Forecasting public health expenditures in the Netherlands

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Abstract

This paper presents the forecasting methodology applied in the Netherlands for the medium-term health expenditure forecast of 2011-2015. The model distinguishes several sub-sectors within healthcare, and decomposes health expenditure growth into four determinants, namely: demographic, epidemiologic and budgetary factors, and the residual. This decomposition provides insight into health expenditure allocation as well as its drivers. The model offers a tool for the analysis of potential budgetary implications of government policies. In particular, in the current application, we make forecasts under two alternative scenarios for policy intervention: no intervention and an increase in compulsory co-payments. Important advantages of the proposed model are its limited data needs, transparency and practicality.

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1 Introduction

Healthcare expenses have been rapidly increasing in most countries over the last 40 years. The growth of the GDP share of healthcare expenses was especially pronounced in the US. In the Netherlands, the issue gained importance in the beginning of 2000s, when within a couple of years the GDP share of health expenses has grown by nearly 2%. Since a large portion of health expenditure is publicly-financed, its forecasted value has important budgetary implications. Therefore, improving forecasting techniques helps improve budgetary policy.

In this paper, we present the forecasting methodology applied in the Netherlands for the medium-term health expenditure forecast of 2011-2015. The methodology is in essence a micro-simulation model. This approach is similar to that used by the European Commission (2009). However, our model adds a more detailed split into sub-sectors and a decomposition of the aging effect into demographic and epidemiologic factors, which provides a deeper insight into health expenditure allocation and drivers. Important advantages of the proposed model are its limited data needs, transparency and practicality, which makes it possible to apply it for making (or alternatively, for cross checking) aggregated health expenditure forecasts in other countries as well.

Traditionally, forecasting models for health expenditures project healthcare costs, based on demographic forecasts and the realized values of per-capita expenses in each age group. In these traditional models, population aging results in a steep increase of national healthcare spending. More recent literature, however, recognizes the importance of epidemiologic factors, which affect health and illness developments. As a result of these developments, people live longer and healthier. This delays their demand for healthcare and results in a lower forecasted growth of healthcare expenses than that in traditional models.

An important step in recognizing this phenomenon was the understanding that the largest part of the individual healthcare spending occurs in the person's last year of life (see Payne, 2007 for a review). For example, Stearns and Norton (2004) show that predictions from a simple model that does not include 'time to death' are 9% higher than from an expanded model controlling for 'time to death'. According to the literature, factors affecting the epidemiologic trends include: individual behavior and risks of diseases (e.g. smoking, obesity, control of hypertension and high cholesterol); health improving effects of medical innovations; and trends in disabilities. For example, Cutler (2008) stresses the importance of the first two factors and their dynamics, posing challenges in estimating total healthcare expenses. The third factor - trends in disabilities - becomes increasingly important as a determinant of long-term care expenses for elderly. Recognizing the importance of this factor, different studies, however, produce diverging estimates. While some authors predict an increase in disability with more population aging, the others expect a decreasing trend (Meijer et al., 2009). It is therefore important to find a reasonable way of incorporating these trends in health expenditure forecasts.

Although demographic and epidemiologic trends considered above can cause changes in both the total amount of health expenditures and their allocation across sectors, one cannot make a reasonable forecast of total health expenditures based on them alone, but one needs to take into account also general economic trends. Getzen (2006) argues that with an increase of the aggregation level, the relationship between healthcare costs and health status/morbidity becomes weaker and smaller in magnitude, while the correlation with income (per capita GDP) becomes stronger and larger. This implies that forecasts of total expendutures need to be made on the macro-level, since macro-economic constraints determine the budgetary room for healthcare. Also the time-horizon for which the forecast is made is important. According to Getzen (2000), in the short term, the current expenses adjusted for the expected change in employment and inflation provide a good estimate; in the medium-term, one should better use the real per-capita spending, adjusted for the trends in income and inflation; and in the long run, one could use the percentage of GDP, adjusted for the effects of structural changes and budget restrictions.

