Net versus gross national income and product

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NET VERSUS GROSS NATIONAL INCOME

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Abstract

From a conceptual point of view, for most purposes net figures of Domestic Product, National Product and National Income are to be preferred to gross figures. Nevertheless, in practice gross figures are most often used on the grounds of various arguments. In this paper these arguments are challenged. To this end, attention is paid to the reliability of capital consumption estimates and the quantitative importance of employing net instead of gross figures. Figures are presented for six OECD-countries over the period 1975-1987.

Contents

1. Introduction

Intermediate consumption can be regarded as the costs of using up non-durables in production. In this regard, capital consumption can be regarded as the costs of using durables. Ignoring capital consumption as a category of cost, implies that the use of durables is assumed to be free of any cost: there is no wear and tear of durables and there is no economic obsolescence of durables due to e.g. changes in technology or relative prices. This assumption is clearly unrealistic and not suited for most purposes. Therefore, from a conceptual point of view it is evident that net figures of Domestic Product, National Product and National Income are to be preferred to gross figures. Nevertheless, in practice gross figures are commonly used. Various reasons for this can be mentioned:

- the national accounting concept of capital consumption is often considered to be inappropriate (or: the concept of capital consumption itself is problematic)
- some argue that there is no appropriate price index to convert capital consumption into real terms and thus that only gross measures in constant prices make sense
- gross measures tend to be more reliable, given the perils of estimating capital consumption
- gross measures are available more quickly
- since the ratio between gross and net measures may be fairly constant over time, some feel that one might therefore just as well stick to gross measures.

(see e.g. Nordhaus and Tobin, 1972, p. 5, Samuelson and Nordhaus, 1985, p. 112, Stone, 1974, para 57 and Usher, 1980, p. 104).

In this paper, the validity of these arguments is questioned. Firstly, the usefulness of gross and net national accounting measures of product and income is discussed (section 2). The consequences of employing gross instead of net figures in theory and in practice is the topic of section 3. Gross and net national accounting figures are compared for six OECD-countries. In section 4, the sensitivity of net figures to various methods to estimate capital consumption is discussed.

Again various figures are presented, in particular for the Netherlands. Present national accounting figures depend on present national accounting conventions. Minor changes in accounting concepts may lead to entirely different gross and net figures. In order to get an impression of the sensitivity of our conclusions to changes in concepts, in section 5 present national accounting concepts and figures for the Netherlands are modified in two ways: firstly, by accounting for capital consumption on infrastructure, and secondly, by recording for (imputed) services of consumer durables. Conclusions are drawn in section 6.

2. The usefulness of gross and net national accounting measures of income and product

2.1 The National Accounting concepts of capital formation and capital consumption

National accounting concepts are concepts intended for measurement. As a consequence, in devising national accounting concepts considerations of measurement play an important role. Unfortunately, there tends to be a clear trade-off between data needs for economic analysis and economic policy on the one hand and considerations of measurement on the other. This is exemplified by the concepts of capital formation and capital consumption in the UN-guidelines on national accounting ("the SNA", UN, 1968). Theoretically proper definitions of these concepts would be:

- capital formation in a given period equals all expenditures which are expected to yield benefits in future periods
- capital consumption in a given period equals the costs of using up capital stock in that period.

For the sake of measurability, the SNA concepts have been defined somewhat differently. Firstly, part of capital formation is actually recorded as (intermediate) consumption. As a consequence, the SNA concept of capital formation does not include for example: small tools lasting more than one year, intangible assets (R&D, human capital), non-reproducable tangible assets (land, mineral deposits), expenditure on durables for consumption purposes (refridgerators, cars, tv's for personal use) and durable goods which are to be used primarily for military purposes (UN, 1968, paras 6.102-6.129). Especially in deriving welfare measures, a more extended concept of capital formation seems appropriate (see e.g. Eisner, 1988).

Secondly, some capital formation is never to be accounted as 'consumed'. Examples are "assets of government services such as roads, dams, breakwaters or other forms of construction except structures. In these instances, it may be considered that outlays on repair and maintenance are sufficient to maintain the assets in their original

condition" (UN, 1968, para 7.20). In this way, some of the most difficult and arbitrary capital consumption calculations, are avoided. The price to be paid is that there exist some imperfections in the concepts of capital formation, product and income.

Similar trade-offs can also be found outside the field of National Accounting. In business accounting, considerations of measurability are usually worded as requirements posed to the 'objectivity' of the accounting figures. This objectivity is traded off against features like the 'comparability' and 'relevance' of the figures (see Lewis and Pendrill, 1985, p. 15). Analogously, in devising tax measures, considerations of equity and efficiency (possibilities of tax evasion and tax avoidance, the costs of administration and control) are traded off.

In the System of National Accounts (SNA; UN, 1968) capital consumption is defined as:
"that part of the gross product which is required to replace fixed capital used up in the process of production during the period of account. This flow is based on the concept of the expected economic lifetime of the individual assets; and is designed to cover the loss in value due to foreseen obsolescence and the normal amount of accidental damage which is not made good by repair, as well as normal wear and tear ... It seems reasonable ... to value consumption of fixed capital on a straight-line basis with reference to the expected economic lifetime of the individual assets ... [E]stimates of consumption of fixed capital should take into account the cost of replacing the assets in the period for which the estimate are being made" (UN, 1968, paras 7.19, 7.21 and 7.22, p. 122, emphasis added, F.B.).

Capital consumption could have been defined in many different ways. Capital consumption is often discussed in relation to the notion of 'maintaining capital intact': capital consumption is defined as the amount/value needed to maintain capital intact. The content of maintaining capital intact is up to much choice. For example: Should financial or physical capital be kept intact? (see e.g. Sterling and Lemke, 1982 and Scott, 1984) or: Should capital be maintained per capita

or irrespective of changes in the population? (Nordhaus and Tobin, 1972) or: To what extent should capital be forward looking (valuation at the net present value of expected future revenues) or backward looking (valuation at historical costs)? (Hicks, 1981a and 1981b). The appropriateness of the alternative definitions can only be judged with respect to their specific purposes. Different types of analysis require different definitions of capital consumption (see also Ward, 1976, table 1, p. 16).

2.2 The logic of gross and net measures

The distinction between gross and net product (income) originates from the need to account for capital formation and capital consumption. In principle, accounting for production and consumption is possible by employing just the concepts of output, intermediate consumption and final consumption. However, in practice clearly not all output is used within the same period. So, for proper assessment of income over periods, the concepts of capital formation and capital consumption must be introduced. The concept of capital formation serves to register part of output not as intermediate or final consumption in the period in which it is produced. The concept of capital consumption performs the function of specifying the allocation of the use of this output over several accounting periods. Both concepts must be regarded as unseparable twins, because accounting for capital formation without accounting for capital consumption is like making a pudding without eating it.

Capital consumption is a cost of production just like intermediate consumption. As a matter of fact, often the use of durable goods is registered as intermediate consumption, e.g. when leasing an office or computers. Denison states: "In sofar as a large output is a proper goal of society and objective of policy, it is net product that measures the degree of success in achieving this goal. Gross product is larger by the value of capital consumption. There is no more reason to wish to

maximize capital consumption -the quantity of capital goods used up in production- than there is to maximize the quantity of any other intermediate product used up in production, such as, say, the metal used in making television sets. It is the television sets, not the metal or machine tools used up in production, that is the objective of the production process" (Denison, 1972, p. 2).

