CHAPTER 1

The welfare of society and economic growth

When I have pluck'd the rose,
I cannot give it vital growth again.
Othello

In the history of mankind, attempts to improve living conditions have only very recently superseded the struggle for survival. In all civilizations, progress has been exceedingly slow, with abrupt, unexpected downfalls. These were concomitant to natural disasters, epidemics and wars. Today, we can estimate that only one fifth of the world population enjoys a standard of life that can be considered acceptable.

The yardstick commonly used to measure standards of living is "income per person". We first show how income reflects the result of economic activity (section 1).[1] We then discuss whether income per person constitutes a proper gauge for the measurement of society's welfare (sections 2 and 3).

1 Income as a measure of economic activity

Fundamentally, nations can benefit, in the long run, only from what they have been able to produce. In turn, the amount produced within a given time span (for instance one year) can be measured from at least three perspectives.

First, we can consider the types of produced goods and services; these can broadly be distributed between consumption goods or services on the one hand, and investment goods on the other. Consumption goods and services are produced for the direct use of consumers. Investment goods (machines, factories, transportation infrastructure, etc.) are produced in order to provide ultimately, at some later date, consumption goods or services. Adding consumption to investment would measure a nation's total activity if the nation had no relations with the

[1] This first section is intended for the reader who has had no introduction to national accounts.

outside world. If this is not so, two major corrections should be introduced: first, one must add to consumption and investment all exports of goods and services; second, all imports should be deducted: indeed, consumption, investment and even exports include imports of goods and services, and imports are no part of a nation's activity.

From a second perspective, we may consider the output generated by the nation's various sectors of activity. We then want to determine how much agriculture or industry, or services have contributed to the nation's global activity. This can be measured by the *net* production of each sector. Net production is the sector's total production net of all purchases from other sectors. Indeed we want to avoid counting twice, or a multiple number of times, the same output. Consider two sectors: the automobile and the aluminium industries. The automobile industry uses, among many other things, aluminium. Simply adding up the production of each sector would amount to counting twice the value of the aluminium. The net production or net output is appropriately called the *value added* of the sector.

A third and final approach is to consider the income generated and distributed throughout the economy. Clearly, this income can be generated only by the value added of each sector of the economy. Three broad categories can be distinguished: labour income, capital income, and profits. Labour income is self-explanatory. Capital income is the remuneration of the (physical) capital stock that has been used in the production process, plus rentals by private individuals. Suppose that, in a given firm, this capital has been rented: the rentals are the capital remuneration. If a firm owns its capital stock, two possibilities arise: first, the firm may have borrowed in order to buy the capital it owns. The remuneration of capital is then the interest payments it pays. If the firm has financed the capital with its own resources, the remuneration of capital is the interest payments it has forgone by acquiring the capital stock instead of lending out its resources.

We will now summarize in an example each of these three approaches to the measure of economic activity within the boundaries of a given country. The global result is called the *gross domestic product*. The adjective "domestic" refers to the fact that the activity is measured within the boundaries of the country considered. The adjective "gross" reflects the fact that investment expenditures *include* amortization – or depreciation – of capital. We will explain in section 2 how to obtain other aggregates also commonly referred to, such as the gross national product and national income. Before that we will illustrate with a numerical example the three approaches to measuring the gross domestic product.

1.1 Three approaches to measuring economic activity: a simple example

1.1.1 The expenditure approach

This is the most natural and arguably the most useful approach from an informative point of view because we are interested in the nature of goods and services that

will be available to society. It breaks down the gross domestic product into its constitutive parts: consumption, investment, plus exports minus imports. One point of detail: during a given year, inventories may have accumulated in the producers' hands; by definition, these have not yet been sold. They are then considered part of investment.

Consumption is usually separated into private consumption and public consumption; private consumption refers to the consumption of individuals; public consumption is that of the state (at the national or at the local level). The same distinction applies to investment. We thus have, for example:

• private consumption:	70
• public consumption:	10
• private investment:	8
• public investment:	7
• exports:	40
• *minus* imports:	−35
Total: gross domestic product:	100

1.1.2 The output (value added) approach

The economy can be divided into a few – or many – sectors. If we consider the traditional three sectors (agriculture, industry, services), we may have:

• value added of agriculture:	4
• value added of industry:	30
• value added of services:	66
Total: gross domestic product:	100

1.1.3 The income approach

Retaining the classification referred to in the beginning of this section could give:

• labour income:	68
• capital income:	26
• profit:	6
Total: gross domestic product:	100

1.2 A global view of the three approaches: the input–output table

It is possible and highly useful to present in one table those three approaches. Indeed, it is by no means obvious that the three approaches amount to the same number. In fact, statisticians establishing those national accounts have to introduce sometimes large corrections to obtain the desired result.

