WIFI WORKING PAPER 4/2018

GDP, Wages, Employment, and Demography: What drives the Financing of Health Insurance? Factor Analysis of the German Statutory Health Insurance 1996–2016

Thomas Neusius

March 21, 2018

GDP, Wages, Employment, and Demography: What drives the Financing of Health Insurance? Factor Analysis of the German Statutory Health Insurance 1996–2016

Thomas Neusius*

Wiesbaden Business School

RheinMain University of Applied Sciences

Bleichstr. 44

D-65 183 Wiesbaden

March 21, 2018

Abstract: For the German statutory health insurance (SHI), the development of health spending and of the contribution relevant income is analyzed between 1996 and 2016 with respect to the relevant economic and demographic driving factors. The analysis allows identification and quantification of the main drivers of the contribution rate (CR) being the percentage of income that has to be paid as contribution to SHI. It turns out that the most dominant driver for an increasing CR is the aging of the insureds. Additionally, the growing employment also had a pushing effect on the CR as the number of contribution paying SHI members did not grow in equal measure. Only a moderate contribution can be ascribed to the reduced growth of the contribution relevant income.

Kurzzusammenfassung: Die Entwicklung von Leistungsausgaben der GKV und von

*T.N. thanks M. Werding, B. Kuhn, S. Schäfer for comments and helpful discussions.

Einkommen der Mitglieder wird im Zeitverlauf für die Jahre 1996 bis 2016 nach volkswirtschaftlichen und demographischen Einflüssen zerlegt. Dadurch kann identifiziert und quantifiziert werden, welche Effekte verantwortlich waren für die Entwicklung des Beitragssatz der GKV. Es zeigt sich, dass im Zeitraum 1996 bis 2016 v.a. demographische Veränderungen zu einem Anstieg der Leistungsausgaben geführt haben. Ein kleinerer Teil der Beitragssatzdynamik ist dem Absinken der Lohnquote am BIP geschuldet, was die These von einer strukturellen Einnahmeschwäche der GKV relativiert. Ein weiterer beitragssatzsteigernder Effekt ist die trotz ansteigender Erwerbstätigenquote nur langsam steigende Zahl beitragspflichtiger Mitglieder.

Keywords: demography; health insurance; medical inflation; health expenditure

JEL classifications: I13,I15,J11,H51

1 Introduction: The financing of the German statutory health insurance

The German statutory health insurance (SHI) is financed in a collective pay-as-you-go system (BUSSE und BLÜMEL 2014; BUSSE u. a. 2017). Contributions[1] are raised as a percentage of individual gross wages, the corresponding *contribution rate* (CR) being the central parameter of financing. Those who pay contributions are called members of SHI, while non-earning dependents of SHI members are covered without being additionally charged.

In recent years, the prosperous German economy outshines the fact that the financing of the SHI faces substantial challenges in the years to come. The demographic development of Germany with an aging population will harm the sustainability of the SHI's funding.

The aging process is present for at least four to five decades, but its impact on the collective pay-as-you-go system will increase as soon as the baby boomer generation reaches retirement age. Obviously, demographic aging puts the SHI under pressure in a two-fold way, as it increases the need for medical services and reduces the labor force, which essentially generates the funding.

The present article addresses the claim that the SHI financing has primarily a problem with collecting sufficient contributions, rather than being challenged by expenditures rising too quickly. More precisely, it was stated that the health expenditures rose in a similar fashion as the gross domestic product (GDP), while the growth of the contribution relevant income (CRI) was slower. Called *structural contribution weakness* (strukturelle Einnahmeschwäche), this judgment has been uttered repeatedly (ALBRECHT u. a. 2013; ROTHGANG 2009; STRAUB 2006; IAQ 2017).

In the following, the *structural contribution weakness* shall be scrutinized. The key economic figures in the period from 1996 to 2016 will be analyzed and decomposed in various factors, like e.g. the demographic effect, the development of the number of SHI members and GDP-related growth. For this purpose, all quantities are adjusted for price on the basis of the consumer price index (VGR PREISINDEX 2018).

[1] In the context of SHI the term *contribution* is used rather than *premium*. This emphasizes the fact that the contribution is not based on the equivalence principle and not on pricing of individual risk, as is the case in private insurance policies.

2 Methods: Decomposition of factors influencing contributions and health spending

The present analysis takes a simple approach: how do contributions and how does SHI spending develop relative to the GDP? In case the total CRI grew with the same rate as the total expenditures, the CR could be held stable in the collective pay-as-you-go system.

Starting with age- and sex-specific[2] per-capita claims, referred to as $K_t(x)$ and derived from statistical observations, the overall SHI spending can be obtained knowing the age and sex structure of the people insured in the SHI. The index t indicates here and in the following the year, in which the quantities were observed, while x refers to the age of the individual insured. If not stated otherwise, summations over x extend from $x = 0$ to $x = 100$.[3] The number of insureds is referred to as $n_t^I(x)$, the SHI's total health spending is

$$H_t = \sum_{x=0}^{100} n_t^I(x) \cdot K_t(x). \tag{1}$$

Relative to the number of insureds, $n_t^I = \sum_x n_t^I(x)$, the expenditure reads

$$h_t = \frac{H_t}{n_t^I} = \frac{1}{n_t^I} \sum_{x=0}^{100} n_t^I(x) \cdot K_t(x). \tag{2}$$

The contribution that has to be paid by the members to the SHI is the product of wages and CR. But in case of high income, the contribution is capped: The government defines a maximal income subject to SHI contribution, called BBG (Beitragsbemessungsgrenze). Income above the BBG threshold is not relevant for the contribution. The BBG is increased each year to compensate inflation.

