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Chapter 1

Introduction

These notes cover the material discussed in class in the first part of the course. The material presented has been compiled by referring to books or other sources cited in the references.

The purpose of the material is to provide support for the topics introduced in class and students are encouraged to refer to other official sources to complement their background. The contents of these notes are also useful for solving the assignment that students are expected to turn in according to the general schedule.

This is the first edition of the notes: any suggestions are welcome to improve the content and make them ready to use.

Of course, any error is my unique responsability.

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Chapter 2

Some basic indicators

In this section we are introducing some basic indicators that are helpful in measuring economic activity. Serrano (2004) discusses the importance of measuring economic activity in order to be able to formulate some comments or provide interpretations of the trend and tendency of the evaluation of macroeconomics aggregates.

The best way to address this issue is to focus on the changes that a few selected variables experiences over time.

2.1 Rate of change and index of variation

This index measures the relative change of the magnitude of a variable between two moments in time. It is often expressed as a percentage.

Let us define A_0 the value of a variable at time $t = 0$ and A_1 the value of a variable at time $t = 1$, **the rate of change** of the variable A passing from time 0 to time 1 is:

$$RC = \left(\frac{A_1 - A_0}{A_0}\right) 100.$$

Therefore, if someone knows the rate of exchange and knows the initial value of variable A, it is easy to compute the value at time 1 by adopting the previous rule:

$$A_1 = A_0(1 + \frac{RC}{100}).$$

As a simple extension of the rate of change, it is possible to compute the **variation index (IV).** This index represents the direct relationship between the magnitude of a variable at the current time and the value of the same variable at a precise moment in time that has been chosen as reference (and whose value is 100). Let us define it by considering the previous variables A_0 and A_1 when we select as reference period $t = 1$:

$$IV = \left(\frac{A_1}{A_0}\right) 100.$$

When we are referring to a change that takes place between two moments in time, it could be from one year to another year or one quarter versus another. We are talking about "*year-on-year*" changes when we are referring to two different moments in time in two different years. We are referring to "*interannual*" changes when we are comparing two periods (for instance, weeks or quarters) in a same year.[1]

Example 1 *(Serrano, 2004) Let us define* $A_0 = 550$ *and* $A_1 = 500$ *and let us define t=1 as the period of reference:*

$$\begin{aligned} RC &= \left(\frac{500-550}{550}\right)100 = -9.09\% \\ IV &= (\frac{500}{550})100 = 90.09. \end{aligned}$$

2.2 Average cumulative rate

Another interesting exerecise is to compute the rate of variation of an economic variable for more than two periods. We may also want to compute a synthetic measure of this value to provide some economic interpretations of the general evolutionary trend. A very easy way to provide such an indicator is to compute a simple arithmetic average of the differen per-year variations, but this may be difficult. Instead, the average cumulative rate indicator allows to achieve this result in a very direct way.

The average cumulative rate basically smooths the annual differences in growth and provides a general results by taking into account the first and the last value of a series. The idea is to capture the average growth by focusing on the progressive increase (or decrease) of the magnitude of a variable as a results of the growth rate. However, this indicator has a major drawback: it has true economic meaning when the series of the variable we are referring to follow a monotonic evolution for the period we are considering. Again, let us consider A_0 as the initial magnitude of a variable A_n the final value of this variable after n time-periods (years, months, quarters....). The average cumulative rate (AVR) can be obtained as:

$$AVR = \left[\left(\frac{A_n}{A_0}\right)^{\frac{1}{n}} - 1\right]100;$$

knowing that:

$$A_n = A_0\left(1 + \frac{AVR}{100}\right)^n.$$

[1] In this respect, an interesting glossary it is available on the OECD website at this URL: http://stats.oecd.org/glossary/index.htm.