For the analysis of productivity, a concept of capital consumption based on technical obsolescence is sometimes preferred to one on the basis of economic obsolescence. The argument is that the volume of capital input of some given capital stock is only affected by wear and tear and not by e.g. foreseen scrapping due to economic obsolescence. For the purposes of productivity analysis, the rental value of gross capital stock (i.e. cumulated gross investment minus scrapping) should therefore be related to gross value added minus the costs of technical obsolescence (Maddison, 1987, p. 656). However, this argument has some major flaws.

Firstly, it disregards that in this concept of net value added the costs of renting capital goods are excluded, while a main part of the costs of owning and using capital goods, i.e. the costs of economic obsolescence, is still included. As a consequence, comparability and aggregation of figures on enterprises owning capital goods and those on enterprises renting capital goods is problematic for this concept of net value added.

Secondly, if the efficiency of capital intensive and capital extensive producing industries (nations) is compared, a main part of the costs of capital intensive production, i.e. the costs of economic obsolescence, is totally ignored. The famous imaginary case of Hayek may further reveal the flaw of using technical obsolescence. "Assume two entrepreneurs, X ... [and Y], to invest at the same time in equipment of different kinds but of the same cost and the same potential physical duration, say ten years. X expects to be able to use his machine continuously throughout the period of its physical 'life'. Y, who produces some fashion article, knows that at the end of one year his

machine will have no more than its scrap value." (Hayek, 1941, p. 276). Should the efficiency of these enterprises be compared by taking account of only technical obsolescence? I think definitely not.

Still, gross measures can be useful for some specific types of analysis. In this respect, Studenski (1958, p. 153) can be cited: "The third important change ushered in by the war was the shift in emphasis from net to gross product figures ... This change, too, was an outgrowth of the government budgetmakers' attempt to achieve a closer connection between the government's budget and the national income estimates. Inasmuch as amortization or replacement of worn-out private capital was being deferred until the postwar period so that the private funds and resources that would ordinarily have been used for that purpose could be diverted to current wartime production, it was important to present the national income figures gross of this item".

The character of the concept of gross value added is perhaps best revealed by drawing an analogy. For some purposes, not accounting for the indirect costs of production and sale of a product makes sense and could be revealing. However, in the end, profitability of a product can only be judged when also its indirect costs are taken into account. In a similar way, the concepts of net value added, Net Domestic Product and Net National Income are to be preferred for most purposes. For example, in employing Domestic Product as a measure of the 'productive capacity' of a nation or in using National Income as a tax basis, net concepts should be used (as most tax authorities will agree to). It might be added that the term 'gross value added' already indicates that some double-counting is involved and that the figures searched for should be net. Gross value added amounts to double-counting, because the production of capital goods is counted as output while no deduction is made for the use of capital goods.

Net value added figures in the National Accounts can be considered inappropriate on the grounds that the concept of capital consumption employed is inappropriate. However, when no alternative capital consumption figures (based on the 'right' concept) are available, two

main options are:

- use the net value added figures although the concept of capital consumption is not entirely appropriate, or
- use the gross value added figures although net value added figures based on the 'right' concept of capital consumption would be preferable.

For most purposes, employing the national accounting concept of capital consumption is more acceptable than using gross figures, i.e. than employing the extreme assumption of zero capital consumption. An exception is that -if capital consumption on the basis of technical obsolescence is preferred- assuming zero capital consumption is preferable to an estimate of economic obsolescence (see Maddison, 1987, p. 656).

Moreover, the gross concepts of Domestic Product and National Income depend on the national accounting concept of capital consumption as well, since these gross concepts include capital consumption by the government and such. It is often overlooked that gross value added of e.g. the government is by convention equal to wages and salaries plus capital consumption. So, net value added of the government is not affected by the concept of capital consumption, in contrast to net value added of enterprises.

Value added figures in current prices are often transformed in constant prices. For example, in order to calculate growth rates in constant prices. It is sometimes suggested (e.g. Usher, 1980, p. 104) that only gross value added can be transformed in constant prices in a meaningful way. However, if capital consumption is defined on the basis of the replacement value of capital stock, deriving a deflator is straight-forward: capital stock should be deflated on the basis of the prices relating to the replacement of capital stock, and therefore this applies as well to capital consumption.

In the absence of capital consumption estimates, gross value added growth rates can be used as proxies for net value added growth rates. The absence of capital consumption estimates often occurs in

constructing short term figures. Another case in point is countries for which not even yearly capital consumption figures are published (e.g. Columbia, see UN, 1985). This use of gross growth rates as proxies for net figures must be qualified, because in many instances it is possible to construct better proxies than gross figures. For example, by assuming a constant growth rate of capital consumption.[1)]

3. Consequences of employing gross instead of net figures

3.1 General modes of employment

The National Accounts present a systematic and quantitative description of a nation's economy. In this description, the aggregates Domestic Product and National Income play an important role. They refer to the economic processes of production and (primary) income distribution. Domestic Product is defined as the sum of value added generated by all resident producers. National Income is the sum of primary income accruing to all resident units. Both aggregates are closely linked: National Income equals Domestic Product plus the balance of primary income (e.g. wages, interest and distributed dividends) received from abroad. Figures on Domestic Product and National Income can be employed in three ways.

Firstly, such figures can serve as summary measures of the processes of production and income distribution. A case in point is when Domestic Product figures are used as indicators of the 'productive capacity' of a nation or when its growth rate is used to judge the 'success' of economic policy. National Income per capita is often used as a rough indicator of relative 'welfare' of a country. The recent practice of the EC to tax its member states on the basis of their GNI is a another example of National Income and Domestic Product serving as summary measures.

In addition, as a second mode of employment, the use of Domestic Product and National Income as a reference value must be distinguished. Examples of the latter are the expression of government debts, government deficits, external account deficits and exports and imports of goods and services as a percentage of Domestic Product or National Income.

A third mode of employment is when these figures are used in calculating relative shares. For example, when the importance of the services sector in domestic production or that of wages in income

distribution has to be assessed for economic policy purposes.

In analyzing or modelling an economy the various modes of employment can be combined.

3.2 The consequences in theory

In this section, various kinds of erroneous conclusions that may occur by using gross instead of net figures are illustrated.

In international comparisons of product and income, countries with a capital intensive mode of production are judged too favourable, because they have a relatively high level of capital consumption. In using GNI (GNP) as a basis for contributions to international organizations like the UN and the EC, capital-intensive countries will be 'overtaxed' and capital-extensive countries 'undertaxed'. Similarly, by employing GNI (per capita) as a kind of welfare measure, differences in welfare between developed country and developing countries seem to be larger than they really are, since most developed countries are more capital-intensive. Analogous arguments hold for GDP as a measure of productivity and for the relative importance of branches as a percentage of Domestic Product.

Similarly, comparisons over time can be biased by employing gross figures. An economic policy favouring capital-intensive production (like Russia in the thirties) may seem to be very successful when judged by changes in the level of gross domestic product, but is less successful when judged by net domestic product. By employing gross measures, a kind of self-fulfilling prophesy is introduced: all capital formation will generate future income at least equal to future capital consumption. This feature may seriously invalidate business cycle analyses: after each capital formation boom, capital consumption and therefore gross product will gradually rise without concomittant increases in 'income'. For the same reason, a massive postponement of

capital formation will show after a while a more drastic fall in GDP than in NDP. So, the volatility of the business cycle may be exaggerated by looking at GDP instead of NDP. It must be remarked that the time lag between capital consumption and capital formation can reduce this effect substantially. In addition, in calculating relative changes this effect might also be mitigated by the fact that NDP is -by definition- smaller than GDP and capital consumption is most probably fairly constant in time: relative changes in NDP may therefore even exceed those in GDP.

