

The Role of Premium Calculation in the Stability of Private Insurance Companies: The Case of Germany

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Abstract

One of the most crucial components of a country's social security system is health insurance. Positive developments of health sector enable the opportunity to receive high quality service. In order to offer these services it is essential to deal with the premium calculation subject seriously. Moreover, the accuracy of these calculations provides the longevity of insurance companies and the lack of gap between their incomes and expenses. In this article insurance premium calculation in the private health sector in the Germany case was investigated. After giving detailed information on the health sector, the relation between the net premium and the principle of equality had been examined and the net premium was obtained. Then by examining the constituting elements, the gross premium was calculated. Consequently to control the risks that may occur in the following years, the importance of reserve accumulation for old ages was emphasized. By premium calculations, the necessity of covering the probable benefits with the total premium and reserves was observed.

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1 Introduction

Health insurance is one of the most important issues among the social security system of a country. Citizens of a country are directly affected from the political decisions taken in the health insurance field [1]. For this reason, people are interested in the issues like

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premium adjustment and limitations of benefits in the health system. In order to avoid the unnecessary growth of health budget, politicians have been legislating numerous laws and reform proposals for years. As can be seen in the case of the United States, reform steps in the health care system taken by presidential candidates play an important role in the election results [2]. Insured people do not want any decline in the level of health care in these proposals. This matter is also valid in the Germany case [3].

When the German health sector is examined, it is obviously seen that it consists of two outstanding elements. One of these elements is public health insurance and the other is private health insurance. In the public health insurance system premiums paid are shared between workers and employers. Premiums paid by employees are automatically deducted from their salaries. In the public health sector non-working spouse and children can benefit from the insurance services with no charge. All members of the public health insurance have to pay equal contribution according to the health care fund which has come into force since July 2009. On January 1, 2011 this rate was settled as 15.5% of gross income provided that the employer covers 7.3% and the employee meets 8.2% of the cost [4]. One of the outstanding characteristics of the German health care system is that the private health care system operates as a second health system by financing the public health care system. It should be noted that such a health system exists only in a few countries in the European Union. Similar systems are possible to be seen in the Netherlands and in Northern Ireland. Thus, the private health insurance sector in Germany is not only a major provider of medical system provider, but it has also become an important competitor of the public health sector [5].

However, the entry in the private health care system in Germany is not accessible for everyone. The Social Security Act restricts the entrance of the majority of the population in the private health sector. It is declared in the 6th clause of the 5th Book of Social Security Act that only occupational groups have the right of free choice between state and private health sector. These professional groups include civil servants, self-employed people, and people who fulfill the annual income condition [5]. According to the income issue, a German citizen needs to have a salary of 4,125 Euros or an annual income over 49,500 Euros in 2011 to be a member of the private health sector [4]. On the other hand, people who do not fulfill these requirements can only get state health coverage.

Private health insurance is known for its better and diversified medical treatments, however the public health insurance is recognized for its limited services. The most decisive reasons of requests for the transition to the private health system is the choice to gain a better service and more favourable price options. But, the existence of disadvantages in the private health insurance should not be ignored only by taking into account those two positive aspects. That is to say, transition from the private health system to the public system is possible under certain conditions. Therefore, main criteria should be carefully reviewed. For a married person public health system is cheaper than the private one. A married person needs to pay for him/herself and his/her spouse separately in the private health system. Increase in premium, marital status, and retirement ages of citizens are the key elements in deciding between the public or private health insurance systems [5].

2 Health Sector

In the Private Health Insurance Association in Germany there were registered 43 members in December 2010. The requirements for becoming a member of this Association are that the insurance company needs to operate within the borders of Germany and it is necessary that this company is approved by Federal Financial Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht) or National Audit Institution (Landesaufsichtsbehörde) [6].

In 2011, the population of Germany was 81.8 million [7] where there were nearly 41 million private health insurance policies purchased at the end of June 2011 [6]. This figure does not contain other classes of insurance like life, automobile, earthquake, fire, etc. In Turkey, the number of private health insurance policies sold until June 2011 was only 1.073.967 [8]. Comparing these two countries it stands out that both private health sectors have big differences.

