+1}\right]\mathcal{W}_t^2}{S_t^2},$$

it follows that maximising (3.7) is equivalent to[12] maximising the simpler expression

$$E_t\left[\mathcal{W}_{t+1}\right]-\frac{1}{2}\gamma Var_t\left[\mathcal{W}_{t+1}\right]. \tag{3.8}$$

It is said that traders are in this case *mean-variance* optimisers: they like high mean values but dislike variance in wealth.

Differentiating (3.8) with respect to ω and setting the derivative equal to zero yields:

$$\left\{\left(1+\iota_t\right)-\left(1+\iota_t^*\right)\frac{E_t\left[S_{t+1}\right]}{S_t}\right\}\mathcal{W}_t-\frac{1}{2}\gamma 2\left(1-\omega\right)\left(1+\iota^*\right)^2\frac{Var_t\left[S_{t+1}\right]}{S_t^2}\mathcal{W}_t^2\left(-1\right)=0.$$

Rearranging the above first-order (necessary) condition (FO(N)C) for optimality, one obtains

[11] For a *normally* distributed random variable $Z\sim N\left(\mu,\sigma^2\right)$, the moment generating function is defined by $\psi_Z\left(x\right)\equiv E\left[e^{xZ}\right]\equiv\exp\left(\mu x+\frac{1}{2}\sigma^2x^2\right)$.

[12] Substituting $\mathcal{W}$ for Z, $-\gamma$ for x, $E_t\left[\mathcal{W}_{t+1}\right]$ for μ and $Var_t\left[\mathcal{W}_{t+1}\right]$ for σ^2 and taking logs results in (3.8).

$$\underbrace{(1+\iota_t)-(1+\iota_t^*)\frac{E_t[S_{t+1}]}{S_t}}_{\text{deviation from UIP}}=-\underbrace{\frac{\gamma\mathcal{W}_t(1-\omega)(1+\iota^*)^2 Var_t[S_{t+1}]}{S_t^2}}_{\text{risk premium }>0}$$

or, written in another way,

$$\underbrace{(1+\iota_t)-(1+\iota_t^*)\frac{E_t[S_{t+1}]}{S_t}}_{\text{deviation from UIP}}+\underbrace{\frac{\gamma\mathcal{W}_t(1-\omega)(1+\iota^*)^2 Var_t[S_{t+1}]}{S_t^2}}_{\text{risk premium }>0}=0, \tag{3.9}$$

which *implicitly* determines the optimal investment share ω. Moreover, expression (3.9) explicitly defines the risk premium, thus rationalising the deviations from UIP found in the data.

4. The Balance of Payments and Forex Reserves

The balance of payments (BoP) is a summary record of all economic transactions between the residents of a country and nonresidents, i.e. the rest of the world (RoW). The BoP refers to a given period of time, e.g. a year or a quarter, so it is a *flow* (not a stock) concept. The BoP statement (or table) obeys a common set of accounting rules and conventions. The IMF has standardised the presentation of the BoP in its "Balance of Payments Manual", whose latest edition is the fifth one (of 1993).

4.1. **Some Terminology.**

Two notions in the BoP definition need some clarification.[13]

The term *economic transaction* means the transfer of an economic value from one agent (individual, business, government) to another. There are two basic types and five subtypes of economic transactions:

(1) a bilateral (or two-way) transfer: involves a *quid pro quo*, i.e. the transferee gives an economic value in return to the transferer; it can be:
   (a) real-financial: one real transfer and one financial transfer in return, e.g. purchase or sale of goods and services with a financial quid pro quo (payment in cash, or extending a trade credit);
   (b) real-real (barter): two real transfers, e.g. exchange of certain goods and services for other goods and services;
   (c) financial-financial: two financial transfers, e.g. exchange of certain financial items for other financial items, e.g. purchase of bonds against payment in cash, or cancellation of outstanding debt against creation of a new one;

(2) a unilateral (also called unrequited or one-way) transfer: does not involve a *quid pro quo*, i.e. the transferee does not give an economic value in return to the transferer; it can be:
   (a) real: e.g. a gift in kind;
   (b) financial: e.g. a gift in money.

The term *resident* does not coincide with the term national or citizen. As regards individuals, residents are defined as the persons whose general centre of interest is considered to rest in a given economy; the pragmatic definition sets the threshold of one year, so anybody who stays more than a year in a country and engages in economic activities (consumption, production, etc.) is considered its resident (for BoP purposes). As regards non-individuals, the general government (central, state and local) and private non-profit bodies serving individuals are, naturally, residents of the respective country. But enterprises obey more complicated rules; the international character of many of them often makes it necessary to divide, for BoP purposes (and in compliance with the IMF Manual), a single legal entity (e.g. a parent company operating in one economy and its unincorporated branches operating in other economies) into two or more separate enterprises, each considered as resident of the country where it operates.