If capital consumption's growth rates are structurally higher (lower) than those of GDP, NDP growth rates are structurally lower (higher) than those of GDP. Capital consumption's growth rates may exceed those of GDP substantially -even over longer periods of time-, when capital formation has increased substantially and the increase in output lags somewhat behind. A case in point could be a country like Japan during the sixties and seventies. Trends towards more capital-intensive (round-about) production could be another reason for structural differences between gross and net growth rates. Such a trend might be induced by changes in technology, changes in demand or changes in relative prices (e.g. the raising of oil prices by OPEC in 1973 substantially increased the economic obsolescence of energy intensive capital goods).

3.3 The consequences in practice

In this section, our theoretical suggestions are put to a test by comparing gross and net national accounting figures for six OECD-countries. These countries are the USA, Japan, the UK, West-Germany, Sweden and the Netherlands.

Concerning these six countries, the amount of capital consumption in Gross Domestic Product[2)] at market prices[3)] varies between 8.8 and 14.2 % in the period 1975-1987; for each country the maximum variation in this thirteen year period is less. (see table 1) This implies e.g. that comparing either their GDP/capita or their NDP/capita may lead to diffe-

rences up to 6 %. Worldwide the amount of capital consumption in GDP fluctuates between -roughly speaking- 5% (e.g. Indonesia) and 25 % (e.g. Finland and the Republic of Korea) (UN, 1982). So, in some extreme cases, comparing GDP per capita instead of NDP per capita can even lead to differences of 20%. Analogous differences result when using GNP instead of NNP in determining the contributions of countries to international organizations like the UN and the EC.

Table 1. Gross and Net Domestic Product for six OECD-countries, 1975-1987.

	Netherlands	West-Germany	USA	Japan[a)]	UK[b)]	Sweden
1. Capital consumption as a percentage of GDP at mp						
- average	9.8	12.0	12.8	13.2	11.8	11.4
- minimum	8.8	11.1	12.0	12.2	11.2	10.3
- maximum	10.4	12.7	14.1	14.2	12.5	12.0
2. Growth rates						
- GDP at mp[c)]	1.8	2.2	3.1	4.3	2.0	1.6
- NDP at mp[c)]	1.7	2.1	2.9	3.9	1.8	1.4
- Average difference	0.1 (6%)[d)]	0.1 (5%)	0.3 (9%)	0.3 (8%)	0.2 (11%)	0.2 (11%)
- Maximum difference	0.4 (26%)[d)]	0.5 (26%)	1.0 (35%)	1.0 (25%)	0.7 (38%	0.6 (40%)
- Coeff. of determination	1.00	1.00	0.98	0.95	1.00	1.00
3. Volatility of growth rates						
- std GDP growth rate	1.6	1.6	2.4	0.9	1.9	1.5
- std NDP growth rate	1.8	1.8	2.7	1.2	2.1	1.7

a) Capital consumption is based on historical costs taken from enterprise accounts. See also note 5.
b) Period: 1975-1986.
c) Average of yearly growth rates. The yearly growth rates are calculated from OECD-figures using base year weights. Calculation on the basis of chain indexes would have been preferrable (see Al et al., 1985). The latter procedure is used in the tables 4 and 5, in which only Dutch data are used as a source.
d) Difference expressed as a percentage of NDP average growth rate.
Figures calculated on the basis of OECD, 1989a.

For our six OECD-countries, employing GDP figures as a reference value can result in a bias of maximum 15 % in terms of NDP. If only the change in, e.g., the value of exports as a percentage of Domestic Product matters, the bias is in general negligable, because capital consumption as a share of GDP is fairly constant over time for most countries.

For the six countries during the period 1975-1987, the growth rates of GDP are all higher than those of NDP, the difference being 0.1 to 0.3 percentage points. In terms of NDP's average growth rates, the range is between 5 and 11% . The maximum differences between GDP and NDP vary between 0.4 and 1.0 % percentage points (between 25 and 40% of NDP's

average growth rates). Such differences may be of substantial importance for economic policy (e.g. in wage negotiations or in all kinds of indexes, pensions, fringe benefits, government debt). For modelling purposes, it is the co-variation which matters. The coefficients of determination between both variables for the six countries are very high (between R^2=0.95 and 1.00). So, choosing GDP instead of NDP growth rates (or vice versa) hardly affects the fit of an econometric model.

In analysing business cycles, the timing of the peaks and troughs and the volatility of Domestic Product are important. Graphs (not shown) reveal that the peaks and troughs in the growth rates of GDP and NDP seem to have the same timing. This finding is not very surprising considering e.g. the coefficients of determination. The standard deviation of NDP growth rates is structurally higher than that of GDP growth rates: the business cycle is up to 25 % more volatile than suggested by GDP.[4)]

Table 2. Capital consumption as a percentage of Gross Value Added at market prices (excluding VAT on final expenditure and SIR-levy, an indirect tax on capital formation) in the Netherlands.

	1970	1975	1980	1985	1988	Share 1985 gross	net	gross share/ net share
Agriculture, hunting, forestry, fishing	8.4	10.9	15.4	14.4	15.9	4.4	4.2	1.04
Mining and quarrying	9.0	4.3	4.1	3.8	11.8	9.0	9.7	0.93
Manufacturing	9.0	11.5	13.8	14.7	13.1	19.2	18.4	1.04
Chemical, rubber and artificial material processing industry	14.2	19.8	26.7	22.6	n.a.	3.1	2.7	1.15
Public Utilities	28.8	31.6	33.6	36.7	35.7	2.2	1.5	1.41
Construction	3.3	4.1	4.6	6.6	5.4	5.4	5.7	0.95
Trade, hotels, cafés, restaurants, repair of consumer goods	5.7	6.0	6.6	6.7	7.1	15.9	16.7	0.95
Transport, storage and communication	20.7	22.0	21.9	24.7	22.5	6.7	5.7	1.18
Other services and n.e.c.	7.4	7.2	7.6	7.9	8.2	41.4	42.8	0.97
Banking, finance and insurance	1.7	1.6	1.6	1.6	1.8	5.6	6.2	0.91
Operation of dwellings	29.0	29.2	30.5	25.2	24.3	6.6	5.6	1.19
General government	5.5	5.1	4.9	5.2	6.0	13.4	14.2	0.94
Defence	0.0	0.0	0.0	0.0	0.0	1.9	2.1	0.89
Total gross value added	8.9	9.6	10.3	10.9	11.3	100.0	100.0	1.00

Figures calculated on the basis of Netherlands CBS, 1989.

In calculating the relative shares of economic activities in Domestic Product, the situation may be different. It seems reasonable to assume that in general the range of fluctuations in the percentage of capital consumption is much larger at a more disaggregated level. Table 2 shows

that for the Netherlands, capital consumption as a percentage of gross value ranges from 0 % for Defence (by definition) and 1.6 % for Banking, finance and insurance to 36.7 % for Public Utilities. The consequences of such differences for relative shares in terms of Domestic Product are quite substantial. For example, in 1985 the gross share of Defence is 11 percent lower than its net share and for Public Utilities the gross share exceeds its net share by 41 % (last column in table 2).