The total CRI in year t, which consists of wages and pensions below the BBG, follows from the distribution of income, $\varphi_t(x;i)$, and the BBG in the same year, BBG_t. The mean of the individual CRI for a member aged x is then

$$i_t(x) = \int_0^{BBG_t} \varphi_t(x;i) i \mathrm{d}i + BBG_t \cdot w_t^{BBG}(x), \tag{3}$$

where the fraction of members with a salary exceeding the BBG is given as

$$w_t^{BBG}(x) = \int_{BBG_t}^{\infty} \varphi_t(x;i) \mathrm{d}i \tag{4}$$

[2]To improve readability, we suppress an index specifying the sex, but all calculations are done with separate data for women and men.

[3]For people aged above 100, statistics is too scarce to obtain reliable estimates.

It follows, as the relevant basis quantity for the CR, the sum of the individual CRI

$$B_t = \sum_{x=0}^{100} n_t^M(x) \cdot i_t(x), \tag{5}$$

$n_t^M(x)$ being the number of SHI members aged x. The average CRI per SHI member is

$$b_t = \frac{I_t}{n_t^M} = \frac{1}{n_t^M} \sum_{x=0}^{100} n_t^M(x) \cdot i_t(x). \tag{6}$$

The overall CRI in year t, B_t, and the total health expenditure, H_t, are the main factors for the value of the CR, which follows approximately from the ratio of H_t and B_t. Further drivers are the tax subsidy paid to the SHI and the management of the liquidity reserve of the national health fund, which organizes the collection of contributions (GÖPFFARTH und HENKE 2013; DEUTSCHE BUNDESBANK 2014). These, and other potential drivers are not covered by the present analysis.

In the following, the development of the two quantities H_t and B_t will be decomposed into the driving factors. The temporal evolution in the time from 0 to t is characterized by growth factors f, which can directly be transformed to annual growth rates as

$$r = f^{1/t} - 1. \tag{7}$$

The macroeconomic development will strongly influence both, health spending and wages. As benchmark for macroeconomic performance, we use the per-capita GDP

$$y_t = \frac{Y_t}{n_t}, \tag{8}$$

where n_t denotes the population. As operationalization of productivity, we introduce the quantity

$$y_t^p = \frac{Y_t}{n_t^w}, \tag{9}$$

where n_t^w is the workforce.

The development of SHI health spending between 0 and t can be expressed as product of the change in the structure of the collective of insureds, the change of the macroeconomic performance and multiple other drivers, which will be collectively represented by a residual term

$$h_t = f_c \cdot f_g \cdot f_{h,res} \cdot h_0. \tag{10}$$

In the above equation (Eq. 10), the change of the collective of insureds is given as the change in the cohorts, weighted with the age-specific claims

$$f_c = \frac{n_0^I}{n_t^I} \cdot \frac{\sum_x n_t^I(x) K_t(x)}{\sum_x n_0^I(x) K_t(x)}, \tag{11}$$

the macroeconomic performance is

$$f_g = \frac{y_t}{y_0}, \tag{12}$$

and the residual factor follows to be

$$f_{h,res} = \frac{1}{f_g} \cdot \frac{\sum_x n_0^I(x) K_t(x)}{\sum_x n_0^I(x) K_0(x)}. \tag{13}$$

From the latter equation it is clear, that the residual term represents how the change in age-specific claims contributes to the development of health expenditure growth exceeding the growth of the per-capita GDP. In this context, technological innovations play a crucial role. However, other effects may come into play, like government induced changes in the benefits of SHI or lifestyle related changes in behavior and demand for medical treatments.

The temporal evolution of the averaged CRI can be expressed as the product of productivity growth, the development of the wage ratio in the GDP, changes in the age structure of SHI members and again a residual term. In the equation

$$b_t = f_{prod} \cdot f_i \cdot f_m \cdot f_{b,res} \cdot b_0, \tag{14}$$

the following factors have been used:

- the productivity growth

$$f_{prod} = \frac{y_t^p}{y_0^p}, \tag{15}$$

- the development of the wage ratio

$$f_i = \frac{W_t \cdot Y_0}{Y_t \cdot W_0}, \tag{16}$$

  where the sum of wages in the national accounts is referred to as W_t,

- the change in the SHI member structure

$$f_m = \frac{n_0^M}{n_t^M} \cdot \frac{\sum_x n_t^M(x) i_t(x)}{\sum_x n_0^M(x) i_t(x)}, \tag{17}$$

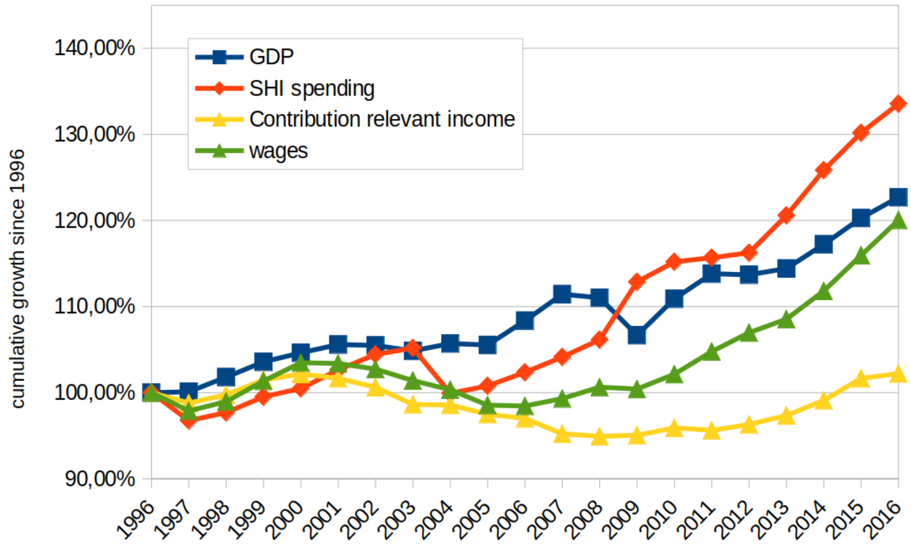

Abbildung 1: *Development of GDP, wages, SHI health spending and total contribution relevant income (CRI). Indexed to 1996, price adjusted with consumer price index. Source:* VGR BIP *2018;* VGR INLANDSPRODUKT *2017;* VGR PREISINDEX *2018;* BMG KJ1 *2016;* SCHÄTZERKREIS BEIM BVA *2017 and previous volumes.*