The methodology proposed in this paper uses these insights from the economic literature. Since we make a national medium-term forecast, the relevant predictor will be the total per capita healthcare spending (corrected for trends in demographics and health), adjusted for trends in national income and inflation. We present our model in section 2. In section 3, we describe the data and provide some historic analysis of health expenditures in the Netherlands. In section 4 we apply the methodology to make medium-term forecasts under two policy scenarios. Section 5 concludes.

2 Model

2.1 Total health expenditures

Since health expenses for an individual depend on the individual's age as well as the type of healthcare received, we divide the population in age groups (in our empirical application, we consider 20 age groups each comprising 5 years) and make a distinction between several sectors within the healthcare industry. We use notations *k* and *l* to refer to sector *k* and age group *l* respectively, and denote $n_{l,t}$ the number of individuals in group *l* in year *t*, and $x_{k,l,t}$ their per capita real expenses on healthcare services from sector *k.*

For the time-being, let us focus on one sector (hence, we drop index *k* in the remainder of this section), and consider the period from year 0 to year *t*. As a start, we suppose that the average health state in each health group does not change over time. Then in each year *t*, the real per capita expenses within each age group represent a sum of (i) per-capita healthcare expenses in this group in the base year, $x_{l,0}$; (ii) government interventions during the years from 0 to *t* , such as specific policies decreasing or increasing the expenses on a particular type of care, $b_{l,t}$; and (iii) the residual term $g_{l,t}$.

(1) $$x_{l,t} = x_{l,0} + b_{l,t} + g_{l,t} \quad .$$

If the average health state in the age group changes during the period, this change will affect the first term in equation (1). In accordance with the literature, we assume that there is an improvement in the health state of each group over time, delaying the need for healthcare at the individual level. We model this as a shift of the original (base year) health expenditure profile, $x_{l,0}$, to the right to reflect an annual increase in life expectancy in good health. Introducing a new parameter h_t ($0< h_t <1$) for the *cumulative* shift of the expenditure profile realized between year 0 and year *t*, we obtain the expression for the first term: $(1-h_t)\, x_{l,0} + h_t x_{l-1,0}$. Therefore, the final expression for health expenses in year *t* is as follows:

(2) $$x_{l,t} = \left((1-h_t)\, x_{l,0} + h_t x_{l-t,0}\right) + b_{l,t} + g_{l,t} \quad .$$

Then at the sector level, the total (nominal) expenditures at time *t* is expressed by the formula:

(3) $$X_t = P_t \sum_l n_{l,t} x_{l,t} \quad ,$$

where P_t stands for the price index corresponding to year *t* (P_0=1). As a price index, we suggest the use of the GDP-price deflator. An important advantage of using a single deflator for all (sub)sectors is that in this case, real values are additive over sectors. Besides, data on (sub)sector-specific inflation rates are usually less reliable, and their use would imply the presence of sector-specific deflators for the government budget intervention, $b_{l,t}$, which can cause interpretation issues. We will touch upon the issue of sector-specific prices in later sections.

2.2 Determinants of real health expenditure growth

Using formulae (2) and (3), the change in real healthcare expenditures, $X_t / P_t - X_0$, can be decomposed into four terms as follows:

(4)
$$
\begin{aligned}
X_t / P_t - X_0 &= \sum_l n_{l,t} x_{l,t} - \sum_l n_{l,0} x_{l,0} \\
&= \sum_l \left(n_{l,t} \left((1-h_t) x_{l,0} + h_t x_{l-t,0} \right) - n_{l,0} x_{l,0} \right) + \sum_l n_{l,t} b_{l,t} + \sum_l n_{l,t} g_{l,t} \\
&= \sum_l \left(n_{l,t} - n_{l,0} \right) x_{l,0} - h_t \sum_l n_{l,t} (x_{l,0} - x_{l-t,0}) + \sum_l n_{l,t} b_{l,t} + \sum_l n_{l,t} g_{l,t} \\
&= D_t^n - D_t^h + B_t + G_t .
\end{aligned}
$$