[13] Both of them also apply to more general, national accounting contexts.

4.2. **Accounting Principles.**
Double-Entry Book-Keeping. The balance of payments is kept under standard *double-entry* book-keeping. This means that each international transaction of the residents of a country will result in two entries that have exactly equal values but opposite signs: a credit (+) and a debit (−).[14] Therefore, the total value of debit entries equals the total value of credit entries, so that the net balance of all entries is necessarily zero; i.e. the BoP always balances, by accounting convention. A *debit* entry (−) occurs when a particular economic transaction gives rise to a demand for foreign currency; or, equivalently, when a good (or a service) or an asset (financial and real) is "imported" (i.e. purchased from abroad). Conversely, all transactions that give rise to a supply of foreign currency result in *credit* entries (+); or, equivalently, when a good (or a service) or an asset is "exported" (i.e. sold abroad).
Timing of Recording. The timing of recording is intended to define uniformly when a transaction has taken place. In general, various rules are possible, e.g.:

- the *payments* basis: transactions are recorded at the time of effecting the *payment*;
- the *commitment* basis: transactions are recorded at the time of concluding the *contract*;
- the *movement* basis: transactions are recorded when the economic value changes *ownership*.

The principle adopted in the IMF BoP Manual is the *change of ownership*, i.e. the movement basis. By convention, the time of change of ownership is taken to be the time when the parties concerned record the transaction in their books.
Uniformity of Valuation of Exports and Imports. The IMF suggests that all exports and imports should be valued on a *fob* (free on board) basis, and not on a cif (cost, insurance, freight) basis, for consistency when measuring the value of commodities exchanged.

4.3. **BoP Components.** The standard presentation of the BoP includes two main accounts and a number of subaccounts, each used according to a particular analytical interest.

4.3.1. *Current Account.* The current account, CA, records the exchange of:

- goods ("visible trade");
- services ("invisible trade"), which include:
  - transport(ation): freight of goods, travel of passengers (for business or tourist reasons) and the related insurance;
  - tourism: expenditures in a foreign country (food, lodging, local transportation, etc.);
  - business and professional services: e.g. of engineering firms, management consultants, computer programmers and so forth, as well as royalties and licence fees from copyright or patent owners
- (net) *factor* income, NFI, also called *investment* income: income from *capital* (e.g. interest on loans, yearly payment of dividends from ownership in a factory operating abroad, but not the initial investment to acquire this ownership) and *labour* (e.g. wages received for temporary work abroad, but not migrant workers' remittances to their families in the country of origin);
- unrequited *current transfers*: remittances of migrant workers (residents of the country of *employment*) to their families (residents of the country of *origin*).

4.3.2. *Capital (and Financial) Account.* The capital and financial account, KA, registers trade in *assets* (financial or real), i.e. all *changes* in a country's foreign financial assets and liabilities (including reserve assets), or, as they are also called, *capital movements* or flows: *inflows* ≡ (foreign) money coming in (to pay for acquisition of domestic assets), or *outflows* ≡ (domestic) money going out (to pay for acquisition of foreign assets).

The fifth edition of the IMF BoP Manual distinguishes between capital account and financial account. The capital account records only unilateral (or unrequited) transfers, e.g. foreign aid and other grants at a government level. The financial account is what was called the capital account previously (i.e. in the first four editions of the Manual). To avoid confusion, bearing in

[14] For a brief but lucid revision on these accounting "technicalities", one may refer to the excellent textbook (at an introductory level) by Caves, Frankel and Jones (2002, 9th ed.), chapter 15.

mind the theories and empirical studies on this balance-of-payments aspect of macroeconomics accumulated over time, we shall refer to the "capital and financial account" implied by the fifth edition of the IMF BoP Manual simply as the (traditional) "capital account".

Several classification criteria can be used within the capital (and financial) account:

- the nature of *operation* or the type of capital (movement or flow): e.g. (foreign) *direct* investment (FDI), where the investor seeks to obtain an effective voice in the management of a nonresident enterprise (often, 10% ownership share has been considered as a cut-off between what is FDI and what is not), or (foreign) *portfolio* investment, where the objective is simply to diversify risk;
- the *horizon* (or length) of the operation: e.g. *long*-term or *short*-term capital (flows);
- the nature of the *operator*: e.g. *private* or *official* capital (flows), the latter category usually subdivided into general government, monetary authority (central bank) and other official institutions.