It may also be the case that we interested in knowing how long a variable would take to achive a specific value. Rearranging the previous expression it is possible to obtain such a missing parameter:

$$N = \left[\frac{\ln\left(\frac{A_n}{A_0}\right)}{\ln\left(1+\frac{AVR}{100}\right)} \right].$$

Exercise 2 *(Serrano, 2004) The value of A in 1997 is 99,200. This variable records a positive AVR=2.729% per-year. What is the value A could achieve in 2005 ?*

NB: n=2005-1997=8.

$$\begin{aligned} A_{2005} &= A_{1997}\left(1+\frac{AVR}{100}\right)^n; \\ A_{2005} &= 99,200\left(1+\frac{2.729}{100}\right)^8 = 123,042. \end{aligned}$$

Chapter 3

Price index

We define **the price level as a weighted average of several different prices**.The reason for using different weights is that some prices are more important than others for the economy. The price of oil, for example, is much more important than the price of apples. By using different weights we allow for changes in some prices to have a larger effect on the price level than changes in other prices.Different choices give rise to different measures of the price level. To visualize the prices and weights that are included, we use the concept **"basket"** of goods and services. We may, for example, create a basket that contains all the goods sold by a particular store on a particular day. The price of this basket is then a price level - it will be a weighted average of the prices of the goods sold that day and the weights will be equal to the number of each good sold. Perhaps the basket contains 100 litres of regular milk but only one frozen cake. The price of regular milk will then have a weight of 100 while the price of frozen cake will have a weight of 1. Changes in the price of milk will then have a greater influence on the price level than changes in the price of frozen cake (Jochumzen, 2010).

In economics we are not just interested in the value of price livels at a given moment in time: we are often interested in the percentage change in the price level between two points in time. We calculate the percentage change by first creating a basket of goods and services. At regular intervals (usually once a month on the first day of the month) we measure all the prices of the contents of the basket (typically as an average of the market) and calculate the price level. Exactly how much it would rise would depend on the weight of the changed price.

Imagine that we have created a particular basket of goods and services. We calculate the price level at four different points in time during 2008 without changing the content of the basket (the weights are unchanged). Suppose that we find the following time series for the price level (Jochumzen, 2010):

Point in time	Jan 1, 2008	Feb 1, 2008	March 1, 2008	April 1, 2008
Price index	60 770	62 400	62 850	62 850

3.1 Price index

Since we are only interested in the percentage change of the price level and not the particular value, we can divide each price level by a given constant so that the numbers are easier to deal with. When we divide a series of price levels by a constant we end up with what is called a time series of price indexes.

Using the same basket as above, if we divide the entire series by 607.70 we get the following time series of price indexes:

Point in time	Jan 1, 2008	Feb 1, 2008	March 1, 2008	April 1, 2008
Price index	*100*	*102.68*	*103.42*	*103.42*

The reason for choosing 60770 is that we want the index to be equal to 100 for the first point in time. The advantage of having an index that starts with 100 is that we will have a clearer picture of the evolution of prices. We may, for example, immediately conclude that prices rose by 2.68% on average in January and by 3.42% during the three months fromJanuary to March. Note that the percentage change of the original price level and the percentage change of the price index is the same. The percentage change will not depend on which point in time we select as our "base" (giving the price index a value of 100). Using the price index, the percentage change during January is (62400 - 60770)/60770 = 2,68% which is exactly the same as the percentage change of the price index (Jochumzen, 2010).

3.2 Consumer Price Index (CPI)

CPI is a price index of a particular basket called the CPI-basket. The CPI-basket contains basically all the goods and services consumed in a country - food, gas, medicine, haircuts, transportation, house rent and so on. The composition of the CPI basket is determined by the value of what is consumed in the country - the larger the value of total consumption of a good or service, the larger the weight in the basket. For example, if we spend twice as much on apples as on pears, apples will have twice the weight in the basket. The exact details of the composition of the basket and how the CPI is calculated are complicated and vary somewhat between countries (Jochumzen, 2010).

3.3 Inflation rate

The inflation between two points in time is defined as the percentage increase of the price index between these two points in time.

It is very important to pay attention to the following aspects:

- Price index is calculated at a particular point in time, inflation over a time period, typically one year
- Inflation may just as well be defined as the percentage change in the price level.

- Inflation is independent of which year we use as our base year for our price index.
- **If the price index decreases between two points in time we say that the inflation is negative or that we have deflation**.