The four terms in the last row reflect respectively the effects caused by (i) the change in the size and the age composition of the population, D_t^n; (ii) shift in the health expenditure profile due to the increased healthy life expectancy, D_t^h; (iii) the macroeconomic costs of policy changes, B_t; (iv) the residual, G_t. The residual comprises all factors which effects we cannot identify separately, such as technological developments, real sector-specific price changes due to the Baumol effect, etc.[2]

Rewritten in terms of growth rates, equation (4) modifies as follows:

(5) $$\hat{X}_t - \hat{P}_t = \hat{D}_t^n - \hat{D}_t^h + \hat{B}_t + \hat{G}_t$$

where 'hats' denote the contributions of the respective variable to the growth of the real health expenditures and the expression $\hat{X}_t - \hat{P}_t$ represents the real growth rate of health expenditures.

[2] Sector-level inflation seems to be the most interesting contributor to the residual, which can potentially be split out from the residual. The economic term 'Baumol effect' refers to the sluggishness of productivity in services (Baumol, 1967). The residual approach to the measurement of the shift in the health expenditure function over time is similar to the Solow residual approach to the measurement of the shift in the production function over time (Solow, 1957).

3 Historic data analysis

The model will be applied for a medium-term forecast of health expenditures in the Netherlands. We distinguish three periods. The *forecast period* is 2011-2015. We use the period of 2001-2008, for which the realized data are already available, as a historic *reference period*. And we incorporate also more actual information that is already partly available for the *current period* , 2009-2010. We combine data from several sources, which we summarize in section 3.1. Based on this data, we define matrices $x_{k,l,t}$ and parameters h_t in sections 3.2 and 3.3 respectively. In section 3.4, we provide a short overview of government policies and health expenditure trends in the historic reference period.

3.1 Data sources

We use data from several sources. The recent data on the total health expenditures in 2007 and their allocation across age groups and sectors come from the National Institute for Public Health and Environment (RIVM, 2007). Data on total health expenditures of each sub-sector, data and forecasts of demographic trends, and GDP-prices are from Statistics Netherlands (2008, 2009 and 2010). The medium-term forecast for the real GDP growth is provided by CPB (2010). The data on government intervention in the decade 2001-2010 are own estimates.

3.2 Matrices of health expenditures

In this section we explain the construction of health expenditure matrices, which we need for the base year of each of the three periods considered (historic reference, current period, and the forecast period).

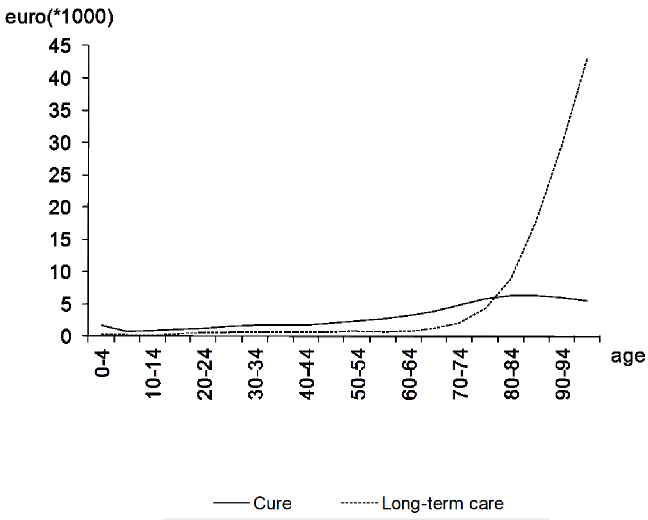
The most recent detailed matrix of per capita health expenditures corresponds to 2007. It allocates health expenditures among 21 sectors and 20 age groups each comprising 5 years. We aggregate some sectors to achieve the split into the major 6 sectors on which we will focus in this study, namely, (i) Hospitals and specialist practices; (ii) GP, dentists, paramedics; (iii) Psychiatric care; (iv) Medicines and appliances; (v) Nursing; and (vi) Healthcare for handicapped.[3] The resulting matrix of per capita expenditures, $x_{k,l,2007}$, represents the allocation of expenditures of each sector over 20 age groups in 2007. Based on this matrix, we can construct matrices of health expenditures for any year, $x_{k,l,t}$.