Table 1: Types of additional insurance in the German health insurance sector [6]

Types of additional private health insurance	Provided services
Additional insurance for publicly insured: 1. Dental 2. Ambulant 3. Hospital stay	1. Particularly expensive dentures, dental implants, teeth cleaning and fillings ² 2. Alternative medicine and coverage of its drug costs, supply of eye-related needs such as glasses and lens 3. Single or twin room accommodation, selection of specialist doctors [9]
Additional insurance for privately insured: 1. Daily sickness benefits insurance 2. Hospital daily benefits 3. Nursing care insurance ³	1. Designed to prevent loss of income in case of sickness 2. For each day in hospital the insured person is paid the amount for everyday agreed in insurance contract. 3. In order to meet the costs which result from the supply gap in the public insurance concerning nursing care.

Table 1 shows the existing types of supplementary insurance in the German health insurance sector. Publicly insured people with medium and high income can improve the quality of health care coverage in the following years by acquiring a supplementary insurance. So that, in addition to the existing limited public insurance coverage other extra dental, ambulant, and stationary optional services can be purchased. Moreover, private insured people can also benefit from additional insurance services due to their sufficient financial opportunities. Daily sickness benefits insurance and hospital daily benefits are the most important insurance types in additional insurances. For example, in daily

²If a person wants to get these services as public insured, then he/she has to cover majority of the costs. These major costs can be decreased with an additional private insurance.

³Additional nursing care insurance is presented as two types of products. First of these types is daily nursing care allowance and the second is the nurse care fees insurance.

sickness benefits insurance people benefit from the daily charge individually agreed in their contracts. Furthermore, in order to prevent the income loss that occurs as a consequence of the hospital stay people make an extra insurance. An additional insurance is also possible to increase the nursing care insurance coverage.

Table 2: The number of the insured people in the private health insurance [6]

The number of the insured according to the type of the insurance:	December 31, 2010	June 30, 2011	The rate of change (%)
Comprehensive health insurance	8.895.500	8.949.500	+0,61
Nursing care insurance	9.593.000	9.653.500	+0,63
Additional insurances:	21.969.400	22.088.100	+0,54
● Ambulant treatment insurance	7.443.200	7.567.500	+1,67
● Insurance for optional service selection in hospital ⁴	5.643.500	5.644.100	+0,01
● Teeth insurance	12.192.100	12.871.800	+5,57
● etc.			

In Table 2 the number of insured people according to the type of insurance in the private health insurance sector is presented. The comprehensive health insurance was purchased by nearly 9 million people in December 2010. The largest number of insured people is in the type of additional insurances. This high figure can be related to the restrictions in the public health insurance. Additional insurances offered by private health institutions to the market are purchased by citizens in order to reduce the risk loads occurring in the following years. Public health insurance usually covers dental treatment, for example, if a filling is needed to be done the public health insurance covers only gold colored dental filling which is not pleasant-looking and unhealthy. However, having an additional insurance enables to have a pleasant looking and better quality filling without causing big expenses for the insured person. The Association of Private Health Insurance relates the increase in the number of additional insurance to two reasons. First of all, narrowing the scope of services offered by the public insurance companies causes people to acquire additional insurance. Secondly, the cooperation between public and private insurance companies is possible after the Modernization Law came into effect in 2003. By this way, purchasing additional health insurance has been made easier. The important thing to be noticed is that the additional insurance does not cover the services offered by complete private health insurance [10].

⁴It is a type of additional insurance which is designed for using various services in hospital. For example, patient can want to be treated by specialist doctor, Professor or want to stay in a one bedded room.

