Adjustment of technical interest rate for supplementary health insurance products based on issue-age rate

"But, as often happens, here too
Things don't go as they appear to."
W. Busch, 1832–1908

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4 March 2021

For supplementary health insurance products where prices are based on issue age (i.e. entry age) and benefits increase with age, the technical interest rate (also referred to as actuarial interest rate or discount rate) plays a key role both in determining prices and in calculating provisions. This article describes how adjustments to this parameter are treated actuarially and shows, using realistic examples, that the current low interest rate environment can result in a significant supplementary financing requirement. Based on the principle that policyholders cover their own benefits through premiums, along with investment returns, over the entire term of a policy, this supplementary financing should be secured via a tariff adjustment, which is made possible by the premium adjustment clause and the absence of an interest rate guarantee. Any excess returns achieved in the past compared with the previous technical interest rate have a mitigating effect. To ensure smooth premium adjustments, premiums should be adapted at regular intervals. Delaying an adjustment could, in extreme cases, threaten insurer solvency, and is not in interest of the insured.

Keywords: Supplementary health insurance, issue-age rate, principle of equivalence, tariff adjustment, technical interest rate, actuarial interest rate, discount rate, low interest rate environment, threat of insolvency

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1 Introduction

In Switzerland, basic health insurance with defined benefit coverage is compulsory and is governed by the Health Insurance Act (KVG/LAMal). Supplementary insurance can be taken out voluntarily to cover benefits over and above these provisions (e.g. hospital stays in private or semi-private wards, certain medications, medical devices, dental care). These optional health insurance policies are governed by the Insurance Policy Act (VVG/LCA) and are the focus of this article. While insurers are not obliged to grant an applicant unconditional cover, they generally waive the right of termination on their part. Given that older individuals or those with pre-existing conditions will likely find it difficult to obtain cover with another insurer, there is a risk that insurance companies may set their premiums at excessively high levels. As a preventive measure, tariffs (and adjustments thereof) are subject to prior review by the Swiss Financial Market Supervisory Authority (FINMA). In addition to the said protection of insured persons against unfair treatment, this supervision is intended to ensure the solvency of the individual insurance institutions.

Morbidity increases with age. For this reason, the anticipated cost of benefits for supplementary hospital insurance policies rises sharply with the age of the insured.

Depending on the method used to determine premiums, this can have different implications:

- Attained-age rate: The rate is determined by the actual – i.e. current – age of the insured. When benefits increase in step with the attained age, so too do the premiums, with the result that a redistribution between older and younger individuals does not occur. Solidarity exists between insured persons with the same attained age, irrespective of their issue age.
- Issue-age rate: The age of the insured person when the policy is first purchased – rather than the actual age – is a characteristic of this rate. Premiums are calculated in such a way that, along with investment returns, they cover the cost of benefits across the entire expected duration of a policy. If the costs increase in step with the attained age, there is a redistribution of expenses and receipts over the term of the insurance contract. Solidarity exists between insured persons with the same issue age, irrespective of their attained age.

In practice, most rates are a hybrid of these two methods.

This article examines products with issue-age pricing and a redistribution of receipts and expenses over time. Similar considerations apply to all products with an ageing provision requirement, in particular also to attained-age rates that are kept constant beyond a certain age.

Redistribution over time affords a provision for healthcare costs that increase with age. Young policyholders pay more in premiums than the costs they incur. The difference is set aside in the form of an ageing provision, invested in the capital market, and later made available, with interest, to cover the higher benefits required in old age.

In this context, the return on investment plays a key role. However, the highly expansionary monetary policy currently conducted by leading central banks, including the Swiss National Bank, is putting the returns on low-risk investments under pressure. This is illustrated by the historical course of yields on ten-year Swiss Confederation bonds (cf. Figure 1).