We assume fixed proportions of health expenditures over age categories, so that matrix $x_{k,l,2007}$ determines the proportions for the allocation of expenses over age categories in any year. Therefore, the expenditure matrix coefficients in any other year *t* are expressed as $x_{k,l,t} = c_{k,t} x_{k,l,2007}$. Here $c_{k,t} = X_{k,t} / X_{k,2007}$ is a scaling factor to ensure that the obtained coefficients $x_{k,l,t}$ are consistent with the data on total nominal expenditures of sector *k* in year *t*, $X_{k,t}$, in accordance with equation (3).

[3] Here and further we will refer to sectors (i)-(iv) as 'cure' sectors and to sectors (v)-(vi) as 'long-term care' sectors.

Figure 3.1 shows the profiles of per capita health expenditures over different age cohorts for the cure sectors (i)-(iv) and long-term care sectors (v)-(vi) separately. It illustrates large differences in per-capita expenses between these sectors, as well as across age categories. As one could expect, health care is used more intensively by the elderly, nursing in particular.

Figure 3.1Per capita health expenditures on cure and care across age categories in 2007



Source: RIVM (2007).

3.3 Trends in life expectancy and health

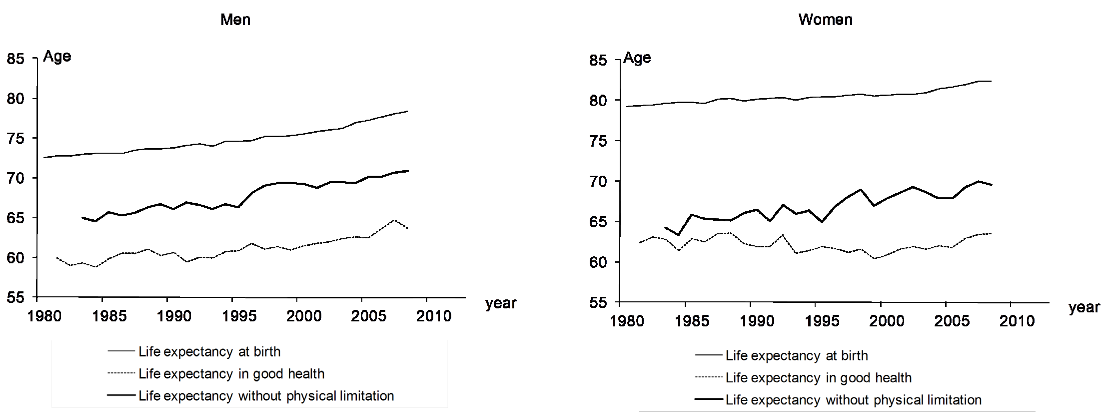
In order to evaluate the second term in decomposition (4), we need to estimate the cumulative shift of the health expenditure profile realized between year 0 and year *t*, h_t. This parameter can be expressed as follows:
Rewritten in terms of growth rates, equation (4) modifies as follows:

(6) $$h_t = (t/5)\alpha\Delta S \text{ ,}$$

where ΔS stands for the expected annual increase in statistical life expectancy, α is the fraction of this increase to be spent in good health, and the multiplier $t/5$ arises because we look at the cumulative shift in the period of t years over 5-year categories.