Table 3: Premiums obtained in the private health insurance sector [6]

Premiums based on the type of the insurance	2010 (Mill. Euro)	First half of 2011 (Mill. Euro)
Complete private health insurance	24.072,1	12.730
Nursing care insurance	2.096	1.070
Additional insurances:	6.406,4	3.350
• Additional protection to the public insurance	4.338,2	2.270
• Daily sickness benefits insurance	1.018,8	530
• etc.		
Insurance for special cases	695,8	350
Total	33.270,3	17.500

In Table 3, the total revenue of 17.5 billion Euro in the first six months of 2011 in the German private health sector is shown. Forecasts suggested that this figure would reach 34.9 billion Euro at the end of 2011 [6]. In contrast, in the Turkish health sector this figure was observed to be 869,590,827 TL on the basis of the sales channel in June 2011 [11]. Private health sector in Germany had a market size of almost 35 billion Euros in that year, while in Turkey this sector did not even reach 1 billion Lira.

Table 4: Insurance benefits payments made by private health insurance companies (Insurance expertise expenses included) [6]

	2010 (Mill. Euro)	First half of 2011 (Mill. Euro)
Health insurance	21.216,7	11.180
Nursing care insurance	698,8	380
Total	21.915,5	11.560

In Table 4 the amount of benefits paid by the private health insurances for the insured people are presented. Comparing Tables 3 and 4, it is recognized that premiums obtained in the private health sector exceeded the insurance benefits costs for 2010. The same fact is repeated in the first half of 2011. This situation clearly demonstrates that private health insurance companies operate profitably.

Furthermore, the financial resources of the private health sector are described in Table 5. Outstanding issue is that besides to the large amounts of premium revenue, other financial resources like investment income and the sum taken from the reserves for premium refund also take an underestimated dimension.

Table 5: Financial resources in 2010 [6]

		Mill. Euro
Premium income	33.250,6	
Money taken from the reserves for premium refund	2.914,6	
Investment income	7.165,6	
Total	43.330,8	

3 Net Premium and its Relation to the Principle of Equivalence

Generally at the beginning of insurance the cash flow in both directions of a homogeneous community must be equal in the calculations concerning the net present value. This two- directional cash flow is composed of the expenditures made by insurance companies for insurance benefits and premiums paid by policy holders. If policyholders in a community have the same expected risk or at least approximately equal risk, then that community is called homogenous. The community discussed in this article consists of the total number of policyholders in the insurance portfolio. The Principle of Equivalence can be described briefly as follows [12]:

$$\text{Total insurance benefits expenditures} = \text{Total obtained premium incomes}$$

Assuming the Principle of Equivalence calculation of the net premium can be shown as below [13, 14]:

- i : interest rate (%3.5 in Germany)
- $v = \frac{1}{1+i}$ discount rate
- ω : age at maturity
- x_0 : starting age of the insurance
- $x_0 + t$: age reached after t insured years
- l_{x_0+t} : remaining policyholders at the age of $x_0 + t$ after t years
- P_{x_0+t} : net premium paid at the age of $x_0 + t$
- A_{x_0+t} : net present value of insurance benefits at the age $x_0 + t$
- K_{x_0+t} : expected insurance benefits at the age $x_0 + t$

Thus, for an insurance community valid formula of the Principle of Equivalence can be expressed as follows [15, 13]:

$$\sum_{t=0}^{\omega-x_0} l_{x_0+t} \cdot P_{x_0+t} \cdot v^{x_0+t} = \sum_{t=0}^{\omega-x_0} l_{x_0+t} \cdot K_{x_0+t} \cdot v^{x_0+t}$$

Due to the demand of a fixed net premium for each age, the formula $P_{x_0+t} = P_{x_0}$ is valid. For this reason, the equation below can be applied:

$$P_{x_0} \cdot \sum_{t=0}^{\omega-x_0} l_{x_0+t} \cdot v^{x_0+t} = \sum_{t=0}^{\omega-x_0} l_{x_0+t} \cdot K_{x_0+t} \cdot v^{x_0+t}$$

By substituting $l_{x_0+t} \cdot v^{x_0+t}$ for D_{x_0+t} in this formula and multiplying both sides

by $\frac{1}{D_{x_0}}$, the net individual premium method is obtained for the community of policyholders as follows:

$$P_{x_0} \cdot \underbrace{\frac{1}{D_{x_0}} \cdot \sum_{t=0}^{\omega-x_0} D_{x_0+t}}_{a_{x_0}} = \underbrace{\frac{1}{D_{x_0}} \cdot \sum_{t=0}^{\omega-x_0} D_{x_0+t} \cdot K_{x_0+t}}_{A_{x_0}}$$