The IMF Manual adopts the first criterion, so the standard subaccounts of the *capital account*, KA (in addition to the unrequited *capital transfers*), are the following:

- *private* capital account, KA^P, consisting of:
  - direct investment, that is, FDI;
  - portfolio investment: securities (i.e. debt and equity) and banking flows (the latter being payments in cash, by cheque or by transfer to a deposit account at a bank);
- *official* capital account or reserve assets, KA^G.

Within each of these categories, further subdivisions are used, based on the other two criteria.

Official (foreign exchange or international) reserves is a *functional* category comprising, in the precise sense of the concept, all those assets available (immediately or after a short notice) for use by the central (monetary) authorities of a country in meeting BoP needs. In practice, forex reserves include:

- monetary gold;
- special drawing rights (SDRs) at the IMF;
- reserve position with the IMF;
- foreign exchange, or, more precisely, short-term foreign government paper such as foreign Treasury bills;
- other (possibly longer-term) claims available to the official (monetary) authorities.

International reserves, as just defined, are measured on a gross basis, i.e. as *gross* official resrves. Subtracting the (short-term) foreign liabilities of the central bank – and, in some countries or cases, of the other official authorities – results in what is known as *net* official reserves. A broader but perhaps less exact measure of international reserves (gross or net) would include as well the medium- and long-term foreign assets (and liabilities) of the central bank.

It should finally be noted that, in addition to the BoP statement, the IMF also compiles and publishes statistics on what it calls the international investment position of a country. Gandolfo suggests another name, the balance of indebtedness. The international investment position records the *net foreign assets* (NFA) of a nation: the outstanding claims of nonresidents to residents and of residents to nonresidents at a given point in time, e.g. at end-year, which means that the NFA position is a *stock* (and not a flow) concept. Obviously, there is by definition a direct link between the NFA positions of a country at two points in time and the BoP statement of the same country for the period between these two dates, which we derive and discuss further down.

4.4. **(Dis)Equilibrium in the Balance of Payments.** As we shall soon discuss, the issue of balance of payments equilibrium, or rather disequilibria and the subsequent adjustment mechanisms and policies, has given birth to what we call today international monetary economics. Therefore it would be useful to sketch some important points on the definition(s) of BoP equilibrium as early as now.

By book-keeping convention (i.e. the double-entry system), the BoP is always in (accounting) balance:[15]

$$CA + \underbrace{KA^P + KA^G}_{\equiv KA} \equiv \underbrace{CA + KA^P}_{\equiv OB} + KA^G \equiv 0 \tag{4.1}$$

Then why is there the issue of BoP disequilibria?

The terminology "balance of payments disequilibrium" relates to the economic meaning of the BoP statement, i.e. it is employed in the economic analysis of external sector developments in a given country. Gandolfo has a good suggestion to use the word "balance" to denote *accounting* identities that always hold and the word "equilibrium" to refer to a certain concept of *economic* equilibrium. He also nicely explains the difference among the concepts employed historically and theoretically to represent various types of BoP (dis)equilibrium. If we have in front of us a BoP statement in the greatest detail of the standard (IMF-recommended) presentation, it begins by the first subaccount, i.e. the trade balance (visible trade), and then continues with the following subaccount, i.e. the services balance (invisible trade), with its first component listed first, etc. Then imagine that one could draw a horizontal line so as to separate the entire detailed BoP structure (by items enumerated according to the standard classification) into two parts, thus dividing it (e.g. between two accounts or subaccounts) into "above-the-line" and "below-the-line" sections. Because of the double-entry book-keeping, one could think of the below-the-line section as "financing" (or "settling") any disequilibrium – surplus (+) or deficit (−) – of the above-the-line section (hence the accounting terminology "draw the line"). Now, depending on where the line has been drawn, historically and theoretically, the BoP has been judged in equilibrium or disequilibrium.[16] The typical balances usually considered are the following (some of these, in particular the trade balance and the basic balance, are outdated, however):

- trade balance (exports minus imports of *goods only*, not services), TB;
- balance on (exports minus imports of) goods *and services*, or *net* exports, $NX \equiv EX - IM$;
- balance on (exports minus imports of) goods, services *and income*, i.e. all components of the current account except unrequited *transfers* are here considered to be above the line, $NX + NFI$;
- current (account) balance, $CA \equiv NX + NFI +$ unrequited *current transfers*;
- *basic* balance ≡ balance on current account and *long*-term capital, $CA + LTKA^P$;
- *overall* balance, $OB \equiv$ current (account) balance and *private* capital (account) balance (including unrequited *capital transfers*), $CA + KA^P$, i.e. all components except changes in *official* reserves, KA^G, are here considered to be above the line.