Both parameters ΔS and α can be estimated from historic trends in population dynamics. Figure 3.2, which is based on the data from Statistics Netherlands (2009), shows the development in life expectancy in the Netherlands over the last three decades and highlights the sharp increase in life expectancy in this period for both men and women. According to this data, the life expectancy at birth has increased between 1980 and 2008 by 5.8 years for men, and 3.1 year for women, thus by at least 0.1 year per year on average. Do people enjoy these extra years of life in good health or in poor health? The life expectancy without physical limitations has increased as well. The increase between 1983 and 2008 was 5.3 years for men and 5.9 years for women. However, other indicators show more modest improvements. In particular, life expectancy in good health has increased over the period by about 4 year for men, but for women no improvement was reported. Based on these partly conflicting data, it seems reasonable to assume that, on average, at least a half of the overall life expectancy increase corresponds to a healthier life. Therefore, $\alpha\Delta S$=0.5 × 0.1=0.05, resulting in h_t =0.01t. Since the profile of healthcare expenses (see Figure 3.1) is very stable for the ages up to 30 and 40 and only then starts increasing, we assume this shift is applied starting from the age category 40-45 (i.e. for $l \geq 9$).

Figure 3.2 **Life expectancy 1980-2008**



Source: Statistics Netherlands (2009).

3.4 Government policy and health expenditure trends in 2001-2010

The historic reference period, 2001-2008, was a period of economic growth, which was also characterized by the rapid growth of health expenditures in the Netherlands. The net public health expenditures grew by 7% per year. Corrected for GDP-price inflation and accounting for budgetary expansions in this period, the trend in real growth was 4¼% per year, exceeding the growth from the earlier two decades, 1980-2000, by 1½% per year. (See Figure 4.1 in section 4.) The increase was also greater than one would expect based on the real GDP growth and the aging trend.

Table 3.1 shows the decomposition of the real health expenditure growth in the reference period into the four determinants. As one can see, next to the population aging, also government policies have pushed the growth of expenses on long-term care. This started with the budgetary expansion to guarantee the right to receive care, which helped improve access to care and reduced waiting lists in 2001-2003. Then in 2003, the patients in the long-term care sector received the right to demand supportive and activating assistance - a measure that has turned out to be much more expensive than expected initially. Finally, the health sector reorganization of 2008, concerning the transfer of psychiatric care from the care sector to the cure sector, has resulted in the increased number of treatments, and thus in the cost increase. (Mot, 2010.)

Several cost-containing policies were carried out in this period as well, notably, policy measures improving cost-effectiveness of medicine prescriptions; the reduction of the coverage in the standard insurance package; the introduction of compulsory 'no claim' in health insurance (which was later changed into compulsory co-payments for certain healthcare services); and the partial revoke of the right of long-term-care patients to demand supportive and activating assistance that was introduced in 2003. Yet, these policies did not offset the healthcare cost increase. While most expansionary measures occurred in the care sector, most cost-containment measures were in the cure sector, which on average resulted in a slightly expansionary budgetary policy. (See Table 3.1.) Note that the residual term $\hat{G}_t$, also shown in this table, was the major contributor to the overall growth of the real health expenditures. Therefore, the population aging and expansionary policy were not the major cost drivers increasing the expenditures in the health sector. The residual growth was especially high in the cure sector, possibly due to the larger scope for medical innovations in this part of the health sector.

In contrast to the reference period, the current period (2009-2010) was marked by the big recession, and therefore, accompanied by considerable cuts in public healthcare spending. Nonetheless, the employment growth in the healthcare sector accelerated in this period to more than 3% annually, while macro-economic employment declined, therefore, the health expenditure share in GDP rose sharply from 8.3% in 2008 to 9.2% in 2010. (See Figure 4.1.)

Table 3.1 **Decomposition of annual real health expenditure growth in 2001-2008**

	$\hat{D}_t^n$	$-\hat{D}_t^h$	$\hat{B}_t$	$\hat{G}_t$	$\hat{X}_t - \hat{P}_t$
Hospitals and specialist practices	0,9	-0,1	0,3	3,3	4,4
GP, dentists, paramedics	0,7	-0,1	-0,9	3,0	2,8
Psychiatric care	0,3	0,0	2,1	3,6	6,0
Medicines and appliances	1,1	-0,1	-3,7	6,3	3,6
Other expenses on cure	0,4	0,0	-1,1	5,5	4,8
Total cure sector	**0,9**	**-0,1**	**-0,4**	**3,9**	**4,3**
Nursing	1,9	-0,6	0,1	2,1	3,6
Healthcare for handicapped	0,3	0,0	2,6	2,3	5,3
Total long-term care	**1,5**	**-0,4**	**0,9**	**2,5**	**4,2**

The decomposition of the real health expenditure growth of the historic reference period, updated where possible with the most actual information about the current period, provides us with the estimate of sector-specific residual terms, $\hat{G}_t$, which are inputs into our forecast for the forthcoming period.