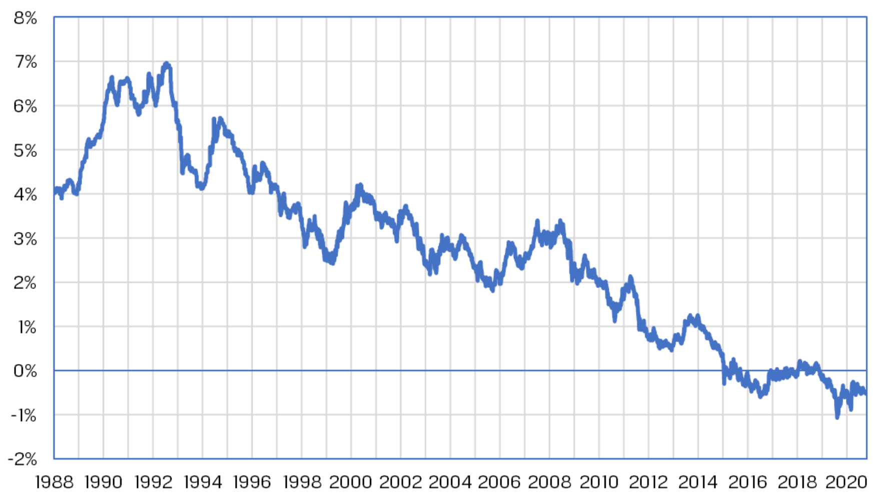

Figure 1: Spot interest rates on ten-year Swiss Confederation bond issues
Source: [SNBspot10y]

With regard to the long-term cover it offers and the concept of providing for the future, a supplementary health insurance product based on issue age is similar to a life insurance policy with regular premium payments. Unlike life insurance, however, the promised benefits are not nominal, but, as in non-life insurance, can vary considerably between policyholders due to unforeseen events (e.g. deterioration in health), and are also highly dependent on the development of long-term healthcare costs. Other differences compared to life insurance include the *absence of an interest rate guarantee* and the *contractual possibility of premium adjustments* to address the aforementioned uncertainties. Furthermore, in Switzerland, ageing provisions are not transferred when a contract is terminated by the policyholder, but are instead used to provide for the future benefits of the remaining policies in the portfolio.

Health insurance products based on issue age therefore do not guarantee a fixed premium over the term of the policy, since rates are adjusted in line with changes to the calculation bases. It would be unrealistic to guarantee a rate over the policy's term, not least because of the uncertain development of healthcare costs.

This article examines how changes to the technical interest rate impact on ageing provisions and actuarially determined premiums against the backdrop of the low interest rate environment. For simplicity, a single cohort of policyholders is initially examined using idealised assumptions, and the technical interest rate is varied. Possible options regarding the technical interest rate level are then outlined, followed by a discussion on the validity of tariff adjustments based on changes to the technical interest rate.

2 Principle of equivalence in issue-age rates

A true issue-age rate is defined by the fact that the issue age – rather than the actual age – is a characteristic of the rate.

In the following, the term 'cohort' refers to a group of contracts incepting in the same year with the same rate attributes (i.e. also with the same issue age). Thus, if both the entry age and entry year are identical for the entire cohort under review, all policies in the cohort will have the same age at all times going forward.

The advantage of considering one single cohort to begin with is that questions regarding a redistribution between different cohorts with the same rate attributes do not arise (different cohorts might differ in terms of actual age, for instance).

2.1 Calculation bases and assumptions

The technical calculation bases are outlined in the table below:

Basis	Used for this article
Benefits by age	Cost of inpatient curative treatment per capita, pursuant to [BfS2017], for men, with a scale factor of 75%, constant from 85 years.[1] The progression of benefits by age is indicated by the dotted line in Figure 2 and is typical for an inpatient supplementary health insurance product.
Mortality by age	SST standard model health insurance 2020, [SSTHealth2020]
Lapse rate by age	Ibid.
Technical interest rate	Focus of discussion

Table 1: Technical calculation bases

We make the following simplified assumptions:

- The cohort is large enough so that it is not affected by random fluctuations.

[1] The appropriateness of assuming a constant progression of benefits from age 85 should be examined on a case-by-case basis.

- With regards to the progression of the technical calculation bases over time, there is initially no uncertainty whatsoever.
- The administrative costs are zero.
- The premium rate does not contain a risk or profit margin.

Exogenous inflation (i.e. the change in age-adjusted mean benefit costs over time) is fully offset by tariff adjustments. It is therefore assumed to be zero in the following. Although not realistic, this assumption is not essential for understanding the topic discussed in this article. The treatment of exogenous inflation in issue-age rates is addressed in a separate article (cf. [TB2020]).

2.2 Redistribution over time and principle of equivalence

As described above, an issue-age rate is characterised by the fact that the actual age is not a rate attribute. Thus, at all times, the premium level is independent of the actual age.