- and the residual term

$$f_{b,res} = \frac{1}{f_{prod} \cdot f_i} \cdot \frac{\sum_x n_0^M(x) i_t(x)}{\sum_x n_0^M(x) i_0(x)}. \tag{18}$$

The residual term covers changes in the distribution of wages, adjustments of the BBG and other effects on the time evolution of the CRI.[4]

3 Results: Empirical evidence from 1996 to 2016

3.1 Macroeconomic development

The macroeconomic performance is measured on the basis of the GDP. Inflation effects are removed by price adjustment with the consumer price index (VGR PREISINDEX 2018).

[4]People with high income may be entitled to switch from SHI to a private health insurance as substitution for the SHI. This may induce a reduced growth of CRI compared to the overall growth of wages.

3.2 Health expenditures of SHI

The SHI health spending, H_t, can be found in Figure 1. Health spending exhibits a remarkable drop from 2003 (136.22 bn EUR) to 2004 (131.16 bn EUR) (BMG KJ1 2016). This cutback is due to a health reform law, called SHI modernization act (GKV-Modernisierungsgesetz), which reduced or canceled various benefits previously provided by SHI. However, the law induced health service providers to prepone some treatments, such that the effect appears stronger than appropriate (DEUTSCHE BUNDESBANK 2004).

The decomposition of the health expenditure per capita, h_t, according to Eq. (10), identified three driving factors,

- growth effect f_g,
- collective effect, i.e., the change of the collective of insureds, f_c, and
- residual effect $f_{h,res}$.

The growth effect can easily be calculated with publicly available data. The calculation of the other two effects can be done on the basis of data describing the age and sex structure of the insureds and the age and sex specific average claims of SHI. Such data are provided by the German Federal Insurance Agency (Bundesversicherungsamt), which is not only the regulating authority for the nation wide operating[5] sickness funds acting as SHI providers. The Federal Insurance Agency also organizes the risk adjustment scheme (Risikostrukturausgleich, RSA), according to which the centrally collected contributions of SHI members are redistributed to the sickness funds.

The collective of insureds, as obtained from the RSA data (BVA 2017) are consistent with the statistics of the insureds, published independently by the German federal ministry of health (Bundesministerium für Gesundheit) (BMG KM1 2016). In contrast, the claims data obtained in the RSA, (BVA 2017), do not allow for every year to deduce the entire SHI health spending, as reported separately (BMG KJ1 2016). This impairs the direct calculation of $f_{h,res}$, while the calculation of f_c is based only on the age and sex specific claims of the final year. In particular for the entire period from 1996 to 2016, the claims of 2016 enter the calculation; in 2016 the claims data are consistent with the overall SHI spending, a figure available also from (BMG KJ1 2016).

[5] Some sickness funds operate just regionally. These are supervised by the federal states (Bundesländer).

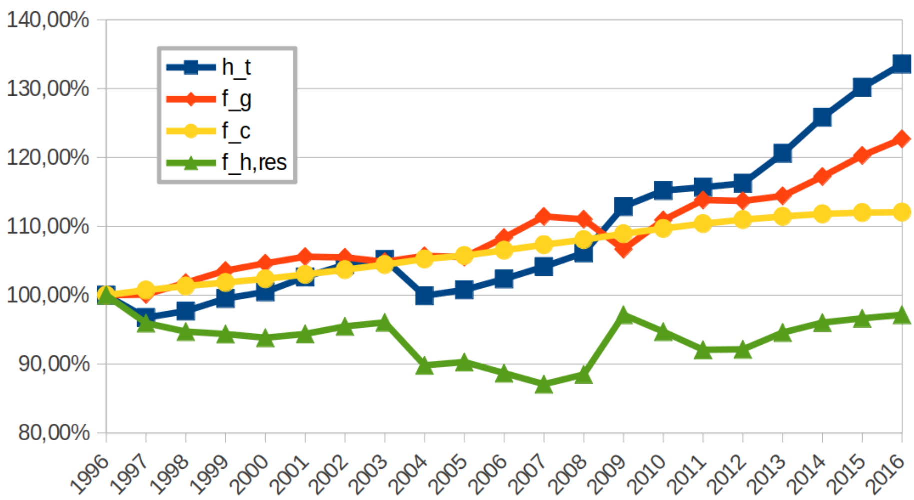

Abbildung 2: *Decomposition of per-capita health expenditure growth, h_t, into driving factors. The growth of expenditure is mainly driven by the GDP growth f_g. A smaller, but persistent trend is the aging of the collective of insureds, f_c, which exhibits very low volatility. All remaining drivers are covered in the residual factor $f_{h,res}$. Source:* (BMG KJ1 *2016;* BMG KM6 *2016;* VGR BIP *2018;* VGR BEVÖLKERUNG *2018;* BVA *2017) and previous volumes.*

