

## Macroeconomic Accounts

### The system of national accounts

Macroeconomic accounting deals with **aggregates** and **accounting identities**, that is with macroeconomic magnitudes and how they relate to each other *by definition*. Macroeconomic accounting *does not* explain how each magnitude changes as a result of a change in other magnitudes. This will be the task of macroeconomic analysis, that we will look at in the next units of the course. In this first unit, we just deal with definitions. All that we say will therefore *always hold* by definition.

The purpose of the system of national accounts is to keep record of the transactions that take place in any economy for the purpose of measuring productive activity and income generated in the economy. Since 1998 all countries should conform the new system of national accounts of the UN—System of National Accounts 1993 (SNA93). Additionally, the Eurostat (Central Statistical Agency of the EU) has produced a standard for members of the EU in accordance with SNA93 called the European System of Accounts 1995 (ESA95). The exposition here will be in accordance with these new systems.

### Institutional units

In the view of the system of national accounts an economy is a system of decision-making units that interact with each other and perform economic transactions. The basic decision-making unit is called an **institutional unit**, which is any entity capable of owning assets, incurring liabilities, engaging in economic activities and transactions. Institutional units are either households or legal persons like corporations, governmental agencies, associations. Production and income are generated as a result of the transactions in which institutional units are engaged.

### Stocks and flows

National accounting keeps record of the variables that describe the working of an economy. A first distinction should be made between **stock variables**, which are defined *at a particular point in time*, and **flow variables**, which are defined *for a particular time period*.

Transactions are always represented by flows over a period of time. Examples of flow variables are: the value of production in a country during a given year, the value of final consumption done by households in a country during a given month, the value of income earned by workers in a province during a given week, etc.

However, institutional units also own stocks of assets or owe stocks of liabilities. Examples of stock variables are: the value of money holdings in a country on the first day of any given year, the value of materials and supplies in storage kept by a firm on the last day of any given month, the value of a household's wealth (value of all assets owned and all liabilities owed) on the first day of any year.

### Sectors of the economy

The institutional units that form an economy are grouped into the following sectors by the system of national accounts. First, the reference point is established, i.e. the economy of interest. All institutional units that have *center of economic interest* in that economy are called the **resident** units and form the **total economy** of interest. All non-resident units constitute the **rest of the world**. By convention, foreign students, border workers, and foreign embassies are non-resident. The total economy is then grouped into the following sectors.

- For-profit institutional units: market producers
  - **Financial corporations** engage in activities such as deposit-taking, lending, and insurance
  - **Non-financial corporations** supply goods and non-financial services
- Non-for-profit institutional units: retain surplus, which cannot be appropriated by its members
  - **General government** central, state and local government, and social security funds
  - **Non-profit institutions** serving households, e.g. churches, red cross, trade unions
  - **Households** which also include the self-employed

A **market producer** is defined as one that covers more 50% of the costs of production from sale receipts. Publicly owned firms that cover more than 50% of the costs are *not* booked under general government, but under for-profit institutions.

Since non-profit institutions serving households are a small sector, they are often reported together with the households sector.

## The circular flow of income

The flow of transactions between sectors give rise to production and the generation of income in the economy. To see how, it is useful to visualize the economy in the following *simplified* way.

- Think of production being done by firms, which sell their output in the marketplace. After paying for raw materials, and intermediate goods, the receipts of sales go to compensate workers, to pay taxes (e.g. value added tax) to the government, and the rest accrues to owners or shareholders as profits or dividends. In this way, the value of production flows as income to households as workers or owners of the firms, and as taxes to the government. Firms may also retain part of their profits as corporate saving.
- Out of their income from labor and ownership households pay income taxes to the government. They also receive transfers like unemployment benefits or pensions from the government. The rest is called disposable income and is used for consumption and saving.
- The government receives taxes from firms and households, it pays subsidies to firms and transfers to households, but it receives more than it pays and the difference is called net taxes, which is an inflow for the government. On the other hand, the government spends in public education and health, in hiring the services of civil servants, etc. The difference between net taxes and government spending is called public saving.
- Private saving (done by households and firms) goes to the financial sector where financial corporations use it to finance consumption and investment projects (financial intermediation).
- Part of consumption spending (jeans, CDs, etc.), part of investment spending (machines, equipment etc.), and part of the demand done by the government (e.g. helicopters) is of imported goods, i.e. goods that are not produced within the economy. The flow of income dedicated to import exits the economy. In the same way, part of the production that takes place in the economy is sold to the rest of the world. This generates a flow of income from the rest of the world into the economy. The difference between the two is called net exports.