For supplementary hospital insurance policies, the estimated benefits increase with a policyholder's actual age. This results in a redistribution over time: in younger years (at the beginning of a policy's term), premiums are higher than benefits, and the amount in the difference goes towards establishing the ageing provisions. After a certain age, the situation is reversed, with the ageing provisions being reduced once again by the higher benefits. These provisions earn interest on an ongoing basis.

When concluding a contract for which the risk factors are calculated individually, the **principle of equivalence** – which states that premiums and benefits should be equal – applies at all times. The present value of future benefits is covered by ageing provisions and the present value of premiums. In this present value approach, future cash flows are discounted using the technical interest rate.

Owing to this relationship between ageing provisions, on the one hand, and the spread between premiums and benefits, on the other, the adequacy of tariff levels and ageing provisions must always be considered together. Since both are based on a present value approach, the technical interest rate plays a key role in this regard.

When applied to the contract start date, the principle of equivalence states that, over the course of the cohort's lifetime, the premiums – along with the interest on ageing provisions – finance the benefits.

2.3 Initial pricing – constant calculation bases

First, in addition to the assumptions described above, it is assumed for simplicity that the calculation bases (including the technical interest rate) remain constant over the entire lifetime of the cohort.

Under the aforementioned assumptions, Figure 2 illustrates the expected development of premiums and benefits by age as a function of technical interest for a cohort of policyholders with an issue age of 31 years.

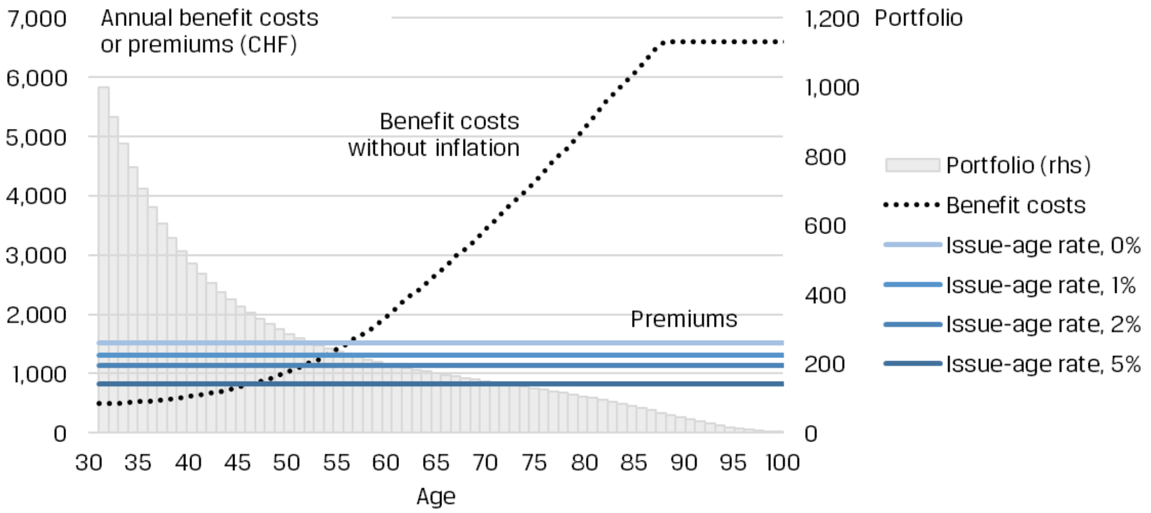

Figure 2: Pricing by issue age as a function of the technical interest rate, where the issue age is 31 years.

The topmost solid line represents the issue-age premium with a technical interest rate of 0%. In comparison with the dotted line, the redistribution over time becomes apparent, since the premium is constant with increasing age in this simplified example. The areas between the lines – left and right of the intersection – are not the same size because the portfolio decreases over time due to lapse[2] and mortality.

Figure 2 shows that the issue-age premium is highly dependent on the technical interest rate: If all other things remain constant, premiums with a technical interest rate of 0% are almost twice as high as they are at 5%. Looking at Figure 1, depending on the time of observation, neither of the values are unreasonable.

In order to depict the principle of equivalence in mathematical terms, we apply the following notation:

[2] In the event of lapse, the pro rata ageing provisions are not transferred to the policyholder, thus benefiting the remaining policyholders. A transfer would result in higher rates.