Therefore, the residual effect in the development of the health expenditure is, other than Eq. (13), obtained as

$$f_{h,res} = \frac{h_t}{f_g \cdot f_c \cdot h_0}. \tag{19}$$

The SHI's expenditures follow between 1996 and 2016 roughly the per-capita GDP (Figure 2), but the graph exhibits less fluctuation around the overall trend than is the case with the GDP. That is likely due to the fact that cyclical effects influence the health spending just moderatly. The change in the collective of insureds affects the growth of the health expenditures to a smaller amount, but steadily, as seen in f_c. This is due to the demographic aging of the collective, i.e., the fact that cohorts with higher age gain more weight in the collective: the mean age in 1996 was at 39.9 and rose to 43.9 in 2016 (BVA 2017). As more than 75% of Germany's residents are covered by SHI, these figures correlate closely with the mean age of the entire population (1996: 39.6 and 2016: 43.7, (STATISTISCHES BUNDESAMT 2016)).

By definition (see Eq. 13), $f_{h,res}$ accounts for all changes in $K_t(x)$ that go beyond the overall trend represented by f_g. Therefore, $f_{h,res}$ does not allow to differentiate between the various contributions that may affect the health expenditures in addition

Tabelle 1: *Driving factors f and average annual growth rates r for development of health expenditure between 1996 and 2016. All figures price adjusted with consumer price index. Source: See Figure 2*

	f	r
expenditure per insured h_t	133.56%	1.46%
growth effect f_g	122.69%	1.03%
collective effect f_c	112.05%	0.57%
residual effect $f_{h,res}$	97.15%	-0.14%

to f_g and f_c. In the health economics literature, the discussion about expansion effects or compression effects goes on for decades (FRIES 1980; GRUENBERG 1977; GEYER 2016). Furthermore, the SHI spending is subject to legislative interventions, as for example the SHI modernization act of 2003 and the introduction of the morbidity-based risk adjustment scheme in 2009 (DEUTSCHE BUNDESBANK 2004; DEUTSCHE BUNDESBANK 2014).

To quantify the effects of the various driving factors, also the annual growth rates can be useful (see Eq. 7). As seen in Table 1, the health expenditure grew between 1996 and 2016 on average with a rate of 1.46% every year. The trend of the GDP growth contributes 1.03% to this figure. Together[6] with the contribution of the collective, $r_c = 0\ 56\%$, there remains an effect of annually -0.14%, which is regardless of its origin subsumed as $r_{h,res}$. This does not necessarily imply the absence of other factors, like the technological change observed elsewhere (BREYER und ULRICH 2000; SMITH, NEWHOUSE und FREELAND 2009). However, the results demonstrate that such effects were balanced by other factors in the observation period.

[6]The growth factors have a multiplicative composition,

$$\frac{h_t}{h_0} = f_g \cdot f_c \cdot f_{h,res}.$$

Using Eq. (7), this can be rearranged using annual growth rates

$$1 + r_h = (1 + r_g)(1 + r_c)(1 + r_{h,res}) \approx (1 + r_g + r_c + r_{h,res}).$$

The approximation is better, the smaller the values of the growth rates are, i.e., if $r \ll 1$.

3.3 Contribution relevant income

The development of the CRI is displayed in Figure 1. Here, we try to understand the determining drivers behind. The CR follows essentially from the ratio of the expenditure H_t and the CRI B_t; hence, it is the primary parameter to secure the financing of the SHI health spending by the contributions levied.

The growth of the CRI per SHI member can be decomposed into the following driving factors, Eq. 14.

- productivity growth f_{prod},
- change in the wage ratio f_i,
- structure of SHI members f_m, and
- residual effect $f_{b,res}$.

The national accounts allow a direct calculation of productivity and wage ratio. The structure of SHI members requires data about the age structure of the SHI members, which are provided by statistics of the German federal ministry of health (BMG KM6 2016). However, age specific data about the distribution of individual CRI or at least the age specific mean of wages and pensions, $i_t(x)$ (see Eq. 3), is not publicly available. Therefore, the following analysis differentiates only between the average wage of the workforce and the average pension of retirees, that can be deduced from (SCHÄTZERKREIS BEIM BVA 2017). Again, the residual term $f_{b,res}$ is obtained indirectly

$$f_{b,res} = \frac{b_t}{f_{prod} \cdot f_i \cdot f_m \cdot b_0}. \quad (20)$$

The development of the CRI follows in the observation period from 1996 to 2016 a similar trend as the productivity, see Figure 3. Both quantities exhibit some degree of volatility and are not closely correlated on short time scales. Therefore, the coupling between productivity and CRI may appear less obvious in other observation periods.

In Figure 3, the effect of the SHI member structure is close to zero. In general, the aging of the population should reduce B_t as more people reach the retirement age. However, as wages correlate positively with age, aging has also a wage-increasing effect. Hence, the time dependency of B_t is not obvious.

