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**The Dutch experience in measuring health output
and labour productivity**

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The Dutch experience in measuring health output and labour productivity

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Abstract

Labour productivity of health services has received a lot of attention in the Netherlands in recent years. Labour productivity requires the measurement of output and labour input. This paper describes the output volume index developed at Statistics Netherlands for hospital health services and some of the problems that are encountered in the measurement of output. Next, possibilities will be discussed for including other health sectors, such as nursing homes and homes for the elderly. The greatest challenge lies in finding a method that takes into account the yearly changes in the composition of products, as some sectors show a strong increase of new extramural services since 2003. On the other hand, the main products of each sector can be tracked from year to year and their volumes and production values are known. This could serve as a basis for an output method that includes hospitals and other sectors. This paper illustrates the output method for hospitals with an application to labour productivity of general hospitals in the Netherlands.

1. Introduction

The measurement of the production volume of health services is becoming increasingly important. The demand for health services is expected to increase due to factors like population ageing and technological progress. A growth of health services can be achieved in different ways, for instance, by investing in input factors, such as capital and labour, and/or by enhancing productivity with regard to one or more inputs, such as labour productivity. At present, there is a lot of attention in Dutch politics for the latter approach. For the overall labour productivity of the Netherlands, the health sector plays an important role.² Appropriate methods for quantifying the yearly development of output and labour input are therefore needed.

Finding an adequate measure for output volume is not straightforward. This task involves the partitioning of total output into a set of individual 'products' (i.e., setting criteria in order to define these products), quantifying their volume and finding weights in order to aggregate these volumes into a value representing total output volume. In order to distinguish health products we need to establish when two products are the same. In this respect, the role of diagnosis and of a patient's health state after a treatment should be determined. In addition, the beginning and the end of a treatment should be established. (For more details, see e.g. Cutler et al. (1998) and Triplett (1999).)

In 2001, Eurostat published a Handbook on Price and Volume measurement which provides guidelines for the development of price and volume measures for nearly each CPA group (Classification of Products by Activity) (Eurostat, 2001). The methods described in the Handbook were adopted in a European Regulation issued in 2002 (Council Regulation, 2002). The objective of the Regulation is to harmonise the methods of deflation used in the National Accounts of European countries in order to improve the comparability of macroeconomic statistics. The Handbook suggests some feasible methods for the abovementioned measurement problems. The Regulation requires that

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² The number of employed persons in the health and welfare sector was 894,000 in 1998 and 1,032,000 in 2004, which is equivalent with 13.6% of the total number of employed persons in 1998 and 14.7% in 2004. (Source: CBS StatLine)

each European country should use at least a so-called “B method” in the National Accounts starting from 2006.³

Kleima et al. (2004) presented a volume index based on hospital discharges in the Dutch Hospital Discharge Register (HDR). The aim of that study was to explore the possibilities for constructing an output index that meets the requirements for a B method. We will summarise this method in Section 2. In Section 3, we will investigate possibilities of including services from other health sectors, such as nursing homes, psychiatric institutes and care of disabled patients.

In Section 4, we will use the output index for hospital health services in order to derive the development of labour productivity for general hospitals. We will use data on labour input and wages for different labour categories in order to develop an overall labour input index. The yearly developments of health output, labour input and labour productivity of general hospitals will be calculated and presented for the period 1998-2004.

In Section 5, we will discuss the present state of our research within the context of the requirements of the European Regulation and the applicability of the output method within the National Accounts. We will also discuss the possible implications of uncertainties in output and labour input data on labour productivity.

2. An output volume index for hospital health services

2.1 An output index for clinical and day treatments

In this section, we summarise the method for calculating an output index for clinical and day treatments based on data from the Hospital Discharge Register (HDR), which is a database managed by the Dutch organisation Prismant. More details about the method can be found in Kleima et al. (2004). Individual inpatient treatments are recorded in the HDR. The following data of discharged patients were used for constructing the output index:

- Date of birth, which allows us to create age classes;
- Diagnosis, according to 11,182 ICD codes;
- The number of hospitalisation days, which reflects the duration of hospital stay;
- Clinical and day treatments are distinguished. Clinical treatment lasts at least 24 hours, while a day treatment lasts shorter than 24 hours.