4. The sensitivity of net figures to various methods to estimate capital consumption

4.1 Present methods of measurement

Capital consumption can be measured directly by deriving estimates from the bookvalues of capital consumption. However, business accounts figures on capital stock and capital consumption are often based on a) historical costs and b) service lives and survival functions prescribed by the tax authorities; the latter are frequently used as an instrument to stimulate investments and need not represent 'true' economic obsolence. As a consequence, capital consumption in business accounts can deviate substantially from the concept in the SNA.[5)] One could try to correct the bookvalues, e.g. for changes in the price level. But in general it is very difficult to use bookvalues for the derivations of capital consumption estimates which are fully consistent with the SNA. For this reason, other estimation procedures are often preferred.

Capital consumption can also be estimated as a function of the value of capital stock, the age-structure of capital stock and the mortality rates involved. In applying the Perpetual Inventory-method (PI-method), the estimation problem is formulated somewhat differently. Capital consumption is then expressed as a function of capital formation in previous years and the mortality rates of that capital stock. In order to arrive at replacement value, a price index of capital formation is needed as well.

Main sources used in OECD-countries for estimating mortality rates and service lives of capital goods are:

- prescriptions by tax authorities
- business accounts
- surveys
- expert advice
- other countries' estimates (see OECD, 1982).

These sources are often not fully independent. For example, expert advise and prescriptions by tax authorities may be determined on the basis of surveys and business accounts.

In most OECD-countries, only a small amount of empirical observation is available on mortality rates and life times of capital stock (OECD, 1988, para 5). As a consequence, most estimates of capital consumption are hardly made on a firm empirical basis. This is exemplified in several ways. Firstly, although it is generally accepted that average service lives change over time, only few Statistical Offices account for such changes (OECD, 1982, para 24).

Secondly, average service lives and mortality rates employed by the Statistical Offices vary to such an extent that it is hard to believe that these differences reflect variations in true economic obsolescence. For example, one half of the OECD-countries calculates capital consumption on a straight-line basis (in conformity with the SNA recommendation), while the other half employs a geometric pattern of capital consumption. Another case in point is the average service life of machinery and equipment in manufacturing activities. This figure is equal to 11 years in Japan, 15 in Germany, 17 in the United States, 22 in Canada and 26 years in the United Kingdom (OECD, 1988, table 2); in the Netherlands 18 years is used. It is likely that part of these differences are mere statistical constructs.

Thirdly, in several countries (e.g. France, Belgium, Norway and the Netherlands), the service lives for machinery and equipment are assumed to be the same in many activities (see OECD, 1988, tables 3 and 4). A priori, at least some difference in service lives among activities is to be expected, if only because the types of machinery and equipment employed varies substantially among activities.

Another statistical problem in applying the PI-method is that it requires fairly long time series on capital formation. For example, assuming a maximum service life of 20 years for some equipment requires that consistent figures on such capital formation are available for the past 20 years. Buildings even last much longer, say on average 50 years. This implies that capital consumption in 1990 has to be calculated partly from capital formation data for 1940 and probably much further back. In the absence of benchmark estimates of capital stock, these data

requirements are difficult to meet. As a consequence, heroic assumptions are often needed to fill this gap. (For more information on the advantages and problems of the PI-method, see e.g. Ward, 1976).

At this stage, it can be concluded that in most countries present capital consumption estimates may be subject to relatively large margins of error. This could have serious consequences for the usefulness of these figures. For example, comparisons over time can be invalidated because changes in service lives are hardly accounted for. Similarly, comparisons between countries can be rather misleading when differences in the services lives and mortality rates employed hardly reflect true economic obsolescence. The quantitive consequences of such measurement errors will be investigated below.

4.2. Margins of error of net figures

The upper bound of Net Domestic Product can be calculated by assuming that capital consumption is equal to zero. In that case, Net Domestic Product is equal to Gross Domestic Product, but somewhat smaller than normal estimates of Gross Domestic Product, because the latter includes usually also a non-zero amount of capital consumption by the government.

The lower bound of Net Domestic Product can be calculated by assuming that capital consumption is equal to fixed capital formation. Then, Net Domestic Product is equal to the Domestic Product resulting from a complete dismissal of the concepts of capital formation and capital consumption.

In expanding economies, 'true' capital consumption must lie in the range indicated by these extreme assumptions. Notice that a relatively large amount of fixed capital formation indicates that the range of possible measurement error in capital consumption is also large. The implication is that taking account of measurement errors in capital consumption is especially important for countries with a capital intensive mode of production, like Japan and other industrialized

countries.

Table 3 shows for six industrialized countries the absolute levels and growth rates of the upper and lower bound estimates of NDP. Compared to present NDP, Japans upper and its lower bound differ most: by respectively +14.5% and -13.3%. This indicates the maximum range of NDP-estimates. When countries are compared on the basis of their upper of lower bounds instead of present NDP, some differences arise. For example, taxing countries on the basis of present NDP or on the lower bound may lead to differences of 5% in their relative contributions. Similarly, taxing the Netherlands and West-Germany on the basis of their GDP or present NDP results in a difference in relative contribution of more than 2%.

With respect to the growth rates of the upper and lower bounds, it can be concluded from table 3 that the differences with present NDP are smaller than 0.3 percentage points (up to 11 % in terms of NDP's average growth rate). The maximum deviations are fairly substantial, especially for the lower bound (capital consumption- capital formation): even differences of more than 2 percentage points (154%) occur. The coefficient of determination between the upper bound and present NDP is very high (minimum of 0.95 for Japan). For the lower bound, this is not the case: for West-Germany, USA and the UK correlation is high (a minimum of 0.88 for West-Germany), but for the other countries a drastic shortening of assumed service lives affects the correlation to a substantial extent.

Of course, in practice the range of error is much smaller than indicated by the two extreme assumptions. In the OECD-study (OECD, 1982, paras 40-48) the sensitivity of capital consumption figures to alternative assumptions regarding service lives and mortality functions (linear, delayed linear, bell-shaped and simultaneous exit) is investigated. In the UK, a decrease of 20% in the assumed service life of plant and machinery in manufacturing results in a 10% increase in capital consumption; the effect of a 40% decrease of service life is an increase of 20 to 25% in capital consumption. For plant and machinery in chemical and allied products industries in the UK, a fall of service

lives from 37 to 30 years between 1947 and 1973 increases capital

Table 3. Fixed capital formation and capital consumption for the sectors 'Enterprises', 'Government' and 'Other', 1975-1987.