Finally, shortened way of the formula for the net premium is as follows [15, 13]:

$$P_{x_0} = \frac{A_{x_0}}{a_{x_0}} .$$

If the net premium P_x is to be reduced by an amount of P_{fix} for policyholders over 65 years which is to be equalized with an additional benefits for the insured, this situation can be expressed in a mathematical way as shown below:

$$\widehat{K}_{x_0+t} = \begin{cases} K_{x_0+t} & \forall t < 65 - x_0 \\ K_{x_0+t} + P_{fix} & \forall t \geq 65 - x_0 \end{cases}$$

and thus:

$$P_{x_0} \cdot \underbrace{\frac{1}{D_{x_0}} \sum_{t=0}^{\omega-x_0} D_{x_0+t}}_{a_{x_0}} = \underbrace{\frac{1}{D_{x_0}} \sum_{t=0}^{\omega-x_0} D_{x_0+t} \cdot \widehat{K}_{x_0+t}}_{\widehat{A}_{x_0}}$$

is to be obtained. As a result, the net premium for the insured people over 65 years is determined as follows:

$$P_{x_0} = \frac{\widehat{A}_{x_0}}{a_{x_0}}$$

4 Calculation of other Factors Constituting the Premium

In order to calculate the gross premium from the net premium, it is necessary to consider the additional costs caused by making an insurance contract, insurance management, and using reserves in hard times for security reasons. These factors are some of the components which make up the premium and all these determinants must be added to the calculation of the gross premium. These seven factors identified are discussed in details below.

Additional costs required to cover the expenses caused by company activities are the followings [13, 16]:

A. Direct costs for conclusion of a contract, α_u

These expenditures are directly related to conclusion of an insurance. Some of these are as below:

- Commissions for the conclusion of insurance contracts: fee paid to mediators
- Fixed costs: Fixed fees made for the conclusion of insurance contracts.
- Additional commissions
- Travel expenses for the conclusion of insurance contracts

- B. Indirect charges for the conclusion of insurance contracts, α_m
 - Costs for insurance contracts application procedures and insurance policy
 - General corporate costs
 - General advertisement expenses
- C. Insurance benefits management expenditures, ϱ
 - Charges caused by correspondence for insurance benefits identification
 - Costs required for expert’s report
- D. Other administrative expenses, β
- E. Costs of additional security, σ
- F. Additional expenditure for standard insurance, Ω
- G. Additional charge stipulated in law

When determining the expense, the following prerequisites must be fulfilled:

1. The identified costs through calculations have to be clearly stated. The costs actually incurred have to be equal to the expenses based on calculation.
2. Actual expenses
 - A. Costs should be associated with its cause.
 - B. Costs should be met in a short-term.
 - C. Costs must be recorded in a special way.
 - D. The accuracy of costs must be provided in a verifiable form.

5 Gross Premium Calculation

5.1 Total Costs Forming the Calculation of Gross Premium

Expenses to be added to the calculation of the gross premium are handled in four groups as follows [13].

5.1.1 Determined additional expenses proportional to premium

Additional costs determined which are proportional to premium are lasting administrative expenses β , insurance benefit management expenditures ϱ , direct costs for conclusion of a contract that are usually paid in the first year α_u , and indirect charges for the conclusion of insurance contracts α_m . Indirect expenses for concluding an insurance α_m are expected to be lower in the first year than in the second year. Another element of the cost is σ that is used for additional security. The sum of all these factors is expressed with Δ as percentage rate. This percentage rate is not dependent on beginning year of an insurance since the net premium remains constant for all insured years.

In Table 6 the percentage of additional costs’ elements are given in symbols. In some cases, the values of additional costs in the first year can differ from the values in second year.