In our approach, each discharge is counted as a treatment. (A discharge also applies to day treatments here.) The discharges are aggregated into distinct groups in order to calculate volume indices in a meaningful way.⁴ For this purpose, the diagnoses were characterised by the 3-digit ICD-9 classification, which resulted in approximately 1000 diagnosis groups.⁵ Since age and hospitalisation duration are not independent for most diagnoses, discharges were also subdivided according to age. Data analyses showed that it is useful to group discharges according to 7 age classes (0, 1-14, 15-44, 45-59, 60-69, 70-79, 80 and older). The individual treatments in the HDR are thus grouped into about 7000 diagnosis/age groups.

In the Netherlands, a “Cost of Diseases” (CoD) study is performed once every five years. However, the prices that are provided by this study are not suitable as weights for the diagnosis/age groups for reasons described in Kleima et al. (2004). The main reason is that the CoD study is performed once every five years and is published about two years after the end of the year of review. This implies that the study does not provide current prices and does not allow readjustment of the

³ A distinction is made between A methods (“most appropriate methods”), B methods (“which can be used in case an A method cannot be applied”) and C methods, “which shall not be used”.

⁴ This was done in order to avoid volumes equal to zero in the reference period, in which case volume indices cannot be calculated.

⁵ According to the European Council Regulation (2002), “methods which use the International Classification of Diseases (ICD) to classify discharges can also be a B method provided the diagnoses are recorded at a very detailed level and appropriate cost weights are used.”

weights on a yearly basis. This is a problem because a Laspeyres index with annually adjusted weights is preferably used for output volume in the National Accounts.

The prices per treatment that were derived in the CoD study appeared to be determined for about 85% by the price of hospitalisation. Analyses showed that weighting with values from the CoD study and weighting with the number of hospitalisation days gave similar volume indices.⁶ These findings led us to adopt the number of hospitalisation days as weights for the diagnosis/age groups, which are available in the HDR every year. We decided to assign the weight of one clinical hospitalisation day to a day treatment since information is lacking about prices of medical operations.

The yearly volume changes in output are obtained by calculating a volume index for all the diagnosis/age groups, which are weighted by the fraction of the hospitalisation days in each group on the total number of hospitalisation days over all the groups in the preceding year. This gives rise to a Laspeyres index, which can be expressed as follows for year t with respect to year $t - 1$:

$$(1) \quad Y_{t,t-1}^D = \sum_{i \in D} v_{i,t-1} \frac{T_{i,t}}{T_{i,t-1}}.$$

In this expression, $T_{i,t}$ denotes the number of treatments or discharges for diagnosis/age group i in year t and $v_{i,t-1}$ denotes the fraction of hospitalisation days for diagnosis/age group i in year $t - 1$, which takes values between 0 and 1. The complete set of diagnosis/age groups is denoted by D . In Section 4, chained indices will be derived from (1) for the Dutch general hospitals over the period 1998-2004 (see Table 1).

The output method described above adds clinical and day treatments within every diagnosis/age group. This can be motivated as follows. The HDR-data show that there is a tendency for substituting clinical treatments by day treatments (see also Table 1). For example, appendicitis is treated more often with laparoscopy than with traditional surgery. We intend to measure such a shift as a price change and not as a volume change. Notice that this shift may affect the weights $v_{i,t-1}$ of the diagnosis/age groups in (1), which are related to prices.

It is worthwhile noting the implications of this approach for medical treatments that consist of a series of hospital admissions. Each admission is counted as a separate treatment in our method. In case of chronic diseases like varicose veins, it can be justified to count each discharge as a separate treatment, because the time between subsequent treatments will vary and the disease cannot be really cured. However, in case of chemotherapy a series of admissions corresponds with the treatment of one diagnosis.⁷ These examples show that it is difficult to find a uniform approach that is ‘correct’ for all types of diseases.

2.2 An overall output index

The HDR covers only clinical and day treatments. Other surveys provide data on the following additional hospital services, which need not be registered in the HDR:

- Outpatient services;
- Other health services, which consist of:
 - Part-time psychiatric treatments;
 - Rehabilitation;
 - Outpatient births;
 - Haemodialysis;
 - Thrombosis services.