Table 1.1 ***A simplified input–output table***

	(1) agr.	(2) ind.	(3) serv.	(4) interm. output	(5) C	(6) I	(7) X
(1) agriculture	—	1	1	2	6	—	4
(2) industry	2	5	2	9	24	15	20
(3) services	3	14	3	20	50	—	16
(4) interm. input	5	20	6	31	**80**	**15**	**40**
(5) labour income	3	20	45	**68**			
(6) capital income	1	8	17	**26**			
(7) profit	—	2	4	**6**			
(8) value added	**4**	**30**	**66**	**100**			
(9) Total output	9	50	72	131			

The input–output table gives at once the three approaches to evaluate the Gross Domestic Product approach is the total of consumption + investment + exports – imports (80 + 15 + 40 − 35 = 100). 66 = 100. Income is distributed to labour and capital, and the remainder is profits (68 + 26 + 6 = 100

This synthetic, global view was first proposed by Wassily Leontief[2] in a so-called "input–output" table. The table can be considered as made of three parts. In the first part (the upper-left part of table 1.1), only intermediate transactions are recorded. Those are the sales of products or services from one sector to another (for instance the aluminium sold to the automobile sector, the wheat sold by agriculture to the food industry, or the insurance premiums sold to the farmers). The table presents in its upper-left 9 squares all possible sales between the three sectors we have considered (there are 6 possible inter-sector sales and 3 possible intra-sector sales: for instance the energy sales to the aluminium industry are sales within the industry sector). The first 3 figures of column 4 (2, 9, 20) sum the sales of each sector to other sectors as well as to itself. The first 3 figures of line 4 (5, 20, 6) are the purchases of each sector from other sectors and from itself. The total of intermediate sales and purchases (31) is the 4th figure of line 4 and column 4.

The second part of the table (columns 5 to 10) breaks down the expenditure side of the gross domestic product into its components (column 5 indicates consumption goods aggregated as the sum of private and public consumption, for a total of 80; column 6 gives private and public investment, etc.). X and M designate exports and imports respectively. The total $C + I + X - M = 80 + 15 + 40 - 35 = 100$ corresponds to the gross domestic product from the expenditure approach and to the example we have given in section 1.1.

It is now possible to determine the total output generated by each sector by adding the total of intermediate goods and services (col. 4) to the column of final demand (col. 9). We thus get column 10. This will be useful to determine the value added of each sector. Indeed, just translate the numbers of column 10 into the horizontal line 9 at the bottom of the table. Just by taking the difference between the total output (line 9) and the total purchases of each sector (line 4) gives the value added by each sector (line 8). This line is the gross domestic product broken down according to value added by each sector ($4 + 30 + 66 = 100$). In turn, each of these net contributions from each sector can be split into their components (labour income, capital income and profits). These are indicated in lines 5, 6 and 7 respectively. Their total in column 4 gives the gross domestic product from the income point of view ($68 + 26 + 6 = 100$).

Thus the three approaches to the gross domestic product can be viewed in a single table. Two conclusions emerge. The first is that if we had to choose from those three approaches that which best reflects the welfare of society, we would probably choose the first, i.e. the expenditure approach, because we are most interested to know what kind of consumption or investment goods will be available to

[2] Wassily Leontief (1906–99) was born in St Petersburg and received his PhD from Humboldt University in Berlin. He taught at Harvard and New York University. One of his first input–output tables divided the US economy into 500 sectors. He received the Nobel Prize in Economics in 1974 for his pioneering work on input–output economics.

society. We do not care about whatever nominal income is generated if it corresponds to huge investments which will be of little use to society.

The second lesson we draw is the one-to-one correspondence between net output and income. Income will increase in an economy if and only if net production – or value added – increases.

1.3 From gross domestic product to national income

The gross *domestic* product (GDP) measures the activity taking place inside the borders of a given nation. However, it may be desirable to have a measurement leading to the revenue accrued to people actually residing in a country. This implies, in particular, adding to GDP the income received from abroad by residents and subtracting the income paid out to non-residents who are working within the boundaries of the country. These corrections concern both labour and capital income. Thus we have:

Gross domestic product (GDP)	+ labour and capital income generated abroad and received by residents
	− labour and capital income generated domestically paid out to non-residents
	= gross *national* product ≡ GNP

Observe that the adjective "national" is most unfortunate since it does *not* refer to the activity of national economic agents; it only refers to the activity of *residents*.

Furthermore, within one year investments may have taken place, but some depreciation of the existing stock of capital has occurred. It is important (especially in the context of economic growth) to know by exactly what amount the capital stock in existence in the economy may have increased. This is why depreciation of capital will be subtracted from (gross) investment to obtain *net* investment, and consequently *net* national product:

Gross national product (GNP) − depreciation = Net national product (NNP).

Finally, it may be interesting to know exactly what amount of income will be distributed to residents before income taxes. For that purpose, two corrections need to be introduced. First, we must deduce from the net national product *indirect* taxes – this is the sales tax paid by consumers to producers, which the latter transfer to the state. These taxes form no part of the value added that is the basis of income distribution by firms, and therefore must be deducted from net national product. On the other hand, firms may receive subsidies from the state. Together with value added these may be used to remunerate production factors such as labour or capital. Thus we have:

Net national product (NNP) − indirect taxes + subsidies = National income.