	Netherlands	West-Germany	USA	Japan[a]	UK[b]	Sweden
1. Capital consumption as a percentage of GDP at mp	9.8	12.0	12.8	13.2	11.8	11.4
2. Fixed capital formation as a percentage of GDP at mp	19.8	20.6	18.3	29.7	17.6	19.4
3. Relative shares of capital consumption:						
- government	6.9	5.5	10.6	4.5	10.7	11.4
- enterprises + other[c]	93.1	94.5	89.4	95.5	89.3	88.6
4. Relative shares of fixed capital formation:						
- government	15.0	13.5	8.7	18.7	13.5	19.2
- enterprises + other	85.0	86.5	81.3	81.3	86.5	80.8
5. Alternative NDP concepts related to present NDP						
- NDP						
* cap. cons.= cap. form.	91.4	92.3	93.9	86.7	94.8	93.7
* present	100.0	100.0	100.0	100.0	100.0	100.0
* cap. cons.= 0	110.1	112.9	113.1	114.5	112.0	111.4
- GDP	110.8	113.6	114.7	115.2	113.4	112.9
6. Growth rates						
- Average NDP at mp[d]						
* cap. cons.= cap. form.	1.7	2.2	2.9	4.3	1.9	1.6
* present	1.7	2.1	2.9	3.9	1.8	1.4
* cap. cons.= 0	1.8	2.2	3.1	4.2	2.0	1.6
- Average deviation from present NDP						
* cap. cons.= cap. form.	0.1 (3%)[e]	0.1 (3%)	0.0 (1%)	0.3 (8%)	0.1 (6%)	0.2 (11%)
* cap. cons.= 0	0.1 (7%)	0.1 (4%)	0.3 (10%)	0.3 (8%)	0.2 (11%)	0.1 (10%)
- Maximum deviation from present NDP						
* cap. cons.= cap. form.	2.7 (160%)[e]	1.4 (67%)	2.5 (86%)	1.7 (42%)	1.7 (91%)	2.2 (154%)
* cap. cons.= 0	0.5 (29%)	0.5 (23%)	0.8 (36%)	1.0 (25%)	0.6 (33%)	0.5 (35%)
- Correlation with present NDP						
* cap. cons.= cap. form.	0.51	0.88	0.90	0.57	0.90	0.67
* cap. cons.= 0	1.00	1.00	0.98	0.95	1.00	1.00
- std NDP growth rate						
* cap. cons.= cap. form.	1.9 (5%)[d]	1.4 (-23%)	1.6 (-42%)	1.4 (13%)	1.7 (-20%)	1.3 (-21%)
* present	1.8 (0%)	1.8 (0%)	2.7 (0%)	1.2 (0%)	2.1 (0%)	1.7 (0%)
* cap. cons.= 0	1.6 (-9%)	1.6 (-12%)	2.5 (-8%)	0.9 (-25%)	1.9 (-9%)	1.5 (-9%)

a) Capital consumption is based on historical costs taken from enterprise accounts. See also note 5.
b) Period: 1975-1986.
c) The sectors 'Enterprises' and 'Other' are grouped, because it is assumed that -in contrast to the sector 'Goverment'- for both sectors gross value added is calculated by subtracting costs from revenues.
d) Average of yearly growth rates. The yearly growth rates are calculated from OECD-figures using base year weights. Calculation on the basis of chain indexes would have been preferrable (see Al et al., 1985). The latter procedure is used in the tables 4 and 5, in which only Dutch data are used as a source.
e) Deviation from present NDP expressed as a percentage of present NDP
Figures calculated from OECD, 1989a.

consumption by 19.5%, a fall to 22 years results in a 43.7% increase. For manufacturing in Canada and Australia in 1976, employing a bell shaped mortality function produces 20 to 25% lower figures than a simultaneous exit assumption. These percentages give a first impression of the maximum margins of error.

Table 4 presents some additional figures for the Netherlands. In order to investigate the sensitivity of capital consumption figures to a substantial and uniform overestimation or underestimation of the service lives, the presently assumed life times for fixed capital formation by enterprises have been doubled and halved. For example, assumed life times for machinery and equipment are at present 18 years; a doubling or halving implies lifetimes of, respectively, 36 and 9 years. A doubling of all the assumed lifetimes for fixed capital formation by enterprises, leads to a 30% decrease in capital consumption, while a halving of these life times effects a 30 % increase in capital consumption. Taking R^2 as a measure, growth rates are hardly influenced by a doubling or halving of life times; this conclusion holds also for the standard deviations of the growth rates. For the Netherlands, only a uniform shortening by more than half of the present life times affects growth rates substantially.

The assumption of such uniform and substantial over- or underestimation of service lives must be regarded as extreme cases. Three reasons can be given. Firstly, if only part of the assumed life times of capital formation by enterprises are over- or underestimated, measurement error in total capital consumption is of course concomittantly smaller. For example, an error of 30% in a component which constitutes 40% of total estimated capital consumption, results in an error of only 12% in this total.

Secondly, in most cases the range of possible service lives obtained by doubling or halving seems rather broad. For example, the range for machinery and equipment in table 5 is 9 to 36 years. This range is broad enough to encompass nearly all the service lives presently used by the OECD-countries to calculate capital consumption of machinery and equipment in all kinds of activities. Probably, the range of error in service lives in a specific activity is much smaller.

Thirdly, in practice errors may counterbalance such that the effect on aggregated capital consumption more or less cancels out.

Another possible source of error in applying the PI-method is the

lack of sufficiently long and reliable time series on fixed capital formation. If only part of this time series is really available (and

Table 4. The consequences of alternative life times for capital consumption of enterprises and Domestic Product in the Netherlands, 1969-1988. Tentative figures[a].

	1970	1975	1980	1985	1986	1987	1988	Average 1969-1988
1. Capital consumption as a percentage of GDP at market prices: enterprises								
a. capital cons.= capital form.	21.2	17.1	17.8	16.6	17.6	17.7	19.1	17.7
b. life times halved	10.8	11.6	12.0	12.4	12.6	13.0	13.1	11.3
c. present	7.8	8.4	8.9	9.6	9.6	9.8	9.8	8.8
d. life times doubled	4.8	5.3	5.8	6.6	6.7	6.9	6.9	5.6
2. Absolute levels in terms of present NDP								
- NDP at mp								
a. capital cons.= capital form.	85.4	90.4	90.2	92.2	91.0	91.2	89.7	90.2
b. life times halved	96.8	97.0	97.1	97.6	97.4	97.1	97.1	97.2
c. present	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
d. life times doubled	103.3	103.6	103.7	103.7	103.6	103.6	103.6	103.6
e. cap. cons.= 0	108.5	109.2	109.9	110.7	110.7	111.0	111.0	109.7
- GDP at mp	109.2	110.0	110.7	111.4	111.4	111.8	111.8	110.5
3. Growth rates								
- NDP at mp								
a. capital cons.= capital form.	4.9	1.4	1.4	1.5	0.5	1.3	1.3	2.5
b. life times halved	5.9	-0.6	0.6	2.4	1.7	0.8	3.0	2.3
c. present	5.6	-0.5	0.6	2.6	1.9	0.9	2.8	2.3
d. life times doubled	5.8	-0.5	0.7	2.5	1.9	1.1	3.0	2.3
e. cap. cons.= 0	5.7	-0.2	0.9	2.6	2.0	1.2	3.0	2.4
- GDP at mp	5.7	-0.1	0.9	2.6	2.0	1.3	3.0	2.4

	Aver. deviation from present NDP	Max. deviation from present NDP	Correlation with present NDP	Stand. Dev.
1. NDP growth rates[b]				
a. capital cons.= capital form.	0.3 (12%)[c]	2.6 (116%)[c]	0.63	2.1 (4%)[b]
b. life times halved	0.1 (3%)	0.4 (18%)	0.99	2.0 (3%)
c. present	0.0 (0%)	0.0 (0%)	1.00	2.0 (0%)
d. life times doubled	0.1 (3%)	0.2 (10%)	1.00	2.0 (0%)
e. cap. cons.= 0	0.2 (7%)	0.5 (20%)	1.00	1.9 (-6%)
2. GDP growth rates[b]	0.2 (7%)	0.4 (18%)	1.00	1.9 (-6%)

[a] Figures calculated on the basis of CBS, 1987, CBS, 1989 and not publicly available figures.
[b] The yearly growth rates are calculated on the basis of chain indexes. As a consequence, the figures in this table are not fully comparable to those in tables 1 and 3.
[c] Deviation from present NDP as a percentage of present NDP.

reliable), measurement errors in capital consumption may occur. Such measurement errors are not likely to be very large for the most recent years. Take for example, machinery lasting 20 years on which only capital formation figures of the last 15 years are available. Assuming constant capital formation during the past twenty years, implies that the measurement error can only apply to 25% of total capital stock. As a consequence, a measurement error in the capital formation figures in the first five years of 30%, results in a measurement error in capital consumption of 7.5%. In case of annually increasing capital stocks, the effects are even less. For example, if the yearly growth rate of capital

formation has been 5%, the effect of such measurement errors in past capital formation is reduced from 7.5% to 5%.