4 Medium-term forecast 2011-2015

As we have just seen in section 3.4, health expenditure growth is affected by government policy. Therefore, to make a forecast one needs to make assumptions about the scope of the government intervention in the future period. These assumptions define scenarios used in the forecast. Here we consider two scenarios. One scenario is based on the assumption that there will be no government intervention in the future (this means that the existing and already announced policies continue to be carried out). This scenario provides a reference about the existing trend in health expenditures and will be called the reference scenario.

Although the reference scenario provides useful information about the trend in real health expenditures, the assumption of no government intervention is probably unrealistic in most cases. Especially if the expected real health expenditure growth under the reference scenario turns out to be high, its accommodation within the existing public financing system may be unsustainable or unaffordable, implying the need for policy intervention. Therefore, it is useful to consider an alternative scenario that would envisage government interventions to keep the publicly-financed share of health expenditures slightly more in check. Since in the medium term, the level of real health expenditure is largely determined by its current level and income growth (Getzen, 2000), we define an alternative scenario in such a way that the growth in publicly financed health expenditures follows the expected real GDP growth, and it can exceed this path only by the effect of aging. This means that any increase above that level has to be privately financed through consumer co-payments for the use of healthcare. This would require a substantial increase in the share of expenditures financed through co-payments (from 5% in 2010 to 30% in 2015), which translates into an increase in the realized average co-payment per adult per year from 120 to 350 euros. Such an average increase can be achieved by a policy intervention that increases the compulsory co-payments per polis per year from 165 euros in 2010 to 775 euros in 2015. More detail on this scenario can be found in CPB (2010).

Figure 4.1 shows the resulting GDP share of public health expenditures under both scenarios: the reference scenario (without policy change) results in a more pronounced growth of health expenses, while the alternative scenario limits the increases to those attributed to aging and income growth.

Figure 4.1 **Net public health expenditures as % GDP**

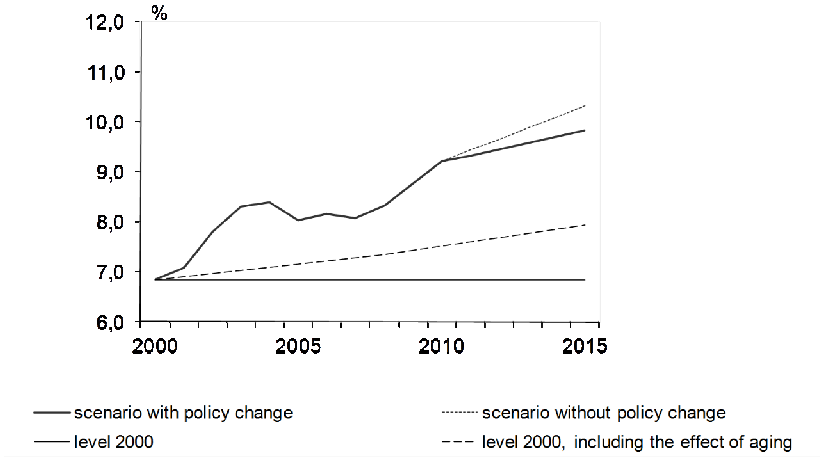


Table 4.1 shows the decomposition of the real health expenditure growth into its determinants. Similarly to Table 3.1, the first two columns correspond to the effects of population aging and epidemiological trends. The next two columns show the contribution of policy interventions, which we now split into two terms. Column $\hat{B}_t^T$ corresponds to the reference scenario and reflects the contribution from the existing policies, which have already been applied or announced by the time of the forecast and will affect future health expenditures (e.g., the policy that reduces the scope of assistance in long-term care). Column $\hat{B}_t^A$ shows the effect of policy intervention specified under the alternative scenario with the increased private co-payments. The main effect of the increase in co-payments shows in the reduced net public expenditures, however, larger co-payments also slow down the growth in consumer demand for health care, slightly reducing gross health expenditures as well.[4] Finally, the residual term has also been split into two items: column $\hat{G}_t^{HR}$ is identical to column $\hat{G}_t$ from Table 3.1 and contains the residual growth in the historic reference period 2001-2008; and column $\hat{G}^{aut}$ contains a correction based on information provided by sector specialists.