Symbol	Explanation
t	Current business year; $t+1$: subsequent year; $t-1$: previous year
x	Issue age (in years)
m	Retention period in portfolio, number of years since entry year
$X = x + m$	Age in current business year
$A_{x+m}^{(t)}$	Present value of future benefits for a contract based on actual age $x+m$, using calculation bases at time t. In addition to discounting, the present value also takes mortality and lapse into account.
$ä_{x+m}^{(t)}$	Present value of future annual payment of constant amount 1 for a contract based on actual age $x+m$, using calculation bases at time t. In addition to discounting, the present value also takes mortality and lapse into account.
$P^{(t)}$	Annual premium in year t
$V_{x+m}^{(t)}$	Ageing provisions for a contract based on actual age $x+m$, using calculation bases at time t. In addition to discounting, the present value also takes mortality and lapse into account.
$\Delta P^{(t)}$	Change to annual premium following change to calculation bases from time $t-1$ to time t, defined as $\Delta P^{(t)} := P^{(t)} - P^{(t-1)}$

Table 2: Notation

Given that the technical bases initially remain constant over the entire term – as per the assumptions mentioned above – the upper index can be dispensed with.

According to the principle of equivalence, in the initial pricing, the present value of annual premium payments must cover the present value of benefits. This determines the initial premium (assuming premiums and benefits are paid in advance) as follows:

$$P \cdot ä_x = A_x \qquad P = A_x / ä_x \tag{1}$$

At a later date, after m years, the present values of premiums and benefits will develop differently. The difference is set aside in the form of ageing provisions V, which are calculated according to the prospective method as follows:

$$V_{x+m} = A_{x+m} - P \cdot ä_{x+m} \tag{2}$$

The equation above states that, at every time m, the present value of future benefits is covered by ageing provisions and the present value of future premiums.

Figure 3 shows how the present values of benefits and premiums in the aforementioned example develop, using a technical interest rate of 2%. At the beginning of the term – on the left-hand side of the chart – the present values for both benefits and premiums are identical, according to (1).

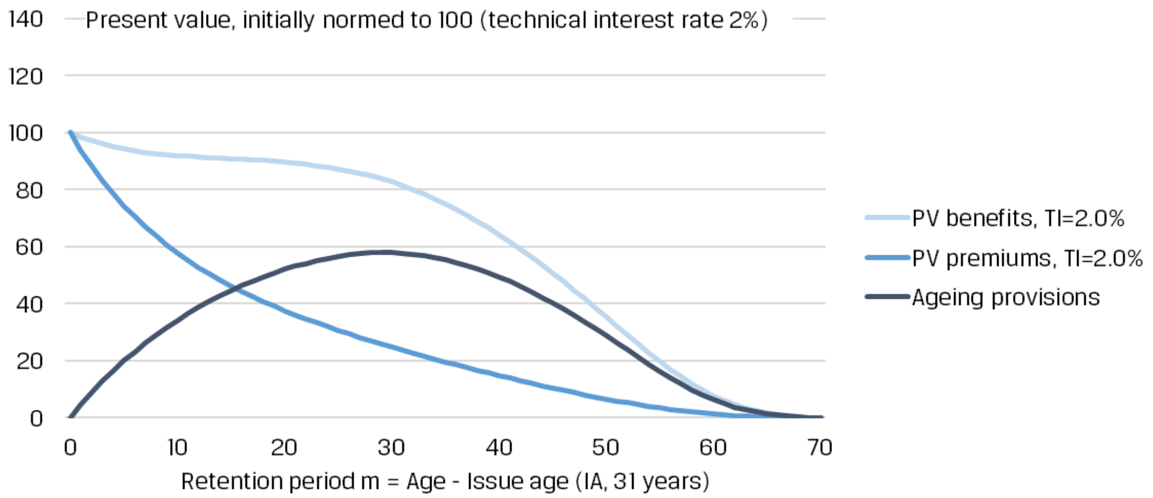

Figure 3: Development of present values of future premiums and benefits according to retention period, for a cohort of policyholders with an issue age of 31 years. The present values are discounted at each point in time with a technical interest rate of 2%. The ageing provisions correspond to the difference between the two present values.

Over time, the present value of future premiums declines faster than the present value of future benefits, because, as can be seen in Figure 2, the premiums are higher than the benefits to begin with. According to (2), the vertical difference between the two curves corresponds to the ageing provisions.