⁶ In the case where the price per hospitalisation day is the same for all treatments, both weights are identical as the prices cancel out in the relative cost weights.

⁷ This would mean that different admissions should be counted as one treatment. Notice, however, that this does not necessarily imply significant differences with our method. If the average number of admissions per chemotherapy is the same in two successive years, then the volume index of the corresponding diagnosis/age group remains the same.

Outpatient services are quantified as the number of visits, which in the available data are not specified with respect to type of specialist. As a consequence, we construct a volume index based on the total number of visits in two successive years. The volumes of the remaining five health services are also quantified as the number of treatments or services. Psychiatric treatments and rehabilitation refer to day treatments. The volume of thrombosis services is measured as the number of blood-takings per year.

We derived an overall Laspeyres index by weighting the Laspeyres indices of the different types of health services. The weights were derived from data on health insurance claims in a pilot study. These data apply to one specific year; we assume that the weights have the same value every year. We denote the set of health services consisting of outpatient services and “other health services” by R . The insurance claim-based weights are denoted by c_D for clinical and day treatments and by c_i , where $i \in R$, for the remaining types of health services. A weight c_i was derived for outpatient visits and for each of the five “other health services” listed above. For every health service type $i \in R$, we denote by $T_{i,t}$ the number of treatments, visits, or otherwise, in year t . The Laspeyres index (1) for clinical and day treatments has been extended to the following overall Laspeyres index $Y_{t,t-1}$:

$$(2) \quad Y_{t,t-1} = c_D Y_{t,t-1}^D + \sum_{i \in R} c_i \frac{T_{i,t}}{T_{i,t-1}},$$

where the nonnegative weights c_D and c_i , for all $i \in R$, are normalised such that they sum to 1. Output indices for the different services are presented in Section 4.1 for the Dutch general hospitals, which will be used next to derive labour productivity.

3. Possibilities of including other health sectors

Beside hospital services, a large part of the health sector consists of services provided by:

- Nursing homes;
- Homes for the elderly;
- Home health care institutes;
- Psychiatric institutes;
- Institutes for disabled patients.

As is the case for hospital services, health services from each of these five types of institutes are provided on the basis of budgets. The costs of health services in the Netherlands are controlled by a law on tariffs of health services (the “WTG-law”). Health institutes submit their set of production agreements to the Dutch organisation CTG, which executes the WTG-law and derives a budget from the production agreements. The total budget for the five sectors above was almost 17 billion Euros in 2003, which is about 3.5% of the Gross Domestic Product of the Netherlands. This budget is close to the sum of the budgets of general, academic and specialised hospitals and the self-employed health professionals. The five sectors thus form a significant part of the output of the total health sector.

Until now, the output volume index numbers for nursing homes and homes for the elderly have been calculated according to a C method in the Dutch National Accounts. The method used so far consists of deflating the total production value or budget by the wage-related part of the tariff of a nursing day. The purpose of this section is to make a brief investigation of the possibilities for developing at least a B method for each of the five health service types. We will do this by studying the production data for these sectors. The CTG maintains a database with production agreements for every year, which are specified by institute and product type, with a tariff-based value for every product.

In global terms, the five health sectors treated in this section are characterised by the following product composition. The main health output of nursing homes consists of nursing, which is expressed as the number of nursing days. It makes up more than 70% of the total budget of the nursing sector. Other outputs are intramural and extramural health services, such as short stays and supplementary

care (intramural), household assistance, home care and assistance of elderly patients in their daily activities (extramural). Homes for the elderly are characterised by a similar product composition, with days of care as the main output. Home health care consists of extramural services.

Health services provided by nursing homes, homes for the elderly and home care institutes show changes in product composition over time. The number of extramural services has increased for each of these three sectors, in particular since 2003, with new products being added in each successive year. In the case of nursing homes, the budget for extramural services increased from 112 million Euros in 2003 to 319 million Euros in 2004. The yearly changes in product composition offer a great challenge in the development of an output volume index for these sectors.