Table 4.1 **Decomposition of the forecasted annual real health expenditure growth in 2011-2015**

	$\hat{D}_t^n$	$-\hat{D}_t^h$	$\hat{B}_t^T$	$\hat{B}_t^A$	$\hat{G}_t^{HR}$	$\hat{G}^{aut}$	$\hat{X}_t - \hat{P}_t$
Hospitals and specialist practices	1,1	-0,1	-0,2	-0,1	3,3	0,1	3,9
GP, dentists, paramedics	0,7	-0,1	0,0	-0,4	3,0	0,2	3,5
Psychiatric care	0,3	0,0	0,0	-0,1	3,6	0,1	3,8

[4] See Newhouse and Sinaiko (2010) for more detail on effects of co-payments.

Medicines and appliances	1,2	-0,1	0,0	-0,7	6,3	0,5	7,0
Other expenses on cure	0,5	0,0	0,0	-0,4	5,5	0,2	5,8
Total cure sector	**1,0**	**-0,1**	**-0,1**	**-0,3**	**4,0**	**0,2**	**4,6**
Nursing	2,6	-0,5	-0,1	-0,2	2,1	0,1	3,9
Healthcare for handicapped	0,3	0,0	-0,1	0,0	2,3	0,0	2,6
Total long-term care	**1,8**	**-0,3**	**-0,1**	**-0,1**	**2,2**	**0,1**	**3,5**
Gross public health expenditures (a)	**1,2**	**-0,2**	**-0,1**	**-0,3**	**3,3**	**0,1**	**4,0**
(Minus) Co-payments	0	0	0	0	20,3	0	20,3
Net public health expenditures (b)	**1,3**	**-0,2**	**-0,1**	**0,0**	**2,0**	**0,1**	**3,0**

(a) Gross public health expenditures include expenditures on cure, long-term care, and also healthcare services provided by the municipalities.

(b) Net public health expenditures are equal to Gross public expenditures minus private co-payments.

Table 4.2 shows the final figures for the forecasted public health expenditures across sectors in the period 2011-2015. It can be seen that the largest increases in this period are to be expected in the cure sector. For keeping the growth of public spending in this sector in line with the expected GDP growth, there will be a need for consumer contributions, for example, in the form of increased private co-payments for receiving healthcare.

Table 4.2 Public health expenditure forecast, alternative policy scenario, 2010-2015

	2010 bln euro	real growth in 2011-2015 bln euro
Hospitals and specialist practices	18,3	4
GP, dentists, paramedics	4,0	¾
Psychiatric care	4,8	1
Medicines and appliances	6,9	2¾
Other expenses on cure	1,5	½
Total cure sector	**35,5**	**9**
Nursing	14,1	3
6Healthcare for handicapped	7,1	1
Total long-term care	**21,2**	**4**
Gross public health expenditures (a)	**60,9**	**13¼**
(Minus) Co-payments	3,1	4
Net public health expenditures (b)	**57,9**	**9¼**

(a) Gross public health expenditures include expenditures on cure, long-term care, and also healthcare services provided by the municipalities.

(b) Net public health expenditures are equal to Gross public expenditures minus private co-payments.

5 Conclusions

We conclude by stressing the transparency and practicality of the methodology proposed in this paper, making it accessible for applications elsewhere. The insight into health expenditure allocation and drivers is helpful for identifying potentially important areas for budgetary and other policy interventions to improve the allocation of public budgets.

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