These opposing effects are not appropriately covered by our analysis. That is the consequence of the very simplistic approach to the income distribution taken here. A

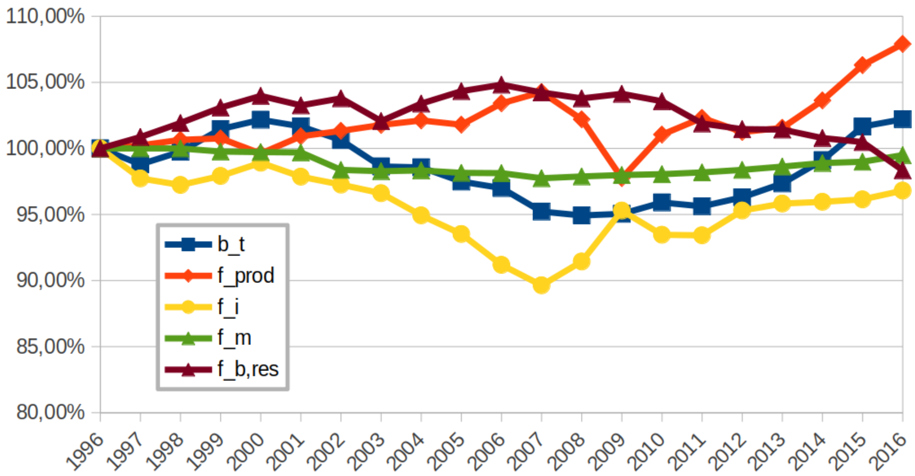

Abbildung 3: *Decomposition of the development of the contribution relevant income (CRI) per SHI member,* b_t*. Productivity,* f_{prod} *outpaced the increase of CRI. The main thwarting factor was a recession of the wage ratio,* f_i*. Small, but effectively mitigating contributions are due to the age structure of SHI members,* f_m*, and of the residual term* $f_{b,res}$*. All figures price adjusted with consumer price index. Sources:* BMG KJ1 *2016;* BMG KM6 *2016;* VGR BIP *2018;* VGR BEVÖLKERUNG *2018;* VGR INLANDSPRODUKT *2017;* SCHÄTZERKREIS BEIM BVA *2017 and previous volumes.*

Tabelle 2: *Growth factors f and annual growth rates r for the development of contribution relevant incomes (CRI) between 1996 and 2016. All figures price adjusted with consumer price index. Source: as in Figure 3.*

	f	r
CRI per member b	102.21%	0.11%
productivity growth f_{prod}	107.91%	0.38%
change in wage ratio f_i	96.81%	-0.16%
change in SHI member structure f_m	99.49%	-0.03%
residual effect $f_{b,res}$	98.35%	-0.08%

more sophisticated analysis may give further insights to the temporal evolution of the age structure of the SHI members and its consequences for the overall CRI.

Overall, the annual growth rate of the SHI health spending between 1996 and 2016, $r_h = 1\ 45\%$ can be attributed in large parts to the per capita GDP growth ($r_g = 1\ 03\%$). In addition, the demographic aging of the collective of insureds contributes a trend of annually $r_c = 0\ 56\%$ to the increasing expenditure.

The growth of the CRI per SHI member, annually $r_b = 0\ 11\%$ between 1996 and 2016, was substantially lower than that of the expenditures. This is a consequence of the GDP outpacing productivity growth, as between 1996 and 2016 the unemployment in Germany was reduced: the workforce grew quicker than the population such that the growth of the GDP per employed stayed behind the growth of the GDP per resident. The effect was intensified by a shrinking wage ratio, even if the effect was rather small with $r_i = -0\ 16\%$. Other effects subsumed in $f_{b,res}$ compensated each other.

3.4 Impact on the SHI contribution rate

The development of the expenditure h_t and of the CRI b_t influences strongly the value of the CR. In practice, additional parameters come into play, such as administration costs, tax subsidies, certain contributions not based on individual income, and management parameters allowing the steering of the CR using reserves of the national health fund (Gesundheitsfonds) held to assure liquidity. Furthermore, the CR is not uniform across the sickness funds. In addition to the unique level of 14.6% every sickness fund is entitled to levy a surcharge which increases the 14.6% to a higher level, according

Tabelle 3: *Contribution relevant income (CRI), SHI health spending, SHI contribution rate (CR) c_t, and required CR as in Eq. (21) between 1996 and 2016. Source:* BMG KJ1 *(2016) and previous volumes.*

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
CRI B_t [bn EUR]	889.07	895.43	904.79	930.68	951.58	964.59	967.88	955.14	967.59	967.64	978.22
health spending H_t [bn EUR]	120.88	118.29	120.12	123.21	125.94	130.63	134.33	136.22	131.16	134.85	138.68
CR c_t	13.48%	13.58%	13.62%	13.60%	13.57%	13.58%	13.98%	14.30%	14.20%	14.20%	14.20%
required CR $\hat{c}_t$	13.60%	13.21%	13.28%	13.24%	13.23%	13.54%	13.88%	14.26%	13.56%	13.94%	14.18%

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
CRI B_t [bn EUR]	989.06	1 018.90	1 026.31	1 049.70	1 073.35	1 112.32	1 149.89	1 194.28	1 243.42	1 293.56
health spending H_t [bn EUR]	144.43	150.9	160.4	164.96	168.74	173.15	182.75	193.63	202.05	210.36
CR c_t	14.80%	14.90%	15.20%	14.90%	15.50%	15.50%	15.50%	15.50%	15.50%	15.70%
required CR $\hat{c}_t$	14.60%	14.81%	15.63%	15.72%	15.72%	15.57%	15.89%	16.21%	16.25%	16.26%

to the economic situation of the sickness fund. This analysis is focused on the national perspective and does not address such sickness fund-specific variations. However, as the health spending and the CRI are the most important drivers of the CR, a required CR is estimated as

$$\hat{c}_t = \frac{H_t}{B_t}. \tag{21}$$

The approach allows to determine a CR, which is sufficient to cover the health spending by the sum of contributions, neglecting tax subsidies, administration costs, and other details of minor impact.

In Table 3 both, the real CR[7], c_t, and the required CR $\hat{c}_t$, are given. Until 2009, both values are relatively close, except in 2000 and 2004. From 2010 to 2016 the required CR $\hat{c}_t$ constantly exceeds the real value c_t. This is partially due to the tax subsidy from the federal budget (DEUTSCHE BUNDESBANK 2014). Furthermore, in 2014 (1.1 bn EUR) and in 2015 (2.4 bn EUR) substantial reserves have been realized. Without these effects the approximation would have been more appropriate.