The following summarizes the various steps transforming gross domestic product (GDP) into net national income.

Gross domestic product (GDP)
+ labour and capital income received from abroad by residents
− labour and capital income transferred abroad to non-residents
= *Gross national product* (GNP)
− capital depreciation
= *Net national product*
− indirect taxes
+ subsidies
= *National income*

1.4 National income at current prices and at constant prices

Suppose that from one year to another we observe an increase in the gross domestic product, or an increase in national income. Can we conclude from this observation that the standards of living have increased? Clearly such a conclusion is not warranted since that increase might be due to the sole increase of prices. It is then important to be able to define in a precise way what part of a change in national income is attributable to a change in prices, and what part reflects an increase in output available to society. For that purpose, price indexes are constructed. We will succinctly describe here the consumers' price index.

We will use the following definitions and notations:

- p_i^t = price of good i at time t (measurement units: \$/unit of the good considered)
- $\frac{p_i^t - p_i^{t-1}}{p_i^{t-1}}$ = relative rate of increase in the price of good i
- $\frac{p_i^t}{p_i^{t-1}} \equiv X_i \equiv$ growth factor of the price of good $i \equiv$ partial price index of good i

We can note that this growth factor reflects also the growth factor of the expenditure necessary to buy one unit, or any fixed quantity, of good i.

Suppose now that between time 0 and time 1 the prices of two goods have undergone different relative increases (perhaps 10% and 30% respectively). Is there a way to define a meaningful "average" of those increases? It is obvious that considering the simple average of those rates (20%) would be of little significance if, for instance, consumers used to spend a large part of their income on one of those items. Therefore, it is natural to try to measure the consequences of such increases for a given consumer in the following way.

Consider the growth factor of the expenditure necessary for this consumer to be able to buy again the same basket of both goods which he or she had initially purchased at time 0, before the price increases.

Suppose that this basket is (q_1^0, q_2^0). Then his (or her) expenditure necessary to buy this basket at time 0, denoted D^0, is:

$$D^0 = p_1^0 q_1^0 + p_2^0 q_2^0. \tag{1}$$

When prices move to p_1^1, p_2^1, the necessary expenditure to buy the same basket becomes

$$D^1 = p_1^1 q_1^0 + p_2^1 q_2^0 \tag{2}$$

and the growth factor of the expenditure is

$$\frac{D^1}{D^0} = \frac{p_1^1 q_1^0 + p_2^1 q_2^0}{p_1^0 q_1^0 + p_2^0 q_2^0}. \tag{3}$$

It can be shown immediately that this growth factor is equal to the average of the partial price indexes of both goods (p_1^1/p_1^0 and p_2^1/p_2^0), the weights being the shares of each good in the individual's initial expenditure, $p_1^0 q_1^0/D^0$ and $p_2^0 q_2^0/D^0$. Indeed, in the numerator of (3), we can make the following transformation:

$$\frac{D^1}{D^0} = \frac{p_1^1 q_1^0 + p_2^1 q_2^0}{D^0} = \frac{\frac{p_1^1}{p_1^0} p_1^0 q_1^0 + \frac{p_2^1}{p_2^0} p_2^0 q_2^0}{D^0}. \tag{4}$$

Denoting $p_1^0 q_1^0/D^0 = \alpha_1$ and $p_2^0 q_2^0/D^0 = \alpha_2$ the individual consumer's expenditure shares on goods 1 and 2, this growth factor is

$$\frac{D^1}{D^0} = \alpha_1 X_1 + \alpha_2 X_2, \quad \text{with} \quad \alpha_1 + \alpha_2 = 1, \tag{5}$$

the weighted average of X_1 and X_2.

This generalizes of course to the case of n goods. The expenditure growth factor is

$$\begin{aligned} \frac{D^1}{D^0} &= \frac{\sum_{i=1}^n p_i^1 q_i^0}{\sum_{i=1}^n p_i^0 q_i^0} = \frac{\sum_{i=1}^n \left(p_i^1/p_i^0\right) p_i^0 q_i^0}{D^0} = \sum_{i=1}^n \frac{p_i^1}{p_i^0} \frac{p_i^0 q_i^0}{D^0} \\ &= \sum_{i=1}^n \alpha_i X_i, \sum_{i=1}^n \alpha_i = 1. \end{aligned} \tag{6}$$

We have just determined the expenditure growth factor for an individual who would have expenditure shares α_i, $i = 1, \ldots, n$. Now the same principle can be extended to a society as a whole: we just need to replace the α_i's of the individual by the *average* shares of society's consumption of each good in total consumption. Call β_i, $i = 1, \ldots, n$ those shares. The consumer price index is then defined as

$$X = \sum_{i=1}^n \beta_i X_i, \quad \text{with} \quad \sum_{i=1}^n \beta_i = 1. \tag{7}$$