The product composition of services by institutes for disabled patients and by psychiatric institutes show only slight variations over time. The main health output consists of treatment days, which are distinguished according to type of handicap for disabled patients (mentally, physically, auditory). Treatments of mentally disabled patients are differentiated further according to severity of handicap, patient's age and institute capacity. Treatments in psychiatric institutes are also differentiated at two levels of detail: by group (addicted patients, children, adults, elderly) and by intensity of treatment or assistance.

The development of an output volume index for the five sectors is hampered by the addition of new and changing products in successive years. The extent of this problem is most serious for nursing homes, homes for the elderly and home care, especially from 2003 onwards. Until then, the product composition of these sectors underwent small yearly changes. Fortunately, the main output of each of the five sectors can be tracked from year to year, which makes it possible to develop an output index for these products. The detailed budget and production data should enable the development of a B method for every sector. The treatment of new products and the integration of their output volumes with the output indices of the main products is an open question at this stage.

4. Application to labour productivity of general hospitals

4.1 Output volume

In this section, we derive the overall output index for health services of general hospitals in the Netherlands during 1998-2004. The purpose of this section is both to illustrate the output index method described in Section 2 and to derive labour productivity because of the attention this measure has received in Dutch politics and the media. We exclude academic hospitals since education forms a substantial part of their output. The part of labour input volume that is involved with education is difficult to determine because separate data on this aspect are not available. This represents a source of uncertainty; we decided to limit uncertainties as much as possible in this study.

Table 1. Output indices for three health service groups and overall output index, for all Dutch general hospitals (1998 = 100). The weights are derived from insurance claims. The hospitalisation days comprise both clinical and day treatments.

	Clinical and day treatments			Outpatient visits	Other services	Overall index
	Hospital. days	Discharges	HDR-index			
1998	100	100	100	100	100	100
1999	95,46	100,55	100,31	100,19	100,51	100,29
2000	90,85	101,12	100,28	100,43	100,66	100,33
2001	88,97	104,58	103,02	101,25	107,67	102,67
2002	88,31	112,22	109,44	103,85	115,84	108,10
2003	88,18	119,03	116,02	105,30	113,20	113,01
2004	87,51	126,68	123,11	111,17	118,78	119,71
weights			0,703	0,269	0,028	

Sources: Statistics Netherlands, Prismant.

Table 1 shows the volume indices for clinical and day treatments (HDR-index), outpatient visits and the remaining five health services described in Section 2.2, for which we calculated one volume index. Table 1 also shows the overall output index, which is calculated from expression (2). The weights of the health service types in this expression are also shown. The indices in Table 1 are all chained indices.⁸ The HDR-index is a chained volume index that is derived from expression (1). Notice that the number of hospitalisation days decreases, while the number of discharges increases. The HDR-data show a shift from clinical treatments to day treatments.

The overall index in Table 1 hardly increases until 2000, while it increases rapidly from 2002 onwards. The behaviour in the first three years of the series is almost the same for the three health service types. The subsequent output increase coincides with changes in policy by the Dutch Ministry of Health, Welfare and Sport in order to reduce waiting times. Until 2001, health institutions could only deliver services that were in accordance with a fixed set of price and volume agreements. In 2001 additional financial means were made available by the Ministry, which allowed health institutions to make additional agreements. Institutions could therefore generate more output than on the basis of the initial set of volume agreements.

4.2 Labour input

Labour productivity relates total output to labour input. In order to calculate labour productivity accurately, it is of crucial importance to identify the characteristics of labour input that may influence output. The OECD productivity manual gives a comprehensive discussion on measurement issues concerning labour input (OECD, 2001, Chapter 4). Factors that should be taken into account are the composition of the labour force and its volumetric unit.

The first factor refers to the differentiation of labour input by category. There may be differences in skills, education and experience that give rise to different contributions in output. One hour worked by a specialist is not the same as an hour worked by a member of the nursing staff. The most appropriate measure for the volume of labour input is the number of hours actually worked (OECD, 2001, p. 39). The number of employee jobs, for instance, does not reflect changes in the average work time per employee. Factors like sick leave and holiday leave affect output and should be included in a measure for labour input.