We see how each individual's expenditure contributes to some other individual's income and how income from sales flows from firms to individuals and back to the marketplace. Nothing goes lost and the system is closed.

## Gross Domestic Product (GDP)

**GDP** is the final result of the production activity of *resident* producer units during a period of time. Thus, it is defined for a geographic area, usually a country, and over a period of time (flow variable). There are three ways to measure production. These correspond to three different definitions of GDP.

### Final expenditure

Production can be measured as the value of all goods and services produced and sold in the economy during a given period. From this viewpoint GDP is the sum of **final uses** of goods and services by resident institutional units **plus exports** and **minus imports**.

$$\text{GDP} = \sum \text{net final sales} \quad (I)$$

Two things are specially important in this definition:

- Final sales* of goods and services are those to the consumer or firm that ultimately use them. *Intermediate sales* of goods and services (**intermediate consumption**) are those to firms that will use them for the production of other goods and services. The latter must be excluded in GDP to avoid double counting.

### Example

Consider an economy with only two firms. Firm 1 produces steel with workers and machines. Firm 2 buys steel and uses it, together with workers and machines, to produce cars. In a given period the steel producer sells steel for €100 to the car producer, pays €80 to workers and makes a profit of €20. In the same period the car producer sells cars for €210, pays €100 for the steel, €70 to workers, and makes a profit of €40. How should we measure production in this economy?

The sum of sales is €310. However, imagine that both firms merge so that the production of steel and cars took place within the same firm. Then the production of steel would not be recorded as sales and we would only see cars sold for €210. Clearly in both cases the production is the same.

We see how the value of steel is included in that of cars, so it should not be counted twice. GDP is thus equal to the value of cars (the only final good) sold in the economy, €210.

- b) *Exports* are goods and services produced by resident units and used by the rest of the world. For consistency, they are counted as final sales regardless of how the foreigners use them. Respectively, *imports* are goods and services produced by non-resident units and used by residents. Thus, they are always subtracted from final sales. That is the meaning of *net* in the definition.

GDP is valued at **market prices**, i.e. the prices paid in the market for the goods and services. Market prices include *for final users* all taxes on products like the value added tax.

Final sales can be broken into the following categories: sales of consumption goods and services (C), sales of investment goods (I), sales to the government (G), and sales to the rest of the world (X); since part of domestic income leaks abroad to pay for imported goods, imports (Q) must be subtracted. Sales to the government (G) may be sales of consumption as well as sales of investment goods. This gives the usual decomposition of GDP that we will use along this course

$$\mathbf{GDP = C + I + G + X - Q}$$

The new system of national accounts however, merges sales of consumption goods and services (C) together with final sales to the government (G) and calls the resulting category **final consumption expenditure**. Final consumption expenditure is then broken down into:

- **Individual consumption expenditure**: when the purpose of consumption expenditure is to meet individual needs, that is the needs of individuals who could, in principle, be identified or singled out by name as benefiting from the expenditure.
- **Collective consumption expenditure**: when the purpose of consumption expenditure is to meet collective needs, that is there is, in principle, no sensible way in which the beneficiaries of the expenditure could be identified or singled out by name.