Introducing the ratio of SHI members among the collective of insureds,

$$q_t^M = \frac{n_t^M}{n_t^I}, \tag{22}$$

the required CR can be rewritten as

$$\hat{c}_t = \frac{h_t}{b_t} \cdot \frac{1}{q_t^M}. \tag{23}$$

The temporal evolution of the member ratio can be characterized with the growth factor

[7] The value is the national mean value of the CRs of the various sickness funds.

$$f_M = \frac{q_t^M}{q_0^M}. \tag{24}$$

Combining Eqs. (10), (14), and (24) with Eq. (23) it follows

$$\hat{c}_t = \frac{h_0}{b_0} \cdot \frac{f_g}{f_{prod}} \cdot \frac{f_c \cdot f_{h,res}}{f_i \cdot f_m \cdot f_{b,res}} \cdot \frac{1}{q_0^M \cdot f_M} \tag{25}$$

$$= \hat{c}_0 \cdot \frac{f_g}{f_{prod}} \cdot \frac{f_c}{f_i \cdot f_M} \cdot \frac{f_{h,res}}{f_m \cdot f_{b,res}}. \tag{26}$$

The GDP growth linearly enters in the second factor in the numerator as in the denominator. Substitution of Eqs. (12) and (15) leads to

$$\frac{f_g}{f_{prod}} = \frac{y_t}{y_0} \cdot \frac{y_0^p}{y_t^p} \tag{27}$$

$$= \left(\frac{Y_t}{n_t} \cdot \frac{n_0}{Y_0}\right) \cdot \left(\frac{Y_0}{n_0^w} \frac{n_t^w}{Y_t}\right) \tag{28}$$

$$= \frac{n_0}{n_t} \cdot \frac{n_t^w}{n_0^w}. \tag{29}$$

With the employment ratio $q_t^w = n_t^w / n_t$ the above expression simplifies

$$\frac{f_g}{f_{prod}} = \frac{q_t^w}{q_0^w} = f_w. \tag{30}$$

It becomes obvious that the required CR according to the approximation of Eq. (21) is independent of the GDP evolution. The required CR is expressed as

$$\hat{c}_t = \hat{c}_0 \cdot \frac{f_w}{f_M} \cdot \frac{f_c}{f_i} \cdot \frac{f_{h,res}}{f_m \cdot f_{b,res}}. \tag{31}$$

Approximately[8], the average annual growth rate of the CR, r_{cr}, is given as

$$r_{cr} \approx r_w - r_M + r_c - r_i + r_{h,res} - r_m - r_{b,res}. \tag{32}$$

The values in Table 4 are consistent with the approximative Eq. (32).

The required CR $\hat{c}_t$ grew annually by 0.90% between 1996 and 2016, see Table 4. The development of the required CR is affected by four complexes.

1. The combination of the employment ratio growth and the member ratio growth.
   An increase of the member ratio mitigates the required CR. The annual effect

[8] Again, for $r \ll 1$ the linear approximation

$$\frac{1}{f} = \frac{1}{1+r} \approx 1 - r.$$

holds.

Tabelle 4: *Growth factors f and average annual growth rates r between 1996 and 2016 driving the required contribution rate (CR), $\hat{c}_t$. In the right column, the sign of r in Eq. 32 is given, as this may reverse the influence on $\hat{c}_t$. Employment ratio f_w and member ratio f_M strongly influence each other and should be combined. The collective effect is $0\ 20\%$ contribution to the annual growth of $\hat{c}_t$. Most influential driver was f_c, with a contribution of $0\ 56\%$. Third ranks the recession of the wage ratio f_i, pushing $\hat{c}_t$ annually by $0\ 61\%$. Remaining residual effects cancel out each other. Source:* BMG KJ1 *2016;* BMG KM6 *2016;* VGR BEVÖLKERUNG *2018;* VGR INLANDSPRODUKT *2017;* SCHÄTZERKREIS BEIM BVA *2017;* BVA *2017 and previous volumes.*

	f	r	sign in Eq. (32)
required CR $\hat{c}_t$	119.61%	0.90%	
employment ratio f_w	113.70%	0.64%	$+$
member ratio f_M	109.25%	0.44%	$-$
collective of insureds f_c	111.87%	0.56%	$+$
wage ratio f_i	96.81%	-0.16%	$-$
residual effect (health expenditure) $f_{h,res}$	97.31%	-0.14%	$+$
member structure f_m	99.49%	-0.03%	$-$
residual effect (CRI) $f_{b,res}$	98.35%	-0.08%	$-$

an the required CR is -0.44%. In contrast, an increasing employment rate has the opposite effect: it pushes, *ceteris paribus*, the required CR (effect on $\hat{c}_t$ here: 0.64%). Only if the increasing employment comes along with an at least equally growing member ratio, the net effect becomes non-negative.[9] Between 1996 and 2016 the net effect turns out to increase the required CR, with an annual contribution of 0.20%.

2. The growth factor f_c represents the change in health spending which is due to a changing structure in the age profile of the collective of insureds. Primarily demographic trends leading to a higher demand of health services are responsible for an annual contribution of 0.56% to the increase of the required CR.

3. The growth factor f_i accounts for changes in the wage ratio. It has an increasing

[9]Typically, unemployed SHI insureds remain in the status of SHI member, as the social security pays a contribution. Only if unemployed people depend economically on other family members being SHI members, they are covered free of charge. Therefore, an increasing employment ratio does not necessarily increase the SHI member ratio.

impact on the required CR and contributes annually with 0.16%. This effect is the most appropriate candidate for the claim of a *structural contribution weakness*.