The inflation rate is computed as any other rate of change being exactly the rate of change of prices (Jochumzen, 2010).

Chapter 4

The Balance of Payments

The Balance of Payments records all the economic transactions of a country with the rest of the world during a specific period (usually one year but it can be also one month or one quarter).

As in the standard account practice:

- Each payment **received from foreign** firms, institutions or citizens is a **credit,**
- Each payment **done to foreign firms**, institutions or citizens is a **debt**.

A complete balance of payments is composed by three sections:

- The **Current Account (CA)** records all transactions from and to foreign countries. These transactions principally include imports and exports of goods and services, payment of interests rate (on dividends) on some investments,rents, insurances, transport costs/incomes, and commissions paid for services. In this chapter we also include immigrant remittances and pensions.
- The **Capital Account (K)** records short and long term capital inflow and outflows.In particular, it includes institutional donations for development and transactions associated to assets as lands or other resources. We also include in this section all bank deposits held by foreign residents in the country and by citizens abroad.
- The **Financial Account (FA)** records operations such as foreign direct investment (FDI) inflows and outflows and all credit or debit leftovers for transactions that took place at a specific moment during the period we are considering, but without being completed with the entire monetary compensation. Investment in foreign treasury bonds (or other assets that guarantee a return) are recorded as well.
- **Variation of Official Reserve Assets (R)** corresponds to the entry or exit of official reserve assets as a consequence of a physical transactions.

- The **Statistical discrepances (SD)** is minor section including measurement errors in the definition of the value of each transaction due, for example, to the different values of the exchanges rates.

The Balance of Payments clears as follows:

$$CA + K + FA - R \pm SD = 0.$$

The fulfilment of this conditions implies that the results of each sections can be positive or negative, but the total value has to sum up to zero. For instance, it may occur that our economy gets negative values of the CA because of more imports than exports. The condition of the parity of the balance of payments implies that to a deficit of the CA has to correspond a surplus of K or FC, namely the debt of the current account section is financed by the inflow of foreign capital in our country.

The best way to elaborate the Balance of Payments of a country is to represent each single section as shown in the following table:

	Credit	**Debit**
CA	Export of goods and services Investment returns from abroad Remittances, pensions etc..from abroad	Import of goods and services Investment returns to abroad Remittances and pensions to abroad
	Balance of the CA: Credit - Debit	
K	Foreign capital inflow as donations from abroad Investment abroad in land and intangible assets	National capital outflow as donations from abroad Foreign investments in lands and intangible assets
	Balance of the K: Credit - Debit	
FA	FDI Inflows Credits grant by foreign institutions	FDI Outflows Credits grants to foreign institutions
	Balance of the K: Credit - Debit	
R	Increase of the reserves of foreign currencies	Decrease of the reserves of foreign currencies
SD		

Remark: The Balance of Payments is based on the notion of double-entry book keeping.

Chapter 5

Gross Domestic Product (GDP)

Gross Domestic Product (GDP) is defined as the market value of all finished goods and services produced in a country during a certain period of time. As discussed in Serrano (2004) data about GDP are taken from the information of the national account and these data are not always a true picture of the economic situation of a country at a specific moment in time. For instace, national account does not provide information about the rate of activity of informal economics. According to some official statistics, informal economics account for (about) 15-20% Spanish GDP, while, for instance, in USA or Germany this value is around 8-10% of GDP. Others categories of activities not included in the national account are the barter exchanges, the self-consumption production as well as other important costs (or revenues) that are associated to the environmental maintenance and to an extent the quality of personal services.

We only include finished goods and services - that is, anything that is sold directly to the consumer. Electric power sold to a steel mill is not included while all the electric power sold directly to consumers is included. The reason is simply that we want to avoid "double counting". Consider for example the production of cars. Car producers have parts produced by other firms which in turn have to be delivered by other firms and so on. If we were to count the value of everything produced by a firm, then most parts of a car would be counted several times. This is why only the value of the finished car is used in the calculation of GDP. Note, however, that if a firm buys a robot that it uses in the production of cars, then this robot is counted (if it is produced in the same country). The car producer is then the "final consumer" of the robot - no value is added to it and it is not resold to another firm (Jochumzen, 2010).