All final expenditure by households is to meet individual needs. By convention, all final expenditure by non-profit institutions serving households is classified as consumption expenditure serving individual needs (so they are treated in the same way as households). Of the final *consumption* by general government some is to meet individual needs (e.g. public education, public health) and some is to meet collective needs (e.g. street lighting, national defense, law and order).

## Value added

**Gross value added** of a firm, industry or institutional sector is defined as follows:

$$\mathbf{Gross\ value\ added = output - intermediate\ consumption}$$

That is, gross value added is what remains of sale receipts after raw materials and intermediate goods have been paid for.

In a *first approximation*, GDP is the sum of gross value added of the various institutional sectors or the various industries in the economy.

$$\mathbf{GDP = \sum\ gross\ value\ added}$$

If a firm produces intermediate goods, its sales correspond to the intermediate consumption of its customers, and thus its value added is not counted twice in GDP. When the final consumer purchases a good or a service in the market, the price includes all the value added created at each stage in the production process.

### Example

In the previous example with only two firms, the value of output for the car producer is the value of car sales €210. Its intermediate consumption is the value of steel sales €100. Thus its value added equals €110. The steel producer has valued added €100, since it does not use intermediate goods. GDP equals the total value added generated by both firms €100 + €110 = €210, which in turn equals the value of final sales in the economy.

### Basic prices vs. purchaser's prices

- The **basic price** is the amount receivable by the producer for a unit of output minus any tax on products and plus any subsidy on products. Basic prices correspond to the value that the producer actually receives for the good or service, thus they are the relevant prices for the producer.

Producers collect *taxes on products* and then remit these further to the government. Taxes on products include value added type of taxes (VAT) as well as other taxes like excise duties (beverages, fuel, tobacco, etc.) or import taxes. Take for example the VAT. The amount of VAT remitted to the government equals the difference between the amount invoiced out (collected through sales) and the amount invoiced in (paid when purchasing intermediate goods). The amount of VAT paid by the producer for the purchase of intermediate goods is deductible for the producer.

On the other hand, producers also receive from the government *subsidies on products* (e.g. a subsidy to an editorial for each unit of text books sold to students). Taxes and subsidies on products change the final price.

- The **purchaser's price** is the price the purchaser actually pays for the products, which includes any tax on products if it is not deductible. Thus, it is the price relevant for the purchaser.

For a final consumer the price of a good or service always includes the VAT, but we already mentioned that the VAT paid for intermediate consumption is deductible for producers.

Gross value added is valued at basic prices, since **output** is valued at **basic prices** and **intermediate consumption** is valued at **purchaser's prices**, which excludes deductible taxes on products. We can now be *more precise* about the value added definition of GDP. In particular,

$$\text{GDP} = \sum \text{total gross value added} + \text{taxes on products} - \text{subsidies on products} \quad (\text{II})$$

Recall that final expenditure includes all (for the final user non-deductible) taxes on products. When taxes on products have been added and subsidies on products have been subtracted, to total gross value added at basic prices (excluding taxes on products), we obtain the value added definition of GDP (def. II) which is equivalent to the final expenditure definition (def. I).

### Example

In our example of economy with two firms, suppose that the steel producer charges 10% VAT and the car producer charges 20% VAT to the price of their sales.

*Final sales:* Final consumers of cars must pay €42 VAT within the price of cars.

$$\text{GDP} = \text{Sales of cars at market prices} = \text{€210} + \text{€42} = \text{€252}.$$

#### Value added

- Value added by steel producer = €100 (output at basic prices)
- Value added by car producer = €210 (output at basic prices) – €100 (intermediate consumption at purchaser's price) = €110.