4. In the present analysis, all remaining drivers were found to be relatively small, effectively. A more sophisticated analysis may allow further understanding of the change in the member structure, f_m, or the two residual terms $f_{b,res}$ and $f_{h,res}$. The combined contribution of these three effects is an annual growth rate of -0.03%, i.e., a small but qualitatively mitigating contribution to the required CR.

   However, various analyses support the assumption, that in the long run medical innovation is an important driver for health spending (BREYER und ULRICH 2000; APPLEBY 2013; SMITH, NEWHOUSE und FREELAND 2009; BRATAN und WYDRA 2013). It is unclear but questionable whether other effects will compensate for that effect, as was the case in the years from 1996 to 2016.

The illustration of the *structural contribution weakness* from (IAQ 2017) exhibits a divergence of the CRI per member and the health spending per member, where the spending per member is correlated with the total [!] GDP. Obviously, the synopsis of theses inherently diverse quantities is misleading. What appears in the illustration as straightforward evidence of the structural contribution weakness turns out to be the rather small effect f_i, due to a recession of the wage ratio.

4 Conclusion

The analysis of macroeconomic trends, the age structure of the SHI members and insureds, and the SHI health spending allowed to identify a set of driving factors that ultimately are reflected in the SHI contribution rate. In the observation period 1996 to 2016, the dominant effect leading to a higher contribution rate was demographic aging, pushing the SHI spending, and increasing the CR by 0.56% every year of the observation period. Another effect was the slower increase of the SHI member ratio compared to the growth of employment, which had an annual impact of 0.20%. With 0.16% annual contribution to CR growth, the recession of the wage ratio ranks third among the drivers of required CR – the effect that comes closest to what was identified as *structural contribution weakness*.

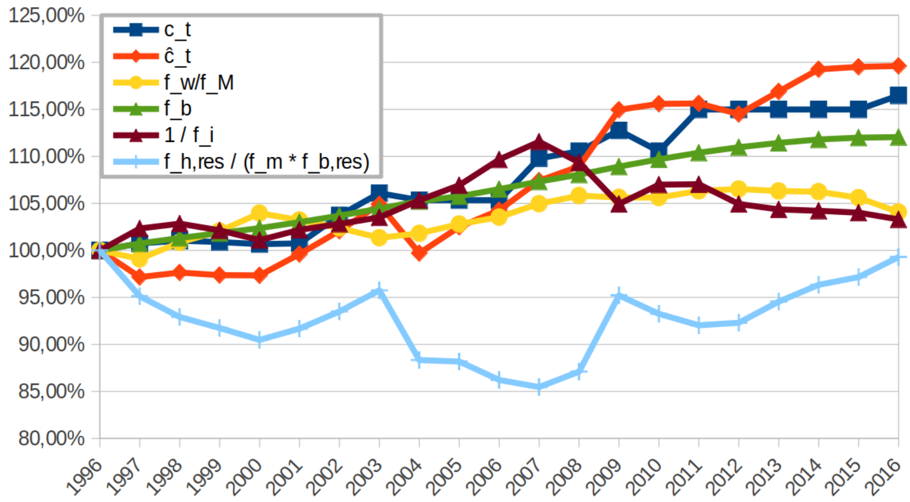

Abbildung 4: *Decomposition of development of the required contribution rate (CR) into growth factors. See caption of Table 4 for details. Source: as in Table 4.*

All remaining influences cancel out each other between 1996 and 2016. The claim that the financing of the SHI has primarily a problem with insufficiently growing contributions appears as an exaggeration if compared to the demographic aging.

Literatur

ALBRECHT, Martin, Monike SANDER, Guido SCHIFFHORST, Stefan LOOS, Jurriaan ANIJS und Bert RÜRUP (2013), *Gerecht, nachhaltig, effizient. Studie zur Finanzierung einer integrierten Krankenversicherung. Zusammenfassung der Ergebnisse*, Bertelsmann Stiftung.

APPLEBY, John (2013), *Spending on health and social care over the next 50 years. Why think long term?*, London: The King's Fund.

BMG KJ1 (2016), *Gesetzliche Krankenversicherung. Endgültige Rechnungsergebnisse 2016*, online verfügbar unter: https://www.bundesgesundheitsministerium.de/fileadmin/Dateien/3_Downloads/Statistiken/GKV/Finanzergebnisse/KJ1_2016.pdf (zuletzt besucht am 20.02.2018).

BMG KM1 (2016), *Gesetzliche Krankenversicherung. Mitglieder, mitversicherte Angehörige und Krankenstand. Jahresdurchschnitt 2016*, online verfügbar unter: https://www.bundesgesundheitsministerium.de/fileadmin/Dateien/3_Downloads/Statistiken/GKV/Mitglieder_Versicherte/KM1_JD_2016.pdf (zuletzt besucht am 20.02.2018).

BMG KM6 (2016), *Statistik über Versicherte, gegliedert nach Status, Alter, Wohnort und Kassenart (Stichtag: 1. Juli des jeweiligen Jahres)*, online verfügbar unter: https://www.bundesgesundheitsministerium.de/fileadmin/Dateien/3_Downloads/Statistiken/GKV/Mitglieder_Versicherte/KM6_2016.xls (zuletzt besucht am 20.02.2018).

BRATAN, Tanja und Sven WYDRA (2013), *Technischer Fortschritt im Gesundheitswesen: Quelle für Kostensteigerungen oder Chance für Kostensenkungen?*, Arbeitsbericht 157, Büro für Technikfolgenabschätzung beim Deutschen Bundestag.