A different way to judge measurement errors in employing the PI-method is to compare PIM-figures with business accounts figures that are based on replacement value. In the Netherlands, business accounts figures on capital consumption for three large companies have been compared with the PIM-figures. During the period 1969-1988, the maximum difference amounts to 30%. However, this maximum is only reached in the years 1969 and 1971. There is a clear downward trend in the differences and from 1978 onwards the differences are even smaller than 5%.

So, on the basis of various piece of evidence, it can be concluded that for various parts of capital consumption the maximum margin of error is roughly 30%. Realizing that a) in most parts the relative errors may be much smaller, and b) some errors will tend to cancel out in the aggregate, it is likely that the error in total capital consumption does not surpass 10%.

Above, it has been made clear that at present capital consumption is fairly small compared to Domestic Product (for most countries smaller than 15%). As a consequence, measurement errors in capital consumption of even 30% will only have small consequences for Domestic Product and its growth rates.

In addition to the relative size of capital consumption and the size of its measurement errors, the consequences of measurement errors in capital consumption figures also depend on the way the NDP figures are used. A substantial measurement error which is fairly constant in time hardly affects the comparison of capital consumption and net domestic product figures in successive years. Similarly, measurement errors of the same magnitude and direction in the capital consumption figures of various countries (e.g. a substantial and uniform overestimation of service lives) does not invalidate the comparison of capital consumption and Net Domestic Product figures of these countries. So, a comparison of Net Domestic Product figures over time or between countries need not be affected by measurement errors in capital consumption figures.

The implications can best be understood by taking a concrete case average. Capital consumption as a percentage of GDP equals 12.0% in West-Germany and is equal to 9.8% in the Netherlands (see table 4). This difference can be decomposed into:

- differences in the relative importance of economic activities (the economic structure)
- differences in the capital consumption rates per economic activity.

There are indeed important differences in economic structure between West-Germany and the Netherlands. For example, value added in Manufacturing as a percentage of total value added equals 18.9% in the Netherlands and is equal to 32.8% in West-Germany (both in 1985). However, such differences only partly account for the difference in capital consumption at the macro-level.

The remaining part must be explained by the sometimes also quite substantial differences in capital consumption per economic activity. For example, capital consumption as a percentage of gross value added in Finance, insurance, real estate and business services equals 11.4% in the Netherlands and is equal to 23.7% in West-Germany in 1985. In this year, capital consumption as a percentage of GDP equals 10.7% in the Netherlands and 13.0% in West-Germany. Excluding capital consumption and gross value added of the activity Finance, would more than halve the gap in 1985 (new ratios respectively 10.6% and 11.5%). Other examples of differences in capital consumption rates are Agriculture (14.4% and 34.1%) and Mining and quarrying (3.8% and 16.1%). From our point of view, these differences are also the most interesting, because we want to assess whether such differences are mainly due to measurement errors or to differences in capital intensity.

The likelyhood of large measurement errors at the activity-level seems to be small, because capital consumption figures are

- not very sensitive to alternative assumptions on life times and mortality functions (maximum errors of 30%) and
- West-Germany and the Netherlands use rather similar assumptions (mostly PIM, simultaneous exit versus bell-shaped mortality functions[6]) and not widely diverging life times: e.g. in the

Netherlands an average life time of 18 years for machinery and equipment and 15 years in West-Germany). As a consequence, estimating capital consumption for identical capital stocks in West-Germany and the Netherlands will result in only small differences (smaller than 10%).

The implication of this argument is that the differences must be explained mainly by differences in capital intensity per activity. In some cases this may be caused by the employment of different technologies for identical output (agriculture?). However, in most cases the absence of homogeneity of output per activity seems to be the more plausible explanation.[7)]

Our conclusion is therefore that the possibility of measurement errors in capital consumption does not seem to be a sound reason to distrust a comparison of the NDP's, NNP's or NNI's of West-Germany and the Netherlands. This implies, for example, that, determining the contributions of West-Germany and the Netherlands to the EC on the basis of their GNP's instead of their NNP's, should not be defended by referring to the possibility of measurement errors in capital consumption.

As a practical solution to surmount measurement errors in capital consumption, Maddison is working on standardized estimates of capital consumption using identical assumptions about service lives, retirement and depreciation patterns. The success of such standardizing depends on the quality of present capital consumption estimates and the extent to which 'true' capital consumption is indeed similar ('standard') in different countries per type of capital good or per economic activity. Standardizing is not without dangers. For example, assuming that the average service life of capital equipment in the Netherlands is equal to that in Japan, might result in misleading capital consumption figures (and NDP figures) as well. A more modest approach would be to standardize only the differences in assumptions considered to be very unrealistic. A case in point is that a substantial difference between the average service lives of capital equipment in the Netherlands and Japan can be considered as realistic, while a similar difference between those in the Netherlands and Germany is judged as very unrealistic.

It should be noted that, due to lack of homogeneity of the category of capital goods or of the economic activity in which the capital goods are employed, even substantial differences between the average service lives in the Netherlands and Germany may be realistic. However, if such differences are assumed without good empirical grounding, standardizing seems appropriate.

5. The quantitative importance of employing gross instead of net figures for some alternative concepts

The figures presented in sections 3 and 4 apply to present national accounting conventions. The differences and correspondance between net and gross domestic product figures found in these sections, may depend to a large extent on the concepts employed. An apparently minor change in concepts might change the large degree of correspondance between NDP and GDP growth rates. The present concepts of capital formation and capital consumption can be extended in many ways. For example, expenditure on developing software or on large advertisement campaigns can be accounted for as intangible assets of enterprises, expenditure by the government on education could be recorded as human capital formation and exhaustion of natural resources as capital consumption. In this section, attention is focused on two alternative accounting procedures: firstly, accounting for capital consumption on infrastructural works of the government, and, secondly, accounting for the services of consumer durables.

According to present conventions, government assets like dams, dikes, the Dutch Deltaworks, roads, bridges, satellites, channels and airfields are not written down. The main logic behind this convention is that estimates of capital consumption on these types of assets are highly arbitrary and that a simple solution to circumvent this estimation problem is to assume that such assets are well-kept. However, the latter assumption does not seem to hold in many instances, even in the developed countries. For example, in the Netherlands many experts have reported on arrears in the maintenance of the sewerage system. From our point of view, it is important to note that by accounting for capital consumption on such governments assets, GDP increases while NDP remains unchanged.

In table 5, the alternative GDP figures are compared to present NDP and GDP figures for the Netherlands. The estimates of the extra amount of capital consumption have been calculated by means of the PI-method. The figures presented show that the differences between the absolute figures of GDP and NDP increase by one percentage point. For the growth

rates hardly any difference can be observed. As a consequence, also the correlation and standard deviations remain unaffected.