The car producer pays €10 deductible VAT so this is not included in the relevant price.

$$\text{Total gross value added} = \text{€100} + \text{€110} = \text{€210 (at basic prices)}$$

*Total taxes on products* received by the government

$$\text{€10 (remitted by steel producer)} + (\text{€42} - \text{€10}) \text{ (remitted by car producer)} = \text{€42}$$

$$\text{GDP} = \text{total gross value added} + \text{taxes on products} = \text{€210} + \text{€42} = \text{€252}$$

### Income

Once raw materials and intermediate goods have been paid for, firms use value added to pay taxes and to compensate the factors of production (labor and capital). The different kinds of income that accrue to institutional units as a result either of their direct involvement in the process of producing value added or of their ownership of assets required for the purpose of production are called **primary incomes**. More precisely, primary income is:

- Primary income for labor and for owners of produced assets, all generated by production:
  - **compensation of employees** (labor income)
  - **operating surplus** (profits of the firm) and **mixed income** (profits of self-employed)
- **Property income:** Primary income for owners of financial assets and non-produced tangible (or 'natural') assets (e.g. land)
- **Taxes on production** (less subsidies) which are by convention the primary income that accrues to the government. Note that *taxes on production* include, on the one hand, *taxes on products* like the VAT and, on the other hand, *other taxes on production* like taxes on land or pollution taxes. The same distinction should be made for subsidies, namely *subsidies on products* like subsidy to a publicly owned firm to reduce the price of the good provided (e.g. subsidy to public transportation firm to reduce the price of the single ticket) and *other subsidies on production* like subsidies to reduce pollution or subsidies to enroll particular types of unemployed (e.g. handicapped persons)

GDP can be defined as the sum of **primary incomes**.

$$\text{GDP} = \sum \text{primary incomes} \quad (\text{III})$$

### Example

In our basic example with two firms  $GDP = \text{total wages} + \text{total profits} = \text{€}150 + \text{€}60 = \text{€}210$

With VAT,  $GDP = \text{total wages} + \text{total profits} + \text{taxes on products} = \text{€}150 + \text{€}60 + \text{€}42 = \text{€}252$

Recall that in the second case we had only taxes on products and no other taxes on production.

### Net domestic product

Fixed capital like machines and buildings deteriorate with the process of production. This deterioration is usually referred to as **depreciation** or **consumption of fixed capital**.

**Net domestic product (NDP)** equals GDP minus consumption of fixed capital. Producers save part of the value of production in order to replace fixed capital. Thus consumption of fixed capital does not reach the hands of households for consumption and saving.

All macroeconomic aggregates can be defined gross or net. The term net in national accounting usually refers to net of depreciation.

### National Income

We mentioned that firms use value added to pay taxes on production, wages, dividends, interests and rents. All these correspond to primary income. However, part of the factors of production may be owned by non-residents, so part of these payments may accrue to non-residents. E.g. non-resident shareholders of resident corporations receive dividends; non-resident banks making loans to residents receive interest payments. Resident units may also receive primary incomes from non-resident units. E.g. a resident owner of a building abroad may receive a rent from a non-resident unit; a resident worker crossing the border every day to work abroad will receive a wage from a non-resident firm.

**Gross (or net) national income** is the sum of primary incomes that accrue to *resident* institutional units. To calculate gross national income we can sum all primary income that accrue to resident units. Alternatively, we can define the *balance of primary incomes of the rest of the world* as the sum of all primary incomes paid from resident to non-resident units minus the sum of all primary incomes paid from non-resident to resident units. Then gross national income can be calculated as

$$\text{Gross national income} = \text{GDP} - \text{balance of primary incomes of the rest of the world}$$

The concept of national income corresponds to that of GNP in the former system of national accounts. National income is not a production but an income concept, so it makes more sense to express it in net terms (excluding consumption of fixed capital which does not reach the hands of households).

### Example

Suppose that the owners of the steel company in our first example are non-resident, although the firm is located in the economy of interest. Then €20 will accrue to the non-resident owners as operating surplus. Moreover, suppose that some resident households cross the border every day to work in a non-resident firm, where they get €50 wages. GDP is still €210. However, the balance of primary incomes of the rest of the world is  $(\text{€}20 - \text{€}50) = -\text{€}30$ . Gross national income is  $\text{€}210 - (-\text{€}30) = \text{€}240$ . Suppose additionally that consumption of fixed capital is €25, then net national income is €215.