We should conclude by saying that BoP (dis)equilibrium analysis is very difficult, in the sense that there cannot be one single number – or (sub)account balance, e.g. from those above – indicating whether a surplus is favourable or a deficit unfavourable. The definition of surplus or deficit, as we have just seen, is an analytic rather than an accounting problem. That is why the use of one or another concept of BoP (dis)equilibrium is ultimately related to the nature of the problem one wishes to analyse.

5. Central Bank Balance Sheet and Intervention Policy

Under a pure floating system, the (nominal) exchange rate is determined by equilibrium in the forex market, so excess demand for foreign currency is necessarily zero. It follows that it is not possible for a country to have BoP problems under *float*, since its overall balance will always be zero: a current account deficit needs to be financed by a (private) capital account surplus or vice versa.

[15] In practice, there is never an exact balance, beacuse of the different sources of statistical information from which the BoP is compiled. To account for such a discrepancy, the BoP statement includes a last item known as "errors and omissions", simply the difference between the total of all credit entries and the total of all debit entries. When it is also considered, as is in the standard, IMF-recommended BoP structure, the balance of payments truly and exactly balances.

[16] A clasic reference is Kindleberger (1969).

Under a *peg* regime, however, central banks intervene in the foreign exchange market. By buying or selling foreign currencies, they aim to prevent exchange rate adjustment, automatic under pure float, and thus allow the overall BoP to be nonzero. To prevent a depreciation of the home currency, a privately determined excess demand for foreign exchange can be met by sales of the central bank's forex reserves. If there is, conversely, excess supply of foreign exchange from the private sector, the central bank can buy it and accumulate (replenish its) official reserves. Changes in the central bank's foreign exchange reserves are recorded in the *official settlements* subaccount, which is the last one in the capital (and financial) account. Mind that *losses of reserves* are *credit* entries (+) in the BoP while *gains of reserves* are *debit* entries (−).[17] These transactions of the central bank in the foreign exchange market whereby it sells and buys foreign currencies to influence the (equilibrium) level of the nominal exchange rate are called (official) foreign exchange intervention(s).

The mechanism of forex intervention is better understood when one looks at the aggregate balance sheet (B/S) of a hypothetical central bank. The monetary *liabilities* of any central bank, called the *monetary base* (or high-powered money), MB, are composed of *currency in circulation* outside the banking system, CC, and commercial *bank reserves* or deposits at the central bank, BR.

$$\text{central bank } \textit{liabilities}: \qquad MB_t \equiv CC_t + BR_t.$$

The central bank's *assets* could be represented, in turn, as comprising *domestic credit*, DC (i.e. credit to the general *government*, DC^G, extended through open market operations in the form of holding Treasury bills and credit to the *banking* sector, DC^B, usually extended through discount lending), and holdings of *net foreign assets* (NFA), NFA^C.

$$\text{central bank } \textit{assets}: \qquad \equiv DC_t^G + DC_t^B + NFA_t^C.$$

The central bank's *balance sheet identity* at a given moment t then states:

$$\text{central bank } \textit{B/S identity}: \qquad MB_t \equiv DC_t + NFA_t^C. \tag{5.1}$$

Since the money supply (also called money stock and measured by $M1$, $M2$ or any other monetary aggregate) varies in proportion to the monetary base, via the (respective) money multiplier,[18] (5.1) shows that in the open economy there is one more determinant of the money supply, namely the change in net foreign assets. So the central bank can alter the monetary base, and ultimately, the money stock by discount lending (change in DC^B), open market operations (change in DC^G) and foreign exchange interventions (change in NFA^C). Observe that under pure float when $\Delta NFA^C = 0$, the central bank controls the money supply just as it does in the closed economy case. A final point to make is that there can as well be *sterilised* intervention: it occurs when the central bank offsets its forex operations by transactions in domestic credit (mostly, through open markets operations) so that the monetary base, and hence (hopefully, if the multiplier is stable or predictable) the money stock, remain *unchanged*, i.e. $\Delta MB_t = \Delta MS_t = 0$.

6. Real and Financial Flows in the Open Economy

The System of National Accounts (SNA, whose 3rd edition, of 1993, is the last one)[19] is a joint methodological publication of the United Nations (UN), the IMF, the World Bank, the Organisation for Economic Cooperation and Development (OECD) and the Commission of the European Communities (EC). The SNA imposes a uniform standard of recording and interpreting economic transactions at a national and international level. Basically, it specifies three interrelated approaches to compiling and aggregating the accounts by institutional sector

[17] Think of this as if the central bank gives rise (artificially) to a supply of foreign currency when it sells /loses/ reserves, and vice versa.