Provided that the calculation bases accurately reflect reality, the initial premium level can be maintained unchanged across the entire lifetime of the cohort. In view of Figure 1, this is not a realistic prerequisite, particularly also with regard to the technical interest rate.

In the following section, we examine the impact of a change in the technical interest rate.

2.4 Adjustment of technical interest rate at beginning of term

If one single cohort is considered, there is no need to adjust the technical interest rate at the beginning of the term, since the current value would be used from the outset. This may be the case, however, if several cohorts exist simultaneously with the same technical bases, albeit with varying entry years.

Figure 4 plots the development of the present values where the technical interest rate is adjusted from 2% to 1% at the beginning of the term.

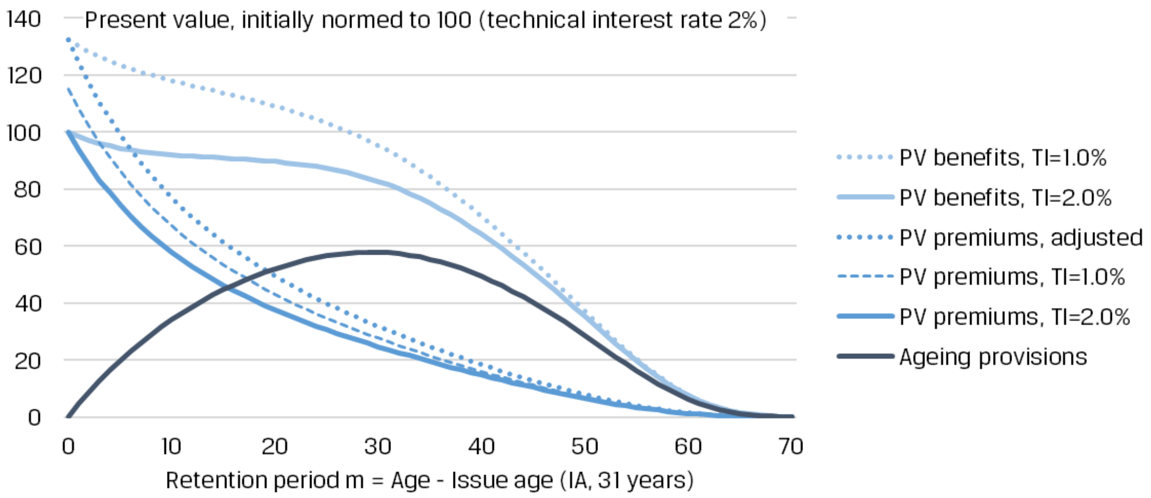

Figure 4: Development of present values of future benefits and premiums according to retention period, for a cohort of policyholders with an issue age of 31 years. The solid lines are discounted at each point in time with a technical interest rate of 2%; the dotted line with a rate of 1%. The dashed line shows the present value of the original premiums, discounted at a rate of 1%.

The dashed line shows the present value of the premiums – initially unchanged, calculated with a technical interest rate of 2% – discounted with a new technical interest rate of 1%. Compared with the 2% discount rate, the present value of the premiums increases. What emerges, however, is that the present value of benefits rises significantly more than the present value of premiums. This is because benefits grow substantially over time (cf. Figure 2), so their present value is thus more dependent on the technical interest rate than the present value of premiums. In order for the premiums, along with the interest on ageing provisions, to cover the benefits according to the principle of equivalence, the premium in this example must be increased by around 15% to the level of the dotted line. This finding is consistent with Figure 2. The development of ageing provisions based on the adjusted present value of premiums and a technical interest rate of 1% corresponds to that based on a technical interest rate of 2%.

2.5 Adjustment of technical interest rate during term

The next example investigates the effect of reducing the technical interest rate from 2% to 1% after a term of ten years (cf. Figure 5).