### National disposable income

We have defined *national income* as the sum of primary incomes that accrues to *resident* institutional units only, excluding income that accrues to non-residents and including income paid to resident units by the rest of the world. Still national income is not the relevant income that is available in the country for consumption and saving yet.

After compensating for the balance of primary incomes of the rest of the world, we have that, on the one hand, firms pay corporate taxes to the government. This increases the government's "disposable income" with respect to its primary income (recall the government's primary income equals taxes less subsidies on production) and it reduces the firms' "disposable income". Households pay social security contributions and personal taxes to the government. This again increases the government's "disposable income" and it reduces the households' "disposable income". On the other hand, the government also pays social security benefits like unemployment benefits and pensions to the households, which reduces the government's "disposable income" and it increases the households' "disposable income".

In summary, national income is again *redistributed* between sectors through transfers. A **transfer** is an unrequited transaction in which one institutional unit provides a good, service or asset (including cash) to another unit without receiving from the latter any good, service or asset in return as counterpart.

We have already mentioned particular examples of **transfers in cash** that typically take place in the economy. The private sector pays transfers to the government in the form of **income taxes** (personal income tax, corporate tax). Households pay **social security contributions** to finance the different social insurance systems (pension and invalidity funds, public health system) and receive from the government **social benefits** (unemployment benefits, pensions). **Other transfers** include those paid exceptionally by the government in case of natural disasters, international aid (to the rest of the world), or even insurance premiums and indemnities.<sup>1</sup> Note that part of the transfers that take place in the economy may be between resident and non-resident units. E.g. international aid.

The *disposable income of any sector* is what is left for consumption and saving after all transfers paid have been subtracted and all transfer received have been added to the income of that sector. Households use disposable income for consumption and saving. Firms use disposable income for (corporate) saving. The government uses its disposable income to finance government spending and for public saving (government surplus).

For the economy as a whole, **gross national disposable income** is the sum of the gross disposable incomes of the institutional sectors. We can also compute it by subtracting from gross national income the current transfers (current taxes on income, wealth, etc., social contributions, social benefits and other current transfers) payable to non-resident units, and adding current transfers receivable by resident units from the rest of the world.

## Summary

GDP – Balance of primary incomes of the rest of the world = Gross national income (GNI)

GNI – Balance of current transfers of the rest of the world = Gross national disposable income (GNDI)

GNDI – Consumption of fixed capital = Net national disposable income (NNDI)

## Households' disposable income—personal disposable income

Of all sectors, households are especially important for they are responsible for most individual consumption and private saving in the economy. Firms also retain part of their earnings before they distribute dividends, but this *corporate saving* is usually only a small part of the total saving in the economy.

Therefore, it is important to distinguish the part of gross national disposable income that accrues to households as workers or owners. What households actually receive for consumption and saving is referred to as **personal disposable income**. To calculate personal disposable income we start with GDP and see what part of the income generated by production and sale actually ends up in the hands of the *resident* households for consumption and saving.

- From GDP *to market prices* we first subtract consumption of fixed capital, which is set aside by firms to replace productive equipment. This gives *net* domestic product (NDP) to market prices.
- Out of NDP *to market prices*, firms pay taxes on production (less subsidies) to the government. The rest is NDP *to factor costs*, because it goes to pay for labor and capital.
- NDP *to factor costs* is used to pay:
  - wages, salaries and other compensations to employees (includ. social security contributions)
  - interests to bondholders and banks, and
  - corporate taxes (direct taxes on firms' surplus) to the government.
  - The rest is profits for the firm's owners or shareholders. Part of these profits may be retained and the rest is distributed as property income.