[18] Recall from standard money and banking courses that any measure of the money supply, MS_t, is proportional to the monetary base, MB_t, with a factor of proportionality, a multiplier m_t, corresponding to the respective money supply definition: $MS_t \equiv m_t MB_t$.

[19] The first edition is of 1968.

into the national accounts of a country. These are the production approach, the income approach and the expenditure approach. We briefly revise below their essence and links.

6.1. **Basic National Accounting in the Closed Economy.** Recall that in the closed economy the value of output, i.e. the aggregate value added, during a given period is called gross *domestic product* (GDP), which we would denote by X. If we ignore *capital depreciation* (which is that part of total final goods output devoted to replacing worn-out capital), there will be no difference between GDP and what was known previously as *national income*, (NI), but is now termed – in compliance with the most recent SNA revision (of 1993) – gross *national product* (GNP), which we denote by the habitual Y:

$$X \equiv Y \text{ (or rather } X \approx Y). \tag{6.1}$$

In the closed economy, there are three classes of agents: households, businesses and the government. So aggregate *expenditure* on goods and services, or *absorption*, A, is the sum of the expenditure by sector, denoted with a superscript P if private and G if government:

$$A \equiv C^P + I^P + \underbrace{C^G + I^G}_{\equiv G}. \tag{6.2}$$

If there is any excess supply, firms are assumed to "buy" the extra output in the form of *inventory accumulation*. One therefore arrives at the accounting identity:

$$X \equiv Y \equiv A \text{ (or rather } X \approx Y \approx A). \tag{6.3}$$

6.2. **Basic National Accounting in the Open Economy.** In the open economy, however, there are a few modifications to these most general (simplified and, hence, approximate) national accounting relations. First, absorption is now a (slightly) different concept and is therefore called *domestic* (or national) absorption, $DA \equiv$ expenditure of the *domestic* sectors on *domestic* output. Second, open-economy GDP differs from closed-economy GDP:

$$X \equiv \underbrace{\left(C^P + I^P + G\right)}_{\equiv DA} + \underbrace{EX - IM}_{\equiv NX}, \tag{6.4}$$

where NX stands for *net exports* (exports minus imports of goods *and services*).

Third, still abstracting from capital depreciation, open-economy GDP differs too from open-economy GNP (or from the older notion of national income):

$$Y \equiv X + NFI \text{ (or rather } Y \approx X + NFI), \tag{6.5}$$

with NFI denoting *net factor income from abroad* (i.e. income from labour services abroad by domestic residents, fees and royalties from FDI, dividends and interest from portfolio investment and the like).

Thus, substituting (6.4) into (6.5) yields:

$$Y \equiv DA + \underbrace{\overbrace{(EX - IM)}^{\equiv NX} + NFI}_{\equiv CA, \text{ ignoring unrequited } transfers} \quad \text{(or rather } Y \approx DA + CA). \tag{6.6}$$

6.3. **Real and Financial Flows in the Open Economy: An Accounting Matrix.** Following Gandolfo's textbook, chapter 6, we now fit the BoP into the whole economy of a country, using several elementary relations – from standard national accounting and flow-of-funds analysis[20] – among the main macroeconomic (real and financial) aggregates in an open economy. We thus link the external sector of an economy with its domestic sector.

[20]The conceptual framework is, of course, based on the SNA (Revision 3).

market \ sector	private	government	banking	central bank	external	ROW totals
goods and services	$I^P - S^P$	$G-T$	$\sim$	$\sim$	CA	0
domestic monetary base	ΔMB^P	$\sim$	ΔMB^B	ΔMB	$\sim$	0
domestic bank deposits	ΔBD^P	$\sim$	ΔBD	$-$	ΔBD^F	0
domestic securities	ΔB^P	ΔB	ΔB^B	ΔB^C	ΔB^F	0
foreign money	$S\Delta M^{*P}$	$\sim$	$S\Delta M^{*B}$	$S\Delta M^{*C}$	$S\Delta M^*$	0
foreign securities	$S\Delta B^{*P}$	$\sim$	$S\Delta B^{*B}$	$S\Delta B^{*C}$	$S\Delta B^*$	0
COLUMN totals	0	0	0	0	0	