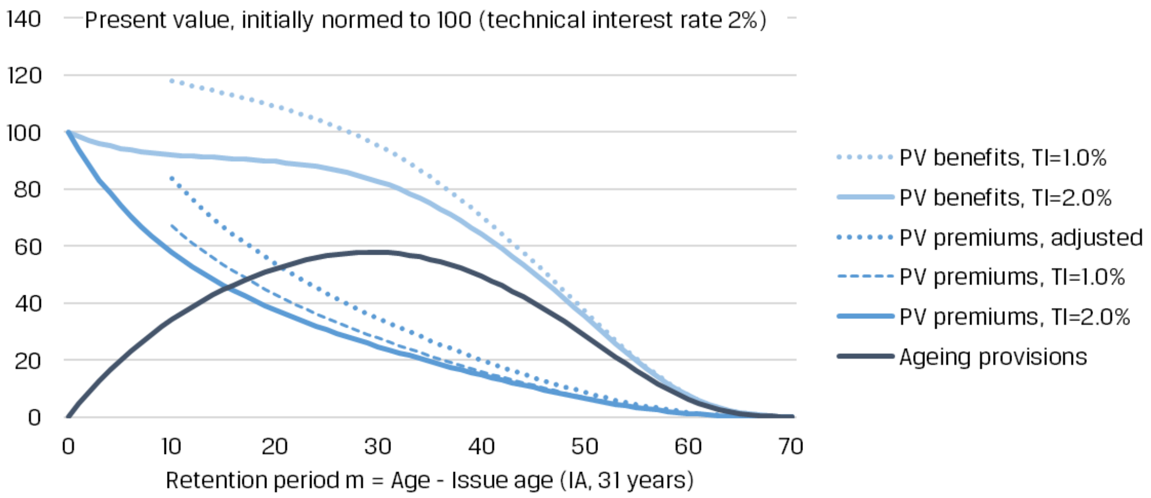

Figure 5: Development of present values of future benefits and premiums according to retention period, for a cohort of policyholders with an issue age of 31 years. The solid lines are discounted at each point in time with a technical interest rate of 2%; the dotted line with a rate of 1%. The dashed line shows the present value of the original premiums, discounted at a rate of 1%.

Once again, the present value of benefits sees a more pronounced increase than that of premiums (which initially remained unchanged). This results in a supplementary financing requirement.

Here, too, the principle should be that the cohort finances its own benefits over its lifetime through premiums, along with the interest on ageing provisions. For this to be possible, the premium in this example must be increased by 25%. Without this adjustment, there would be a funding gap (the difference between the lower dotted line and the dashed line) amounting to around 50% of the ageing provisions, or more than four-and-a-half times an annual premium.

The necessary premium adjustment is greater than in the previous example, because the ageing provisions that had been set aside with the lower premiums are not sufficient to cover the benefits together with the now reduced interest rate.

If the premiums had already been higher at the beginning of the term than with the technical interest rate of 2% applicable at the time, the increase now would be lower or irrelevant. We revisit this line of thought in the following section.

Based on these introductory examples, we formulate the relationships in mathematical terms, using the notation from Table 2.

The premium adjustment is calculated in two steps:

- Step 1: The calculation of the ageing provisions (prospective calculation method) with the valuation assumptions from the previous year:

$$V_{x+m}^{(t-1)} = A_{x+m}^{(t-1)} - P^{(t-1)} \cdot \ddot{a}_{x+m}^{(t-1)} \tag{3}$$

- Step 2: According to the principle of equivalence, the present value of future benefits must be covered by ageing provisions and the present value of future premiums, using updated calculation bases:

$$A_{x+m}^{(t)} = \quad V_{x+m}^{(t-1)} + P^{(t)} \cdot \ddot{a}_{x+m}^{(t)} \tag{4}$$

In this calculation, only the technical interest rate is adjusted between the previous year and the current business year. The following emerges by inserting (3) into (4), using the definition $\Delta P^{(t)} := P^{(t)} - P^{(t-1)}$:

$$\underbrace{\Delta F = \Delta P^{(t)} \cdot \ddot{a}_{x+m}^{(t)}}_{③} = \underbrace{\left(A_{x+m}^{(t)} - A_{x+m}^{(t-1)}\right)}_{①} - \underbrace{P^{(t-1)} \cdot \left(\ddot{a}_{x+m}^{(t)} - \ddot{a}_{x+m}^{(t-1)}\right)}_{②} \tag{5}$$

Expressed in words: The increase in the present value of future benefits ① is partially offset by the increase in the present value of future premiums ②, calculated using the current premium level. Given that the cash flow duration for benefits is higher than for premiums, this compensation is incomplete. The resulting supplementary financing requirement ③ is applied to an increase in the annual premium. Figure 6 illustrates the relationship (5).