GDP is a flow variable and not a stock variable. By a flow variable we mean a variable that is measured in something per unit of time. Being a flow, **it is not a measure of the total wealth of a country but a measure of the "income" of the country during a certain period of time.** So, if GDP is high, it is quite likely that the total wealth of the country is increasing over time (some wealth is lost to depreciation). Therefore, there is often a connection between what we perceive as a "rich" country and a high GDP per capita.

In addition, in countries with large immigration and emigration flows, the GDP is not the best measure of the true income produced by "citizens". In this case the **GNP (Gross National Product)** is a more suitable measure of the income of those countries. For instance, in countries like the United States statistics about GNP are the most referred to in statistics for measuring the annual "income" of the country.The GNP is obtained as:

$$GNP = GDP \ \pm \ remittances.$$

5.1 Real GDP

In order to be able to make reasonable comparisons of GDP over time, we must adjust for inflation. For example, if prices are doubled over one year, then GDP will double even though exactly the same goods and services are produced as the year before. **To eliminate the effect of inflation we divide GDP by a price index and we define real GDP as GDP divided by a price index**.

It is not very common to use CPI in the construction of real GDP. The reason is that CPI measures the price evolution of consumer goods while GDP includes investment goods as well as consumer goods. Instead, it is common **to use a GDP deflator as a price index**.

$$GDP\ deflator = \left(\frac{\text{nominal GDP}}{\text{real GDP}}\right) 100$$

The GDP deflator measures the price evolution of a basket whose composition is close to the composition of GDP. The difference between the CPI and the GDP deflator is fairly small however. In economic analysis, it is also quite common to approximate the the GDP deflator with the CPI: the CPI series are always available for any territorial unit while GDP deflator is more complicated to compute. This easy data availability makes of the CPI a good approximation of the GDP deflator (Jochumzen, 2010 and Burda, 2005).

Example 3 *(Serrano, 2004). Let us consider the following values of GDP:*

	1999	*2000*	*2001*
Nominal GDP	*590*	*609*	*646*
GDP deflator	*147*	*153*	*159*

1. Determine the value of real GDP

2. Calculate the GDP series at prices 2000 by assuming that the GDP differences are purely due to the effect of changes in prices and not in quantities.

3 Calculate the GDP deflator for 2001=100.

Answers:

1. Real GDP: it is the ratio between nominal GDP and the GDP deflator

$$\textbf{1999}: \left(\frac{590}{147}\right) 100 = 401.36; \ \textbf{2000}: \left(\frac{609}{153}\right) 100 = 398.03; \ \textbf{2001}: \left(\frac{646}{159}\right) 100 = 406.28;$$

2. In order to compute the GDP series at prices 2000, we consider that the nominal value of GDP in 2000 is the reference. Therefore:

$$\textbf{1999}: \left(\frac{590}{609}\right) 100 = 96.88; \ \textbf{2000}: \left(\frac{609}{609}\right) 100 = 100; \ \textbf{2001}: \left(\frac{646}{609}\right) 100 = 106.07;$$

3. In order to calculate the GDP deflator taking as a reference 2001, we need to compute a variation index:

$$\textbf{1999}: \left(\frac{147}{159}\right) 100 = 92.45; \ \textbf{2000}: \left(\frac{153}{159}\right) 100 = 96.23; \ \textbf{2001}: \left(\frac{159}{159}\right) 100 = 100;$$

Finally, **remind that GDP that is not adjusted for inflation is often called nominal GDP**.

It is also very important to pay special attention when making international comparisons to assess the level of income of a country (or any other territorial units). First, when comparing GDP across countries to state their level of income, it is very important to get rid of any size effects (namely, the total Chinese GDP is orders of magnitude larger than total Swedish GDP, but this does not mean that the Swedish income is lower than the Chinese one). In order to overcome this problem we must compare **GDP per capita between countries.**

Since the GDP value is a nominal one, it may happens that the value of the comparisons may fluctuate a lot because of the effect of a high volatile exchange rate. Once more, we have to control for this volatility. A way of avoiding dependence on the exchange rate is to compute the GDP per capital at country level by using the **purchasing power indicators** (refer subsection 5.1).