Part of these incomes accrue to non-resident units (interest to foreign banks, dividends to foreign shareholders). Also, income generated outside the economy may accrue to resident units (interest paid to resident bondholders by non-resident firms). NDP to factor costs minus the balance of primary incomes of the rest of the world is net *national* product (NNP) to factor costs.

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<sup>1</sup> Insurance premiums and claims are a special case of transfers. When a household decides to pay for a non-life insurance policy (accident, fire, loss by theft) the convention is that the insurance service provided is not a counterpart to the premium paid, but the premium is treated as an unrequited transaction. In case that an indemnity is then paid at some point, this is not considered to be part of the same transaction, but a different unrequited transaction. Non-life insurance premiums and indemnities are treated as transfers. The commissions or fees associated with insurance premiums are considered to be the price of the service provided by the insurance firm and enter GDP as value added by insurance providers. On the other hand, life insurance is treated separately as a form (and part) of saving.

- The part of NNP to factor costs that is not retained by firms as corporate saving, and does not go to the government as corporate taxes, goes to resident households as employees or owners of capital. Additionally, households receive transfers from the government (social security benefits). Note also that at this stage some transfers may take place between resident and non-resident units; e.g. the government may pay pensions to non-resident households, or it may send transfers for international aid, and households may receive transfers in cash from relatives in other countries (called remittances). Once the balance of current transfers of the rest of the world has been accounted for, we obtain *personal income*.
- Out of personal income households still have to pay direct taxes on personal income and other fees (like vehicle licenses or parking fines to the local government). What remains constitutes their *personal disposable income*.

## Balance of payments

The balance of payments is the set of accounts that keeps record of the economy's transactions with the rest of the world. Every economy's balance of payments must be organized in conformity with the International Monetary Fund *Balance of Payments Manual*. The balance of payments has two parts.

- The **current account** (CA) that records current transactions; it has three parts:
  - Balance of goods and services which records exports and imports of goods and services.
  - Balance of primary incomes which records not only labor income, but also investment income on holdings of assets like dividends on shares, and interests on bonds or loans.
  - Balance of current transfers which includes workers remittances, international aid, payments to and from the EU budget.
- The **capital account** (KA): Records capital transactions (capital transfers, direct investment, portfolio investment)

Note the distinction between direct investment and investment income. If a non-resident buys shares of a resident firm, the amount invested in shares is recorded in the KA. Then every time that dividends are paid on these shares, they are recorded as primary income in the CA.

In the next section we discuss why having a CA deficit implies that the country as a whole must borrow from the rest of the world. Respectively, having a CA surplus implies that the country as a whole is lending to the rest of the world. This constitutes a key macroeconomic identity. If the country is borrowing, capital is flowing in. If it is lending, i.e. acquiring foreign assets, capital is flowing out. The KA records these flows. Therefore, the KA balance should equal (with the opposite sign) the CA balance. In fact, since these numbers come from different sources it is never exactly so. Differences are regarded as statistical discrepancies.

## Basic identity of national accounting

Recall the decomposition of GDP according to the different categories of final sales:

$$\mathbf{GDP = C + I + G + X - Q}$$

In the previous section we saw that the CA balance is the sum of net exports ( $X - Q$ ), net payment of primary incomes and net transfers to the rest of the world. Recall that we defined GNDI as GDP minus the balance of primary incomes and the balance of current transfers of the rest of the world. Thus,

$$\mathbf{Y := GNDI = C + I + G + CA}$$

GNDI is used for consumption, saving and paying taxes.

$$\mathbf{Y = C + S + T}$$

Putting these two together and rearranging we obtain

$$\mathbf{(S - I) + (T - G) = CA}$$

Parenthesis highlight *net* flows to the private sector, the government and the rest of the world (CA). Each of the three net flows can be thought of as a form of saving. The identity says that net private saving plus public saving (total saving in the economy) must equal the current account balance. This key identity of national accounting can be read as follows:

- positive current account balance imply that the country as a whole is saving;
- negative current account balance imply that the country as a whole is borrowing.