The data on labour input, which are presented below, are collected in a survey conducted by the Dutch organisation Prismant. The survey covers all the general hospitals in the Netherlands. Labour input is measured in full-time equivalents (fte's). The labour agreements on contractual hours of work during a working week have not changed since 1998, so that the conversion from fte's to contractual hours has no effect on labour productivity for the period considered in this paper (1 working week is equivalent with 36 hours). We have subdivided the hospital staff into categories based on the uniform classification standard outlined by Prismant. The following categories have been created:

- Personnel under contract in general hospitals:
 - Nursing staff;
 - Medical staff (includes specialists and other scientific staff);
 - Other clinical staff (laboratory, psychosocial support and other support staff);
 - Trainees;
 - Administrative personnel;
 - Housing staff;
 - Infrastructure management staff;

- Personnel not under contract in general hospitals:
 - Self-employed specialists;
 - Other staff, mainly recruits from agencies.

⁸ In all the tables and figures we set the index for the reference year 1998 at 100, which is in accordance with usual conventions. Notice that we use the value 1 in all the formulas instead.

The group of self-employed specialists consists of specialists who have a practice in a general hospital. The second group of personnel that is not under contract in a general hospital comprises consultants, doctors and personnel involved in administrative functions. The development of fte's within each of the above categories during 1998-2004 is shown in Table 2.

In our calculation of an overall volume index for labour input we have adjusted the fte's by annual rates for sick and maternity leave. The two rates are combined into a single rate for every year, which is also shown in Table 2. The annual rates are values averaged over all the labour categories. As we do not have the rates at category level, we assume that the annual rates for sick and maternity leave are the same for each category.

For every year, we calculated a Laspeyres index for labour input by weighting the indices of every labour category according to the salaries in each category, which include contributions to social security payments and supplements regarding vacation and health insurance. The weights are equal to the share of the summed salaries within each category on the total sum of the salaries over all the categories. We denote the amount of fte's in category i for year t by $F_{i,t}$ and the combined rate for sick and maternity leave in year t by r_t . The Laspeyres labour index for year t with respect to year $t - 1$ then becomes:

$$(3) \quad L_{t,t-1} = \frac{1 - r_t}{1 - r_{t-1}} \sum_i w_{i,t-1} \frac{F_{i,t}}{F_{i,t-1}},$$

where the salary-based weights for labour category i are denoted by $w_{i,t-1}$, which refer to year $t - 1$. Of course, the summation in (3) is over all the labour categories.

Table 2. Labour volume indices for labour categories and overall index, for all Dutch general hospitals (1998 = 100).

	Administr.	Housing	Infrastruct.	Trainees	Clinical staff			Not under contract		Sick and mat. leave	Overall index
					Nursing	Medical	Other	Self-empld	Other		
1998	100	100	100	100	100	100	100	100	100	7.2%	100
1999	103,65	99,36	98,42	96,06	100,34	110,55	101,58	99,21	111,53	7.5%	101,48
2000	107,77	99,72	97,37	95,80	99,66	109,97	102,20	100,95	137,62	8.0%	102,82
2001	112,43	97,80	93,68	91,94	100,91	115,25	103,86	106,64	164,99	7.7%	106,16
2002	119,32	102,06	97,89	103,81	103,37	127,96	107,91	109,75	164,53	6.9%	111,66
2003	125,03	100,92	98,42	100,25	104,82	136,72	111,81	115,65	132,91	6.3%	114,40
2004	125,68	96,38	98,42	96,77	106,16	150,30	115,21	115,77	115,84	6.1%	115,67
weights '98	0,185	0,126	0,022	0,031	0,259	0,055	0,132	0,138	0,052		
weights '04	0,146	0,074	0,020	0,024	0,319	0,096	0,177	0,101	0,043		

Sources: Statistics Netherlands, Prismant; Vernet (sick and maternity leave only).

Table 2 shows moderate to strong increases within all clinical staff categories, including the self-employed personnel, and the administrative staff. The fte's of medical specialists increase faster than the fte's of the nursing personnel. This could be related to the shift from clinical treatments to day treatments. Table 2 also shows that recruited personnel increases rapidly until 2001, while it decreases fast during the next years. The initial increase may be a consequence of labour market measures by the Dutch Ministry in order to reduce waiting times in hospitals. The subsequent decrease of fte's among recruits could be the result of a more cost-effective employment policy by hospitals. (Beside the salaries of recruits, health institutes also have to pay recruitment agencies for their services.) Notice that the decrease in fte's, together with the decrease and levelling off in other labour categories, slowed down the overall labour input considerably in 2004.