Table 6: Components constituting the percentage rate of additional costs [13]

Factors causing additional expense	First insurance year	Second insurance year

Administrative expenses	β	β
Insurance benefit management expenditure	ϱ	ϱ
Direct costs for conclusion of a contract	α_u	-
Indirect charges for the conclusion of insurance contract	α_{m_1}	α_{m_2}
Costs of additional security	σ_1	σ_2
Total	Δ	Δ

5.1.2 Fixed additional expenses

Some of the expenditures can be handled by calculating the cost per unit. Thus, some of the additional expenses may be included to the calculations in fixed amounts. The total amount of fixed expenditures is characterized as γ . However, the calculation of fixed additional costs do not play an important role in the applications of the private health insurance nowadays [13].

5.1.3 Savings obtained from the waiting period and the risk selection

With this method of creating savings it is possible to build a certain reserve. Within the scope of health insurance the standby period is clearly defined in the insurance contract act. With the term of the standby period the time from the beginning of insurance until the starting date of using services covered by the insurance is described. In Germany the standby period is described in details in the First and Second Clauses of the 197th paragraph of the Insurance Contract Act. According the First Clause the standby period for the insurances in the types of comprehensive health insurance, daily sickness benefits insurance and hospital daily benefits would be 3 months if the standby period have been agreed by the insurance company and the insured person together. Also if a standby period has been arranged between both parties for services like birth, psychotherapy, dental treatment, dentures and orthodontics, this time should not exceed 8 months. On the other hand, the standby period for nursing care insurance should not be more than 3 years [17].

While the indirect charges for the conclusion of insurance contracts α_m , the insurance benefits management expenditures ϱ , and other administrative expenses β are added to the premium calculation as percentage rate, the direct charges for the conclusion of insurance contracts α_u should be covered fully or partially by using the risk reserves obtained in the first two years. These savings are obtained by checking through medical risk control the answers that insured person gives to health questions during the application before insurance act is signed. As a result of this health risk management process a decision has to be made regarding the insurance application if it is to be accepted or not. On the other hand, the acceptance of some applications is related to complicated special requirements such as costs for an additional risk. Insurance companies choose healthier and less risky individuals to their existing insurance portfolios using risk selection application [16].

Moreover if the standby period is set between the insurer and the insured, then the policy holder can not receive any insurance benefits before the end of the standby time which is usually 3 to 8 months. By the use of such applications, insurance companies prevent new policyholders to enter with their previous diseases. Furthermore due to obtained savings

as a result of standby period, insurance companies build capital reserves. Since savings received from risk selection and standby period are not considered in the calculation of net premium, these reserves can be used for the direct charges for the conclusion of insurance contracts α_u . These costs can be spread to the expected insurance time in the case that charges for the conclusion of insurance contracts are not adequately met (Zillmer Method) [18].

Another additional expense is the cost of additional security σ that is added to premium calculations. This factor should normally be between 5% and 10% of the gross premium.

5.2 Gross Premium

When the total additional expenses $\Delta = \alpha_u + \alpha_m + \beta + \varrho + \sigma$ are considered in gross premium calculation, the monthly gross premium calculation, b_{x_0} can be formulated as follows :

$$b_{x_0} = \frac{P_{x_0}}{12 \cdot (1 - \Delta)}$$

According to the Zillmer Method if α shows the number of monthly premiums needed to be paid to cover the amount of direct costs for conclusion of a contract α_u , then the formula can be expressed as below [18]:

$$P_{x_0}^Z = P_{x_0} + \frac{\alpha \cdot b_{x_0}^Z}{a_{x_0}} \quad (\text{Annual premium})$$

$$b_{x_0}^Z = \frac{P_{x_0}^Z}{12 \cdot (1 - \Delta)} \quad (\text{Monthly premium})$$

When this formula is calculated based on annual net premium, monthly gross premium can be written as follows:

$$b_{x_0}^Z = \frac{P_{x_0}}{12 \cdot (1 - \Delta) - \frac{\alpha}{a_{x_0}}}$$

The most important point in this formula is that fixed additional costs are not considered, i.e. additional costs in percentages. are added to monthly gross premium in the calculations.