5.2 Economic growth

By (nominal) GDP-growth we mean the percentage change in (nominal) GDP over a specific period of time. **Real GDP growth is defined as the percentage change in real GDP**. The **real growth** tells us how much the economy has grown during a particular period when the effect of inflation is removed. The measure of real growth is the most common indicators adopted to draw insights about the economic perspective of a country or any other territory.

Exercise 4 *(Serrano, 2004) Let us consider the following data:*

	2000	*2001*	*2002*
GDP in current prices	*609*	*646*	*697*
GDP in constant prices 1997	*510*	*521*	*536*

Questions:
1. Determine the GDP deflator,
2. Inflation rate,
3. Real GDP growth rate in 2001 and 2002,
4. GDP 2002 at constant-2000 prices.

Answers:
1. GDP deflator (1997=100):

$$\textbf{2000}: \left(\frac{609}{510}\right) 100 = 119,41; \ \textbf{2001}: \left(\frac{646}{521}\right) 100 = 123,9; \ \textbf{2002}: \left(\frac{697}{536}\right) 100 = 130,00.$$

2. Inflation rate: here we do not possess any information about the ICP, therefore we compute the inflation rate by using the GDP deflator:

$$\textbf{2001} = \left(\frac{123,9 - 119,41}{119,41}\right) 100 = 3,76\%; \ \textbf{2002} = \left(\frac{130 - 123,9}{123,9}\right) 100 = 4,92\%.$$

3. Real GDP growth rate: we consider the GDP at constant prices

$$\textbf{2001} = \left(\frac{521 - 510}{510}\right) 100 = 2,1\%; \quad \textbf{2002} = \left(\frac{536 - 521}{521}\right) 100 = 2,88\%.$$

4. GDP 2002 at costant-2000 prices. This new condition implies that the GDP deflator in 2000 is 100. Therefore

$$GDP_{2002}(00 = 100) = \left(\frac{697}{\frac{130,0}{119,4}}\right) 100 = 640,17.$$

5.3 The components of GDP

GDP is defined as as the market value of all finished goods and service produced in a country during a specific period of time. We will now look closer at the definition and the components of GDP

The composition of the GDP is given by the following elements:

- Firms deliver finished goods to the goods market (semi-manufactured goods circulate within

the box firms). Firms are compensated for the goods and this compensation is equal to GDP.

- Consumers receive goods from the goods market where prices are determined through supply and demand.
- In order to pay for the goods, the consumers deliver factors of production (labor and capital) to the factor markets.
- Firms buy factors of production using the income they receive from the goods market.

Note that the flow of money from firms to the factor markets is exactly the same as the flow of money from the goods market to the firms. If this was not the case, firms as a group would make a profit or a loss. But since all firms are owned by individuals (directly or indirectly through pension funds and other funds), all profits or losses must eventually fall on the consumers (Jochumzen, 2010).

5.3.1 GDP from the supply side

A firm in our model is a unit which adds value to products. These products may be raw material, semi-manufactured goods, final goods and services. By adding value, we mean that the firm acquires the good, adds value to it and then sells it. Firms add value by using factors of production (mostly various forms of labor and capital). **We define value added (*va*) as the difference between the revenue and the cost of the goods**. If a supermarket buys a fish for 4 euro and sells it for 5 euro, it has added 1 euro of value to the fish.

Since the value added in each firm is equal to the return to the factors of production, the total return to the factor market must be equal to the sum of value added from all firms, which is equal to the GDP (Jochumzen, 2010**).**

The total return to the factor market =

$$\text{Sum of all value added} = \sum_{i=1}^{n} va_i + TAX = GDP,$$

with n the total numer of sectors and TAX **the net taxes on the production (and products). TAX is obtained as the difference between the taxes less and subsidies or transfers to the production (and products)**.