TABLE 1. An Accounting Matrix of Open-Economy Real and Financial Flows

The accounting framework summarised in the table is simplified but exhaustive. It is exhaustive in the sense that it includes all types of transactors (five *sectors*) and transactions (six *markets*) in the open economy. It is simplified, at least because the tilde ($\sim$) signs in the table recognise that an entry is assumed empty for the sake of simplicity.[21] The framework records *flows*, that is, movements or changes having occurred during a given time period, therefore the Greek capital delta notation (Δ), which by convention means a *variation* (in the *stocks* involved). The superscripts indicate the sectors which *hold* a particular asset (not issued by themselves), whereas a stock entry with no superscript identifies its respective *issuer*-sector. In the last two rows, S is the nominal exchange rate: it multiplies the change in those financial assets (money and bonds) which are denominated in foreign currency to convert them in the same monetary unit, enabling us to write down the relationships in the table. In fact, our notation $S\Delta M^*$ is a shorthand for $S_t M_t^* - S_{t-1} M_{t-1}^*$ and $S\Delta B^*$ for $S_t B_t^* - S_{t-1} B_{t-1}^*$, from where it is evident that if the exchange rate stays *unchanged* (the case under *peg*), one will have $SM_t^* - SM_{t-1}^* = S\left(M_t^* - M_{t-1}^*\right) = S\Delta M_t^*$; but if the NER fluctuates (the case under *float*), that will give rise to what is known as valuation adjustments in foreign currency denominated assets and liabilities.

The table can be read along either the rows or the columns. In any case, as it is an accounting presentation, the algebraic sum of the magnitudes in any row and any column is necessarily zero.

6.3.1. *Interpreting the Row Identities.* First taking the *row* identities, the following economic interpretation can be given.

- *1st* row: the current account (surplus)
  (i) as an excess of national ($\equiv$ private-sector + government-sector) saving over investment:

$$CA \equiv \left(S^P - I^P\right) + (T - G)$$

$$CA \equiv \left(S^P - I^P\right) + \left[T - \overbrace{\left(C^G + I^G\right)}^{\equiv G}\right]$$

$$CA \equiv S^P + \underbrace{\left(T - C^G\right)}_{\equiv S^G} - \underbrace{\left(I^P + I^G\right)}_{\equiv I^N}$$

$$CA \equiv \underbrace{S^P + S^G}_{\equiv S^N} - \underbrace{\left(I^P + I^G\right)}_{\equiv I^N}$$

$$CA \equiv S^N - I^N; \tag{6.7}$$

hence, we can also interpret a current account *surplus*, $CAS \equiv CA \equiv S^N - I^N > 0$, as an *accumulation* of net foreign assets by a nation with respect to the rest of the world, $\Delta NFA > 0$, that is:

[21] The only dash ($-$) in the table is used to designate that there can be no entry for logical reasons.

$$CAS \equiv CA \equiv \Delta NFA > 0, \tag{6.8}$$

which – bearing in mind the accounting convention of BoP book-keeping that a purchase of an asset is a *debit* entry $(-)$ while a sale is a credit entry $(+)$ and, therefore, an *accumulation* (*positive* change) of net foreign assets in a given time period corresponds to recording $-\Delta NFA$ – can also be written as:

$$CAS \equiv CA \equiv -\Delta NFA, \text{ so that } \underbrace{CA + \underbrace{\Delta NFA}_{\equiv KA}}_{\equiv BoP} = 0; \tag{6.9}$$

by analogy, a current account *deficit*, $CAD \equiv -CA \equiv -\left(S^N - I^N\right) \equiv I^N - S^N > 0$, is interpreted as a *decumulation* of net foreign assets by a nation with respect to the rest of the world, that is:

$$CAD \equiv -CA \equiv -\Delta NFA > 0, \tag{6.10}$$

which – bearing again in mind the accounting convention of BoP book-keeping that a *decumulation* (*negative* change) of net foreign assets in a given time period corresponds to recording ΔNFA – can also be seen written as:

$$CAD \equiv -CA \equiv \Delta NFA, \text{ so that } \underbrace{CA + \underbrace{\Delta NFA}_{\equiv KA}}_{\equiv BoP} = 0; \tag{6.11}$$