Table 5. The consequences of alternative concepts on the difference between GDP and NDP figures in the Netherlands: Recording consumer expenditure on durables as capital formation and recording capital consumption on infrastructure, 1969-1988. Tentative figures[a)].

	1970	1975	1980	1985	1986	1987	1988	Average 1969-1988
1. Absolute levels in terms of NDP								
- GDP at mp								
a. present concepts	109.2	110.0	110.7	111.4	111.4	111.8	111.7	110.5
b. 1a + infrastructure	110.2	111.2	112.0	112.8	112.8	113.2	-	111.6[a)]
c. 1a + consumer durables	122.9	124.2	125.1	125.6	125.2	125.4	123.4	124.6
2. Growth rates								
- GDP at mp								
a. present concepts	5.7	-0.1	0.9	2.6	2.0	1.3	3.0	2.4
b. 1a + infrastructure	5.7	-0.1	0.9	2.6	2.0	1.3	-	2.4[a)]
c. 1a + consumer durables	6.1	1.1	2.0	2.5	1.8	1.0	2.7	3.0
- NDP at mp	5.6	-0.5	0.5	2.6	2.0	0.8	2.6	2.3

	Aver. deviation from NDP	Max. deviation from NDP	Correlation with NDP	Stand. Dev. comp. to NDP
1. GDP growth rates				
a. present concepts	0.2 (7%)	0.4 (18%)	1.00	-0.1 (-6%)
b. 1a + infrastructure[b)]	0.2 (8%)	0.4 (20%)	1.00	-0.2 (-12%)
c. 1a + consumer durables	0.7 (33%)	1.8 (79%)	0.89	0.0 (-2%)

a) Figures calculated on the basis of CBS, 1973, CBS, 1987, CBS, 1989 and some not-publicly available figures. In addition, some assumptions about the service lives of consumer durables had to be made. Yearly growth rates calculated on the basis of chain indexes.
b) Period: 1969-1987.

The situation is different when the services of consumer durables are accounted for. Compared to present NDP, the expenditure on consumer durables is quite substantial in many countries: for instance 13.2% in the Netherlands and 17.3% in the USA (both in 1985). In our calculations for the Netherlands, we have assumed that the value of the services of consumer durables is equal to capital consumption.[8)]

Table 5 shows that accounting for the services of consumer durables raises the difference between Gross and Net Domestic Product (= capital consumption) from 10.5% to 20.2% in terms of NDP. Similarly, the difference between both growth rates increases from 0.2% to 0.6%; the maximum deviation increases from 0.4 to 1.5 percentage points (from 18 to 79% of NDP's average growth rate). So, the accuracy of GDP growth rates as proxies of NDP growth rates decreases substantially by employing this alternative accounting procedure. Nevertheless, the

correlation between GDP and NDP growth rates remains high and the standard deviations are of the same magnitude. In this respect, GDP growth rates are rather similar to NDP growth rates.

The increased importance of capital consumption due to accounting for the services of consumer durables also has implications for the consequences of measurement errors in capital consumption on GDP and NDP. The figures on the absolute levels of GDP in table 5 show that capital consumption by households is larger than that of enterprises and the government. The result is that GDP becomes even more vulnerable to measurement errors in capital consumption than NDP.

10. Conclusions

For most purposes, net figures on Domestic Product, National Product and National Income are to be preferred, because capital consumption should be accounted for as costs involved in generating product and income. For example, in economic policy it does not make sense to aim at maximizing gross value added since this can in fact imply that a specific category of cost (i.e. capital consumption) is maximized.

Since capital consumption figures are deemed quite unreliable, it is commonly concluded that gross figures are to be preferred. We reject this implication for the following reasons:

Firstly, since the objective of national accounting is to arrive at reliable net figures, gross figures are only one of the possible estimates of net figures. For example, for short term indicators even assuming a constant growth rate of capital consumption might yield a better estimate of net growth.

Secondly, it is rather peculiar to note that all calculations made by national accountants in constructing net domestic product and income figures are accepted by the users, except the capital consumption estimates. For example, figures on own-account production, imputations for owner-occupied dwellings, etc. are commonly taken at face-value. In addition, attention is seldomly paid to differences in general estimation procedures among countries, even though these differences may be also quite substantial.

Thirdly, the consequences of measurement errors in capital consumption figures can be minor for various reasons. For example, when measurement errors are fairly stable, this does not affect comparisons over time. Another case in point are measurement errors which cancel out, so that the measurement error in total capital consumption can be quite low despite large measurement errors at a lower level of aggregation.

Fourthly, not only net but also gross figures depend on estimates of capital consumption. It is often overlooked that government's gross

value added is -by convention- calculated as the sum of costs like wages and capital consumption. Although NDP figures depend on estimates of capital consumption to a much larger extent than GDP figures, this changes if capital consumption of consumer durables is also accounted for.

Finally, it must be remarked that National Accountants should have taken the reliability of estimates into account in devising concepts; this applies to 'imputations' like own-account production as well as to capital consumption. Rejecting the concepts of Net Domestic Product and National Income on the grounds that capital consumption cannot be estimated accurately, implies that capital formation and capital consumption must be formulated alternatively. Three options deserve attention:

- no capital formation is recorded at all (instead of capital formation either intermediate or final consumption must be recorded)
- capital consumption is equal to capital formation
- capital consumption is zero (on the assumption that capital stock is kept in good condition).

The concept of GDP does not coincide with either one of these options. In fact, GDP is an ambiguous concept, since on the one hand it accepts capital consumption figures for the government while on the other hand it rejects the capital consumption figures for enterprises.

From a more practical point of view, one question remains: what difference does it make when gross figures are employed instead of net ones?

For six OECD-countries (United States, United Kingdom, West-Germany, Japan, Sweden and the Netherlands), gross and net national accounting figures have been presented during the period 1975-1987. Some of the results were:

- comparing nations on the basis of either GDP/capita or NDP/capita may lead to relative differences up to 6 %. In worldwide comparisons, even differences of 20% occur. Differences of a similar magnitude may result when using GNP instead of NNP in determining the contributions of countries to international organizations like the EC.

- growth rates of GDP are substantiallly higher than those of NDP, varying between 0.1 and 0.3 percentage points. In terms of NDP's average growth rates, the range is between 5 and 11%. The maximum differences between GDP and NDP vary between 0.4 and 1.0 % percentage points (between 25 and 40% of NDP's average growth rates). Such differences are of substantial importance for economic policy.
- for modelling purposes, it is the co-variation which matters. The coefficients of determination between net and gross growth rates for the six countries are very high (between R^2=0.95 and 1.00). So, choosing GDP instead of NDP growth rates (or vice versa) hardly affects the fit of an econometric model.
- the standard deviation of NDP growth rates is structurally higher than that of GDP growth rates: the business cycle is up to 25 % more volatile than is suggested by GDP.

Notes

1) Taking gross growth rates assumes identical growth rates for GDP and capital consumption instead of separately estimated National Accounts capital consumption growth rates. This means that a bold assumption about the relationship between gross value added and capital consumption is preferred to estimates based on, say, accumulated capital formation figures and estimated life times. If the life times used are somewhat outdated, the choice is between a bold assumption about gross value added and capital consumption on the one hand and a bold assumption about accumulated capital formation and capital consumption on the other. To me, the latter assumption is clearly preferable, because -in contrast to accumulated capital formation and capital consumption- only indirect relationships exist between gross value added and capital consumption. Only if National Accounts capital consumption figures are considered to be extremely unreliable, the bold assumption implied in preferring gross to net growth rates may be acceptable.