In an open economy, part of the economy's consumption and investment expenditure can be financed through saving done in another economy. If the economy saves more than it uses for consumption and investment, this savings will go to finance other economy's final expenditure.

## Real versus Nominal, Deflators versus Price Indices

### Real and nominal GDP

When we are trying to measure production in an economy we cannot just add up the quantities of the different goods produced. We cannot, for example, add number of haircuts together with the tones of iron produced. To construct GDP quantities are converted into *values* through prices. Thus, what we sum up is the value of the different goods produced. Suppose that an economy produces only two goods and requires no imports. The (nominal) GDP in year  $t$  is given by

$$\text{Nominal GDP}(t) = P_t^1 Q_t^1 + P_t^2 Q_t^2$$

Note that GDP can change if the quantities produced change and if the prices change. We are interested in separating these two effects. We want to be able to measure separately changes in quantities produced on the one hand and changes in prices on the other hand. For this purpose we distinguish between nominal and real GDP. Nominal GDP is computed using the *current* selling prices. Real GDP is computed using the prices of a given *reference period* (base year). Real GDP in year  $t$  using base year 0 is given by

$$\text{Real GDP}_0(t) = P_0^1 Q_t^1 + P_0^2 Q_t^2$$

For this reason, we refer to nominal GDP as **GDP at current prices** and to real GDP as **GDP at constant prices** of year 0 (the reference year). Note that real and nominal GDP always coincide at the base year.

### Measuring changes in production

To measure the actual change of production in an economy between any two given years, we should compare real GDP in those two years, instead of nominal GDP. Real GDP for the two years that we want to compare give us the quantities produced each year valued at constant prices of year 0. Comparing these we come closer to comparing the change in the quantities produced. We separate the effect of prices on the value of production.

### Measuring changes in prices

On the other hand, comparison between nominal and real GDP of the same year can be used to measure the change in prices. If we compare nominal GDP( $t$ ) and real GDP<sub>0</sub>( $t$ ), we have the same set of quantities and different prices. Basically it is like comparing two weighted averages of prices using the quantities as weights.

#### Simple price indices

$$\frac{P_t^1}{P_0^1}, \frac{P_t^2}{P_0^2}$$

If we want to measure changes in prices, we could do the comparison for each good.

#### Average price indices

$$\frac{P_t^1 + P_t^2}{P_0^1 + P_0^2}$$

We could also calculate arithmetic averages of prices for each year. Here the price of each good is attached the same weight in the average.

#### Weighted average price indices

$$\frac{P_t^1 Q_t^1 + P_t^2 Q_t^2}{P_0^1 Q_t^1 + P_0^2 Q_t^2}$$

Here *weighted averages* of prices are compared, where the weights are given by the quantities produced or consumed.

It is important that we use the *same weights*!!!

**Paasche-type index:** Uses *current quantities* as weights.

Numerator is average price at  $t$  weighted by quantities at  $t$ ; denominator is average price at 0 weighted by quantities at  $t$ .

$$\frac{P_t^1 Q_0^1 + P_t^2 Q_0^2}{P_0^1 Q_0^1 + P_0^2 Q_0^2}$$

**Laspeyres-type index:** Uses *base year quantities* as weights.

Numerator is average price at  $t$  weighted by quantities at 0; denominator is average price at 0 weighted by quantities at 0.

### GDP deflator

Measures the change in average prices of goods **produced** in the economy. It is a Paasche-type index. Thus, it uses **current quantities** produced as weights. The GDP deflator equals nominal GDP divided by real GDP. It therefore includes exports and it does not include imports (goods that are not produced in the economy).



### **CPI index**

Measures the change in average price of goods **consumed by a typical** consumer of the economy. This price index is based on the basket of goods consumed by an 'average citizen' in the base year. The weights used are thus the **quantities** of this basket in the **base year**. It is a Laspeyres-type index. Since it includes goods consumed by a typical consumer, it includes imported goods.

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