(ii) as an excess of national income, called GNP in the last SNA revision, Y, over *domestic* (or *national*) absorption: $DA \equiv C^P + I^P + G$, with *disposable income* to (private-sector) households defined in the usual way as income minus (net) taxes, $Y_d \equiv Y - T$, and used to consume or save, $Y_d \equiv C^P + S^P$; hence, $S^P \equiv \underbrace{(Y - T)}_{\equiv Y_d} - C^P$, so that:

$$CA \equiv \left(S^P - I^P\right) + (T - G)$$

$$CA \equiv \overbrace{\left[\underbrace{(Y - T)}_{\equiv Y_d} - C^P\right]}^{\equiv S^P} - I^P + (T - G)$$

$$CA \equiv Y - \underbrace{\left(C^P + I^P + G\right)}_{\equiv DA}$$

$$CA \equiv Y - DA, \tag{6.12}$$

as we already saw in (6.6) above (and, again, ignoring unrequited current *transfers*);

- *2nd* row: domestic monetary base in terms of issuer (LHS) and holders (RHS), where $-\Delta MB$ is a negative excess demand for high-powered money, that is, an excess supply of currency in circulation plus bank reserves,

$$-\Delta MB \equiv \Delta MB^P + \Delta MB^B;$$

- *3rd* row: domestic bank deposits in terms of issuer and holders,

$$-\Delta BD \equiv \Delta BD^P + \Delta BD^F;$$

- *4th* row: domestic securities (bonds) in terms of issuer and holders,

$$-\Delta B \equiv \Delta B^P + \Delta B^B + \Delta B^C + \Delta B^F;$$

- *5th* row: foreign currency (money) in terms of issuer and holders,

$$-S\Delta M^* \equiv S\Delta M^{*P} + S\Delta M^{*B} + S\Delta M^{*C};$$

- *6th* row: foreign securities (bonds) in terms of issuer and holders,

$$-S\Delta B^* \equiv S\Delta B^{*P} + S\Delta B^{*B} + S\Delta B^{*C}.$$

6.3.2. *Interpreting the Column Identities.* The *column* identities are interpreted as follows.

- *1st* column: budget constraint, or change in financial wealth, of the (domestic) private sector,

$$S^P - I^P \equiv \underbrace{\Delta MB^P + \Delta BD^P + \Delta B^P + S\Delta M^{*P} + S\Delta B^{*P}}_{\equiv \Delta \mathcal{W}^P, \text{ where } \mathcal{W}^P \text{ is private sector's stock of financial wealth}};$$

- *2nd* column: government budget constraint; the government budget deficit is financed by issuing securities, where $-\Delta B$ is a negative excess demand for securities, that is, an excess supply of securities,

$$-\Delta B \equiv G - T;$$

- *3rd* column: budget constraint of the banking sector,

$$-\Delta BD \equiv \Delta MB^B + \Delta B^B + S\Delta M^{*B} + S\Delta B^{*B};$$

- *4th* column: budget constraint of the central bank,

$$-\Delta M \equiv \Delta B^C + S\Delta M^{*C} + S\Delta B^{*C};$$

- *5th* column: rest of the world budget constraint,

$$-S\Delta M^* - S\Delta B^* \equiv CA + \Delta BD^F + \Delta B^F.$$

6.3.3. *Interpreting Two Key Derived Identities.* There are a few *derived* identities, i.e. that can be derived from those already directly observed in the rows and columns of the accounting matrix. Two of them represent *meaningful* (economic) constraints, namely:

- overall balance of payments, OB (LHS below): to derive it, one can start from the 5th column identity above and then use the identities of the 5th and 6th rows to decompose the foreign money and bonds; rearranging, one obtains:

$$OB \equiv CA + \left(\Delta BD^F + \Delta B^F\right) -$$

$$- \left[\left(S\Delta M^{*P} + S\Delta B^{*P}\right) + \left(S\Delta M^{*B} + S\Delta B^{*B}\right)\right] \equiv$$

$$\equiv S\Delta M^{*C} + S\Delta B^{*C} \equiv S\Delta IR^{*C}, \tag{6.13}$$

which – bearing in mind the accounting convention of BoP book-keeping that a purchase of a(n) (reserve) asset is a *debit* entry $(-)$ while a sale is a credit entry $(+)$ and, therefore, an *accumulation* (*positive* change) of international reserves in a given time period corresponds to recording $-S\Delta IR^{*C}$ – can also be written:

$$OB \equiv CA + KA^P \equiv -S\Delta IR^{*C} \text{ so that } \underbrace{\underbrace{CA + KA^P}_{\equiv OB} + \overbrace{S\Delta IR^{*C}}^{\equiv \Delta NFA^C}}_{\equiv BoP} \equiv 0. \tag{6.14}$$

(6.13) says that the *overall balance* (of payments) equals the *change* in central bank's *international reserves* expressed in national currency, $S\Delta IR^{*C} \equiv S\Delta M^{*C} + S\Delta B^{*C}$ (in their broader definition to include some not so liquid foreign bond holdings, and with a negative sign $-S\Delta IR^{*C}$ to indicate increase in the BoP accounting sense, to be more precise);