6 Aging Reserve

Due to the investment policies pursued by the Association of the Private Health Insurance, reserves have increased. Aging reserves of total policyholders have reached

158 billion Euros at the end of 2010 by increasing 8.7%. The obtained net interest rate of 4.23% exceeded the applied interest rate of 3.5% used in the calculations [6]. In summary, private health insurance companies use the reserves that they build for their customers to meet increasing service demands of their policyholders in old age. However, in the public health insurance system reserves are not only open to the use of insured people, but also they can be used by the government [19, 20].

In order to understand the formation of aging reserve, the elements of premium paid should be examined. Premium consists of three main elements. These are savings, risk, and cost [15].

$$\text{Premium} = \text{Risk} + \text{Savings} + \text{Cost}$$

The premium calculations made it clear that expected benefits in following years must be covered with total premium income and reserves. Since the long-term goal of the premium calculation is to meet the increasing costs in old age, collected reserves plays an important role in achieving this target.

$$\text{Total Premium} + \text{Reserves} = \text{Expected insurance benefits costs}$$

Risk premium obtained for risk share depends on the age of insured person. Of course, there would be a big amount of difference between the risk premium of a 30 years insured person and 50 years old insured person. Because, a 50 years old person has a bigger risk of illness. Therefore, the risk premium of this person would be much higher. But, the net premium P_{x_0} calculated according to the Principle of Equivalence depends only on the insurance starting age x_0 of the person and it should always remain constant. The reserves formed by premium payments necessarily made in the beginning years of insurance, because of Principle of Equivalence on one hand and the net premium remaining constant in spite of rising risk premium on the other hand, are used to finance the gaps that may occur later.

Since the expected insurance benefits, i.e. estimated health care expenses K_{x_0} will increase monotonically as the age of the insured person increases, the following relation occurs [15, 13, 16]:

$$P_{x_0+t} > P_{x_0}$$

By substituting P_{x_0+t} into $\frac{A_{x_0+t}}{a_{x_0+t}}$ in the formula above, the following formula is derived:

$$A_{x_0+t} > P_{x_0} \cdot a_{x_0+t}$$

The most important point here is that the service that the policy holders will get starts after premium payments. The net present value surplus emerging at the time t is equal to

the capital accumulation which is also called as aging reserve. The net present value difference is equal to zero since the built reserve at the end of the insurance period of an individual is spent in old age. Thus, the following relation is valid [15, 13]:

$$V_{x_0, t} = A_{x_0+t} - P_{x_0} \cdot a_{x_0+t}$$

In this formula entrance of the policyholder into insurance at the age of x_0 and formation of the reserve $V_{x_0, t}$ after staying t years insured are expressed. This aging reserve formula can be illustrated with the net premiums paid [15, 13].

$$V_{x_0, t} = A_{x_0+t} - P_{x_0} \cdot a_{x_0+t} = (P_{x_0+t} - P_{x_0}) \cdot a_{x_0+t}$$

As a result, it can be said that the difference between the net premiums paid by the person who entered insurance at the age of x_0 and another person entering insurance at the age of $x_0 + t$ is equal to the savings.

$$P_{x_0} = P_{x_0+t} - \frac{V_{x_0, t}}{a_{x_0+t}}$$

7 Results

It is a fact that the health system is one of the most important issues for a country. Political reforms made in this area play important roles in the career success of politicians. In this article German private health sector is discussed. When the premiums in private health insurance are investigated it is seen that the Principle of Equivalence in which each person is responsible from him/herself is used as a base. Moreover, in the premium calculations the premium comprises of three major parts: savings, risk, and cost. One of the most important issues in premium calculation is that the risks that may occur in following years are considered seriously. The subject that the expected insurance benefits are to be met by total premium earnings and reserves is also one of the most important aims of health insurance. Consequently, aging reserves are built with this method and the private health insurance companies are protected from unexpected insurance benefits since the accumulated savings are reinvested to obtain revenue. In the German health insurance sector it can be easily recognized that the premium calculations are done with great care which can be proved by observing the big amount of reserves. As a result it can be said that in Germany the private health insurance system operates quite well which contributes to the satisfaction of the private policyholders and to the stability of private health insurance sector.

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