5.3.2 GDP from the demand side

Since the private sector receives the entire return from the factors of production, the national income is equal to the GDP and we can use the symbol Y for national income as well. The private sector pays taxes to the government. Here we must include all taxes, income taxes,

value added taxes, selective purchase taxes and payroll taxes (which are ultimately paid by the private sector since it owns the firms). Part of these taxes will be returned to the private sector in the form of pensions, child allowances, sickness benefit, unemployment benefits and so on (Jochumzen, 2010). All these are examples of transfers from the government. We denote government expenditure by **G**. Total consumption by the private sector is denoted by **C**. Consumption needs not be equal to disposable income as the private sector can save and borrow. We define the private sectors savings as SH = YDisp - C (H for household). If C > YDisp then SH < 0, which implies that the private sector (in the aggregate) is borrowing money. The total value of all exports to the rest of the world is denoted by **X**, while the total value of all imports from the rest of the world is denoted by **M**. If M > X then the value of all goods and services received from the rest of the world is larger than the value of goods and services that we send to them. The difference, SR = M - X is rest of the world savings and this is also the amount we borrow from the rest of the world, which must eventually be paid back by exporting more than we import.

Finally, we have to take into account investments. When we use the word investment, we typically mean "gross investment". Basically, gross investment consists of all finished goods that we have produced but not consumed. T**he gross investment (I) is composed by gross fixed investment and changes in inventories.** Gross fixed investment is the total amount of investment in fixed capital. If a firm produces more than it sells in a particular period of time, its inventory will increase. This will be counted as a positive investment. In the same way, we will have a negative inventory investment whenever inventories decrease (Jochumzen, 2010).

By correctly summing up properly the previous components we get to the expression of the total nominal GDP (at current prices) from the demand side as follows:

$$GDP = Y = C + I + G + X - M$$

Example 5 *Let us consider the following values:*
Private consumption (C): 1 283
Gross investment (I): 456
Public consumption (G):728
Import (M): 1 093
Export (X):1 299
GDP= 1283+456+728+1299-1093= 2673

5.3.3 GDP from the income side

As the sum of all returns from the factor markets, the total GDP can be also obtained as the sum of wages, return on capital and so on.

In this respect, the value of the GDP includes wages of the employees, rents (for land or real estates), interests and other returns on financial activites, taxes (on production, consumption and import) minus subsidies or public transfer to the production or trade activity. Therefore, the nominal GDP at current prices can be obtained as:

$$GDP = wages + other\ incomes + tax(prod + import) - subsidies(prod. + import).$$

Exercise 6 *These are data refer to the Catalan GDP in 2007 (mill. €)*

Exports	64.977
Gross investment (capital formation)	58.059
Final consumption (families	135.673
Imports	78.869
Wages of employees	97.807
Value added agriculture	1.786
Value added energy	3.432
Value added industry	36.821
Value added construction	20.149
Other incomes and revenues	89.169
Public expenditure	28.840
Value added market services	107.265
Value added no market services	18.658
Net taxes on production	20.569
Net taxes on production and imports	21.704

a. 1) GDP: demand side

Export	64.977
Gross investment (capital formation)	58.059
Private consumption	135.673
Import	-78.869
Public expenditure	28.840
GDP 2007 market prices (€)	**208.680**

a.2) PIB: supply side

VA Agriculture	1.786
VA Energy	3.432
VA Industry	36.821
VA Construction	20.149
VA Market Services	107.265
VA No market services	18.658
Net taxes on production	20.569
GDP 2007 market prices (€)	**208.680**

a.3) GDP: revenue and income side

Wages	97.807
Others incomes and revenues	89.169
Net taxes on production and import	21.704
GDP 2007 market prices (€)	**208.680**

Chapter 6

Indicators of competitiveness

The information we compile to compute the GDP from the demand side allows for getting some complementaty insights about the evolution of the competitiveness of a country.

The most natural (and intuitive) indicator refers to the trade account, namely the difference between exports and imports (X-M). A positive trade accounts implies that a country is particular competitive in the international markets. This situation entails some positive benefits: the GDP (hence the available income) increases and the exchange rate of the country is expected to apreciate. Another easy way to check the status of competitivenes is by looking at the **terms of trade** of a country. The terms of trade is the ratio between the prices of exports and the price of imports. It measures the quantity of foreign goods can be purchased with one unit of domestic output (Burda, 2005).