- budget constraint of the aggregate banking sector, i.e. of banks plus the central bank:

to derive this last identity, we first aggregate and rearrange the 3rd and 4th columns above:

$$-\Delta BD - \left(\Delta MB^B + \Delta MB\right) \equiv$$

$$\equiv \left(\Delta B^B + \Delta B^C\right) + \left(S\Delta M^{*B} + S\Delta M^{*C}\right) + \left(S\Delta B^{*B} + S\Delta B^{*C}\right),$$

from which, rearranging terms again and using some definitions, as shown below, we get

$$\underbrace{\underbrace{-\Delta BD}_{\equiv \Delta BD^P + \Delta BD^F,\ \text{3rd row}} \quad \underbrace{-\left(\Delta MB^B + \Delta MB\right)}_{\equiv \Delta MB^P,\ \text{2nd row}}}_{\Delta MS \equiv \Delta MB^P + \Delta BD^P + \Delta BD^F} \quad \equiv$$

$$\equiv \underbrace{\left(S\Delta M^{*C} + S\Delta B^{*C}\right)}_{\equiv S\Delta IR^{*C},\ \text{international reserves, from (6.13)}} + \underbrace{\left(\Delta B^C + \Delta B^B + S\Delta M^{*B} + S\Delta B^{*B}\right)}_{\equiv \Delta NonMS,\ \textit{non-money(-stock)}\ \text{financial assets}}$$

$$\Delta MS - \Delta NonMS \equiv S\Delta IR^{*C}, \tag{6.15}$$

which states that the change in central bank's international reserves expressed in the national currency, $S\Delta IR^{*C}$, is equal to the change in the money stock, ΔMS – say, its $M2$ (broad money) definition – less the change in the non-money(-stock) – that is, all other – financial assets, $\Delta NonMS$.

6.3.4. *A Note of Caution.* In concluding this somewhat long, national-accounting revision section, we need to note that the framework just presented is useful in organising our thinking about the aggregate real and financial flows in an open economy but, as Gandolfo (2001) clearly stresses, "it would be logically invalid to draw causal relations automatically" from it (p. 77). What the identities state is merely what should hold *ex post*, and as such they remain only accounting identities, and not macroeconomic theories.

6.4. **The Current Account Balance and Intertemporal Trade.** Since we mentioned theories, a fundamental one in open-economy macroeconomics is to treat the current account balance as a measure of intertemporal trade. This is, in essence, a major theme in Obstfeld and Rogoff's (1996) graduate textbook. We shall return in more detail to this point further in our course, but for now let us briefly summarise what it is about.

An open economy – like the real-world ones – is different from a – hypothetical, textbook – closed economy in a crucial way: it can cushion economic shocks and smooth consumption across time (and states of nature) by *borrowing and lending* (and sharing risks) *in international financial markets*. In other words, an open economy can trade in financial instruments (assets for the holder, liabilities for the issuer) with other open economies. The time dimension (but not the risk-sharing dimension) involved in such trade in financial assets of a country with the rest of the world is termed *intERtemporal trade*, denoting *resource exchanges across time*. By contrast, conventional intRAtemporal trade means the exchange of goods and services within a single time period.

Hence, a country's current account balance, defined (or understood) as the change in the value of its net claims on the rest of the world – or, equivalently, the change in its net foreign assets (NFA) – is, in fact, a measure of the country's intertemporal trade. Abstracting from the negative sign in front of the standard BoP accounting notation $-\Delta NFA$ meaning an increase in

the net foreign assets of a nation (as well as from unrequited transfers), most textbooks[22] often write this intertemporal view of the current account as:

$$CA \equiv \Delta NFA. \tag{6.16}$$

(6.16) is an analogous economic-analysis notation for the BoP-accounting records (6.9) and (6.11) above.

Because of the importance of such an approach to the current account for macroeconomic analysis, it will reappear in some of the theoretical models we shall consider in the course. As we work through these models, more clarity will be gained on this concept and its interpretation(s).

In a similar fashion (i.e. abstracting from the negative sign in front of the standard BoP accounting notation $-\Delta NFA^C$ meaning an increase in the net foreign assets of a nation's central bank or monetary authority), the overall balance of payments is often represented in the literature as:

$$OB \equiv \Delta NFA^C. \tag{6.17}$$

Again, (6.17) is an analogous economic notation for the BoP accounting identity (6.14) above.

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[22] E.g. Mark (2001), p.13.