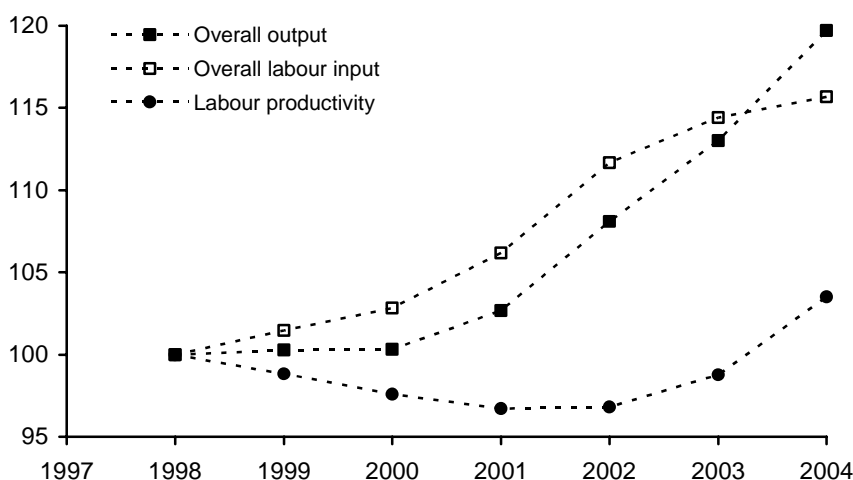
4.3 Labour productivity

Labour productivity is defined as the ratio of output volume to labour input. Labour productivity reflects how efficiently labour is combined with other factors, such as capital, to generate output. In this study, we decided to choose gross output instead of value-added, since the contribution of

intermediate labour inputs (mainly recruits) to output is unknown. We therefore included intermediate labour inputs in the calculation of the overall labour volume index.

The chained index for labour productivity is shown in Figure 1. Labour productivity decreases until 2001, which is a consequence of the fact that overall output increases at a lower rate than overall labour input. In this period, health services were delivered on the basis of a fixed set of production agreements. The corresponding yearly output volumes did not change much. In the last two years we see the opposite behaviour, in which overall output increased at an almost constant high rate, while labour input increased at a lower rate. The increase of labour input has slowed down, which contributed to an increase of labour productivity in 2004 by 4.8% with respect to 2003.⁹

Figure 1. Development of overall output, labour input and labour productivity (1998 = 100). The dashed lines are merely drawn to guide the eye.



5. Discussion

In this paper, we described the output volume index for hospital health services developed at Statistics Netherlands. We also considered the possibility of developing an output index for other health sectors, such as nursing and homes for the elderly. We are confident about the possibility of developing a B method for the other sectors, because very detailed output and budget data are available for every sector. The main output of each sector can be tracked from year to year, which could serve as the core of an overall output index. The integration of the output volumes for new products is a great challenge that has to be dealt with in the future.

Although the international focus is mainly on the development of price and output indices that satisfy the requirements established in the European Regulation of 2002, we should not ignore other problems. One of these problems is the treatment of uncertainties in output, labour input and productivity. In our example of labour productivity of general hospitals in Section 4, uncertainties can be identified in the cost weights of hospital health services, as these are based on an outdated source. Variations of 5% in the values of the weights in Table 1 affect the Laspeyres labour productivity indices by 0.2% at most. When academic hospital services are included, the uncertainty in the labour input share that is involved with education has to be dealt with as well. The combination of different sources of uncertainty may lead to larger variations around the base results. The identification and quantification of uncertainty and its effect on output, labour input and productivity is a subject that should merit more attention.

Labour productivity is also receiving a lot of attention in other sectors beside hospital health services, such as services by nursing homes. As soon as a suitable output volume index has been developed for the sectors treated in Section 3, we will also quantify labour productivity for these sectors. Eventually, we will have a comprehensive picture of output and labour productivity for the

⁹ As a comparison: labour productivity of the Dutch market sector increased with 4.5% in 2004. (Source: CBS StatLine)

health sector and their development in time, which we can compare between different health sectors and also with the Dutch economy as a whole.

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