On the trading side, the competitiveness of a country identifies with the share of export in in the international countries.

6.1 Prices and trade

The level of prices across countries affects the trade directions. A country usually records high export flows when the price of the good and services it offers on the international markets is lower than that of the direct competitors. When talking about prices in the international markets, we are not only referring to the nominal value of a good (or service) but also the exchange rate that allows it to pass from a currency or another. The relationship between prices, exchange rates and international trade is quite complex. A country whose currency is particularly depreciated on the international markets can enjoy some technical benefits to be able to export at quite constant rates even if the internal prices (namely inflation) are increasing. Of course, the same country would be in serious trouble on the import side given that the price of imported goods and services is progressively increasing too.

In economics, one usually refers to the concept of **purchasing power parity** when asserting that the real exchange rate is constant. This idea implies that the price level of a same good (in different) countries is equalized across these countries when converted into the same currency. Let us consider the price of a worldwide good (the BIG-MAC, for instance);

the PPP would be expressed as follows:

$$\text{Absolute } PPP_{€/\$} \Longrightarrow e = \frac{P(€)}{P(\$)};$$

where e is the spot exchange rate between \$/€; $P(€)$ is the price of the BIG-MAC in € and $P(\$)$ is the price of the BIG-MAC in \$.

As a consequence of the PPP, we are able to compute the **real exchange rate** (between two currencies): it is the cost of foreign goods in terms of domestic goods:

$$e_{\text{real}} = e\frac{P_{\text{hom}\,e}}{P_{abroad}}.$$

To the same extent, if we want to use an index to express the potential competitiveness of a country with respect to a group of countries as an area (for instance, a US company looking at the competitiveness in the EURO zone) we need to compute the **effective exchange rate.** This rate is an index consisting of a weighted average of a country's exchange rate with respect to a selected sample of trading partners.

The *nominal effective exchange rate* (**TCE**) is a weighted average of a sample of bilateral exchange rates selected according to a specific criteria, once we transformed the individual exchange rate values into an index (e_I) :

$$TCE = \sum_{i=1}^{j} w_i e_{Ii};$$

where w_i is the relative weight of currency i in the group of j currencies $\left(\sum_{i=1}^{j} w_i = 1\right)$.

In the same wein, the **real effective exchange rate (TCER)** (still referred to the previous sample of j countries) is obtained as a TCE corrected by the difference between the home and trade prices:

$$TCER = \frac{TCE * P^*}{P};$$

where P is the price index of the home country while P^* is the price index for the group of j-countries we take as reference. If the value of TCER increases, the competitiveness of the country betters because either the currency depreciates or the inflation is lower than abroad. Similarly, a decrease of TCER implies an appreciation of the currency (or an inflation higher than that of the partners) and, therefore, the competitiveness of the country drops (Serrano, 2004).

6.2 Other indicators of trade competitiveness

There is a quite aboundant bunch of indicators to study the international competitiveness of a country. Among them the most common ones are:

- Contribution of exports to GDP: it is the quota of exports in the national GDP

$$Exp\_part = \frac{X}{GDP}.$$

- Export (import) share: it measures the relative position of a country as a client and a provider in international trade for a $i-$sector:

$$Exp\_share_i = \left(\frac{X_i}{M_i}\right) 100; \; Imp\_share_i = \left(\frac{M_i}{X_i}\right) 100.$$

- Degree of openess to trade: it measures the importance of international trade in the GDP formation

$$OpTrade = \left(\frac{M+X}{GDP}\right) 100.$$

  This index can take value greater than 100 when we are considering the so called *small open economies.* These economies are particularly active in the trading activities; trade is one of the principal source of revenue of the local population.

- Quota of export in the national trade flows at country level: it measures the importance of exports of in the total national trade flows:

$$Quo\_Exp = \left(\frac{X}{M+I}\right) 100.$$

  This indicator allows to depict the main features of the trade composition of a country: when the value of this index is larger than 50, the export flows from this country i are bigger than the import ones.

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