2) Figures learn that for most countries, in using the absolute figures the difference between Domestic Product and National Income figures (both at market prices or factor costs) is usually negligable. For example, for our six OECD-countries during 1975-1987 the difference between GDP and GNI, both at market prices, is always less than 2%. A rare exception to this 'stylized fact' can be found in Luxemburg where the difference between GDP and GNI amounts to, e.g., 35% of GDP in 1987. An implication of this stylized fact is that comparing Gross and Net National Income figures will usually yield results of the similar/same magnitude and direction as comparing Gross and Net Domestic Product figures. For example, when the difference between GDP and NDP is 10% of GDP, the difference between GNI and NNI will also be -approximately- 10%. If the GDP growth rate is 2 % and the NDP growth rate is 3%, the difference between the growth rates of GNI and NNI will in general also be -approximately- 1% (e.g. GNI is equal to 3% and NNI is 4%).

   In order to avoid misunderstanding, it might be added that -unlike the absolute figures of GDP and GNI- the growth rates of GDP and GNI can differ substantially. This is due to the fact that the difference between Domestic Product and National Income is a net item (net primary income received from abroad), which is therefore relatively very volatile. For example, a change in net primary income received from abroad of 100% is no rare exception. A 100% change in an item which is only 2% of the total, affects the total approximately 2%. This is very substantial compared to the annual growth rates of most countries.

3) Investigating the consequences of employing GDP instead of NDP gives somewhat different results for comparing at market prices than at factor costs does. For our six OECD-countries in the period 1975-1987, GDP at market prices exceeds GDP at factor costs by -roughly- 10%. Therefore, capital consumption as a percentage of GDP at market prices is somewhat lower than at factor costs, i.e the relative difference between Gross and Net Domestic Product is at factor costs

somewhat larger. Similarly, the growth rate of NDP at factor costs is also somewhat more affected by the growth rate of capital consumption. With these two minor modifications in mind, only Gross and Net Domestic Product figures at market prices need to be discussed, because the results obtained (the differences between absolute figures and between growth rates for gross and net Domestic Product) apply also -to a somewhat increased extent- to the comparison at factor costs. An analogous argument on market prices versus factor costs holds probably also at the more disaggregated level of sectors and economic activities.

4) The standard deviation of the deviations from the trend in the absolute figures is also often used as an indicator of volatility (see, e.g., Balke and Gordon, 1989). The precise content of this indicator is up to much choice, because it depends upon the way the trend is calculated (regression-curve, moving averages, 'sketching by hand', etc.) and the period considered (including or excluding an excentric starting year might result into significant differences). For these reasons, and because the purpose of this paper is not a study of various measures of volatility, calculations have been restricted to the standard deviations of the growth rates.

5) In the National Income and Product Accounts of the United States (United States Department of Commerce/BEA, 1986, e.g. Table 1.16), capital consumption according to the National Accounts ('Capital consumption allowances with capital consumption adjustment') as well as its difference with capital consumption as recorded in the business accounts ('Capital consumption adjustment') are presented. This capital consumption adjustment is in general smaller than 10%. The explanation for this relatively small difference might be that there are two opposing forces: valuation at historical costs tends to make capital consumption in business accounts smaller than in the national accounts, while government policy to stimulate capital formation by taxing on the basis of unrealistically high mortality rates has usually a countervailing effect.

6) Employing bell-shaped mortality functions or the assumption of simultaneous exit does not lead to large differences (OECD, 1989b, para 6). In addition, since bell-shaped mortality functions result in lower estimates of capital consumption, employing bell-shaped mortality functions for the Netherlands as well, would only increase the difference between both capital consumption/GDP ratios.

7) This explanation could be tested by comparing capital consumption and capital stock figures for the Netherlands and West-Germany for various types of capital goods at the most disaggregate activity-level. More precise statements are only possible with extensive case-studies at hand. However, the latter type of studies are difficult due to the lack of sufficiently detailed data on capital stock and capital consumption for both countries.

8) The value of the services of consumer durables could also be estimated as the sum of capital consumption and some opportunity cost for the amount of capital invested. However, the comparison between gross and net would have resulted in more or less the same results.

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National Accounts Occasional Papers

NA/01 Flexibility in the system of National Accounts, Van Eck, R., C.N. Gorter and H.K. van Tuinen (1983).
This paper sets out some of the main ideas of what gradually developed into the Dutch view on the fourth revision of the SNA. In particular it focuses on the validity and even desirability of the inclusion of a number of carefully chosen alternative definitions in the "Blue Book", and the organization of a flexible system starting from a core that is easier to understand than the 1968 SNA.

NA/02 The unobserved economy and the National Accounts in the Netherlands, a sensitivity analysis, Broesterhuizen, G.A.A.M. (1983).
This paper studies the influence of fraud on macro-economic statistics, especially GDP. The term "fraud" is used as meaning unreporting or underreporting income (e.g. to the tax authorities). The conclusion of the analysis of growth figures is that a bias in the growth of GDP of more than 0.5% is very unlikely.

NA/03 Secondary activities and the National Accounts: Aspects of the Dutch measurement practice and its effects on the unofficial economy, Van Eck, R. (1985).
In the process of estimating national product and other variables in the National Accounts a number of methods is used to obtain initial estimates for each economic activity. These methods are described and for each method various possibilities for distortion are considered.

NA/04 Comparability of input-output tables in time, Al, P.G. and G.A.A.M. Broesterhuizen (1985).
It is argued that the comparability in time of statistics, and input-output tables in particular, can be filled in in various ways. The way in which it is filled depends on the structure and object of the statistics concerned. In this respect it is important to differentiate between coordinated input-output tables, in which groups of units (industries) are divided into rows and columns, and analytical input-output tables, in which the rows and columns refer to homogeneous activities.

NA/05 The use of chain indices for deflating the National Accounts, Al, P.G., B.M. Balk, S. de Boer and G.P. den Bakker (1985).
This paper is devoted to the problem of deflating National Accounts and input-output tables. This problem is approached from the theoretical as well as from the practical side. Although the theoretical argument favors the use of chained Vartia-I indices, the current practice of compilating National Accounts restricts to using chained Paasche and Laspeyres indices. Various possible objections to the use of chained indices are discussed and rejected.

NA/06 Revision of the system of National Accounts: the case for flexibility, Van Bochove, C.A. and H.K. van Tuinen (1985).
It is argued that the structure of the SNA should be made more flexible. This can be achieved by means of a system of a general purpose core supplemented with special modules. This core is a fully fledged, detailed system of National Accounts with a greater institutional content than the present SNA and a more elaborate description of the economy at the meso-level. The modules are more analytic and reflect special purposes and specific theoretical views. It is argued that future revisions will concentrate on the modules and that the core is more durable than systems like present SNA.

NA/07 Integration of input-output tables and sector accounts; a possible solution, Van den Bos, C. (1985).
The establishment-enterprise problem is tackled by taking the institutional sectors to which the establishments belong into account during the construction of input-output tables. The extra burden on the construction of input-output tables resulting from this approach is examined for the Dutch situation. An adapted sectoring of institutional units is proposed for the construction of input-output tables.