BREYER, Friedrich und Volker ULRICH (2000), Gesundheitsausgaben, Alter und medizinischer Fortschritt: Eine Regressionsanalyse, in: *Jahrbücher für Nationalökonomie und Statistik*, **220**(1), S. 1–17.

BUSSE, Reinhard und Miriam BLÜMEL (2014), Germany: health system review, in: *Health systems in transition*, **16**(2), S. 1–296.

BUSSE, Reinhard, Miriam BLÜMEL, Franz KNIEPS und Till BÄRNIGHAUSEN (2017), Statutory health insurance in Germany: a health system shaped by 135 years of solidarity, self-governance, and competition, in: *The Lancet*, **390**(10097), S. 882–897, DOI: 10.1016/S0140-6736(17)31280-1.

BVA (2017), *GKV-Ausgabenprofile nach Alter, Geschlecht und Hauptleistungsbereichen, 1996-2016 (Stand: 19.12.2017)*, online verfügbar unter: http://www.bundesversicherungsamt.de/fileadmin/redaktion/Risikostrukturausgleich/Info-Dateien%20und%20Auswertungen/GKV_Altersausgabenprofile_1996-2016.xlsx (zuletzt besucht am 12.01.2018).

DEUTSCHE BUNDESBANK (2004), Financial development and outlook of the public health insurance scheme, in: *Monthly Report*, **56**(7), S. 15–31.

— (2014), Germany's statutory health insurance scheme: past developments and future challenges, in: *Monthly Report*, **66**(7), S. 29–50.

FRIES, James F. (1980), Aging, Natural Death, and the Compression of Morbidity, in: *New England J. Med.* **303**(3), S. 130–135.

GEYER, Siegfried (2016), Morbidity compression: a promising and well-established concept?, in: *International Journal of Public Health*, **61**(7), S. 727–728, DOI: 10.1007/s00038-016-0853-5.

GÖPFFARTH, Dirk und Klaus-Dirk HENKE (2013), The German Central Health Fund. Recent developments in health care financing in Germany, in: *Health Policy*, **109**(3), S. 246–252, DOI: 10.1016/j.healthpol.2012.11.001.

GRUENBERG, Ernest M. (1977), The failures of success, in: *Milbank Q.* **55**(1), S. 3–24, DOI: 10.1111/j.1468-0009.2005.00400.x.

IAQ (2017), *Entwicklung von BIP, GKV-Ausgaben und beitragspflichtigem Einkommen 1995 - 2016*, Kommentierte Infografik, online verfügbar unter: http://www.sozialpolitik-aktuell.de/tl_files/sozialpolitik-aktuell/_Politikfelder/Gesundheitswesen/Datensammlung/PDF-Dateien/abbVI52.pdf (zuletzt besucht am 21.02.2018).

ROTHGANG, Heinz (2009), *Finanzierung von Kranken- und Pflegeversicherung nach dem Koalititonsvertrag – eine erste Einschätzung*, Folien zum Vortrag im Rahmen des Gesundheitspolitischen Kolloquiums zu aktuellen Vorschlägen zur Finanzierung des Gesundheitswesens am 25. November 2009 in Bremen.

SCHÄTZERKREIS BEIM BVA, Hrsg. (2017), *Schätztableau des GKV-Schätzerkreises, Schätzung vom 12. Oktober 2017. Stand: 13.10.2017*, online verfügbar unter: https://www.bundesversicherungsamt.de/fileadmin/redaktion/Risikostrukturausgleich/Schaetzerkreis/20171013_Schaetztableau_2018_BMG_BVA.pdf (zuletzt besucht am 18.02.2018).

SMITH, Sheila, Joseph P. NEWHOUSE und Mark S. FREELAND (2009), Income, Insurance, And Technology: Why Does Health Spending Outpace Economic Growth?, in: *Health Affairs*, **28**(5), S. 1276–1284, DOI: 10.1377/hlthaff.28.5.1276.

STATISTISCHES BUNDESAMT (2016), *Population: Germany, reference date, age*, online verfügbar unter: https://www-genesis.destatis.de/genesis/online (zuletzt besucht am 20.03.2018).

STRAUB, C. (2006), Gesundheitsökonomie als Ansatz für eine Synthese von Leistungsfähigkeit und Finanzierbarkeit der gesetzlichen Krankenversicherung, in: *Bundesgesundheitsblatt*, **49**(1), S. 73–80, DOI: 10.1007/s00103-005-1187-2.

VGR BEVÖLKERUNG (2018), *Volkswirtschaftliche Gesamtrechnung des Bundes - Bevölkerung, Erwerbstätigkeit*, Genesis 81000-0011, online verfügbar unter: https://www-genesis.destatis.de/ (zuletzt besucht am 20.02.2018).

VGR BIP (2018), *Volkswirtschaftliche Gesamtrechnung des Bundes - Bruttowertschöpfung, Bruttoinlandsprodukt*, Genesis 81000-0001, online verfügbar unter: https://www-genesis.destatis.de/ (zuletzt besucht am 18.02.2018).

VGR INLANDSPRODUKT (2017), *Fachserie 18 Reihe 1.5: Volkswirtschaftliche Gesamtrechnungen. Inlandsproduktsberechnung 2016*, online verfügbar unter: https://www.destatis.de/DE/Publikationen/Thematisch/VolkswirtschaftlicheGesamtrechnungen/Inlandsprodukt/InlandsproduktsberechnungLangeReihenXLS_2180150.xlsx (zuletzt besucht am 20.02.2018).

VGR PREISINDEX (2018), *Verbraucherpreisindex (inkl. Veränderungsraten)*, Genesis 61111-0001, online verfügbar unter: https://www-genesis.destatis.de/ (zuletzt besucht am 20.02.2018).