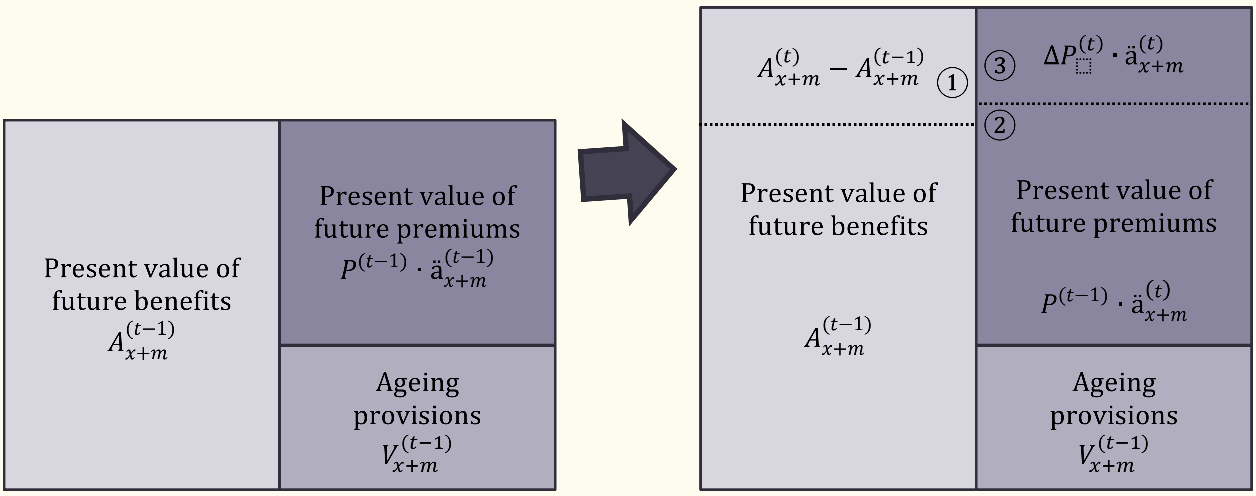

Figure 6: Graphical representation of adjustment of issue-age rate with regard to technical interest rate.

Table 3 presents the supplementary financing requirement ΔF and the resulting equivalent premium adjustment for different issue ages and retention periods that would arise if the technical interest rate were changed from 2% to 1%.

Issue age	Supplementary financing requirement ΔF relative to annual premium			Equivalent relative premium increase		
	Retention period 0	10	20	Retention period 0	10	20
26	1.9	4.8	7.8	16%	29%	41%
31	2.1	4.6	6.3	15%	25%	32%
36	2.1	3.9	4.7	13%	20%	25%
41	1.9	3.1	3.2	11%	16%	18%

Table 3: Effect of adjustment of technical interest rate from 2% to 1% for different issue ages x and retention periods m. Left: Supplementary financing requirement ΔF as per (5), based on annual premium. Right: Equivalent relative premium increase.

The supplementary financing requirement corresponds to a multiple of an annual premium. When applied to premiums, the resulting rates of increase would be in the low to mid double-digit territory.

2.6 Selecting the technical interest rate

While the technical interest rate in the preceding sections was assumed to be a known calculation parameter, the following section will discuss the selection of this parameter.

The principle of equivalence – which states that the cohort finances its own benefits over its lifetime through premiums, along with the interest on ageing provisions – should apply.

Various approaches are conceivable in the context of this principle:

- Option A: The technical interest rate is adjusted on a regular basis and corresponds to the relevant expected return on investment. According to (5), the adjustment of the technical interest rate results in an adjustment of the tariff.
- Option B: A prudent (low) technical interest rate is selected so as to keep premiums as stable as possible for the duration of the term.

An example illustrates the two options. At any point in time, only the relevant expected return on investment is known. This estimated variable is subject to the following annual fluctuations:

- 3% in the first three years;
- 0.25% decline per annum for the subsequent eight years;
- Constant at 1% from the ninth year.

With regard to Figure 1, the scenario above is a schematic reflection of the spot interest rates on ten-year Swiss Confederation bond issues in the period from 2005 to 2014, with the decline accelerating from 2008 onwards. The continued expansion of the low interest rate phase from 2015 is not conveyed in this scenario.

Since the course of the expected return on investment is known in this example (which in reality is not the case), the equivalent premium – which is constant over the entire term – can be calculated with the help of (1) in the context of option B. This premium corresponds to a constant technical interest rate of around 1.1%, which represents a prudential margin of almost 2% compared with the return on investment expected at the beginning of the term. Figure 7 shows the development of the annual premium on the basis of both options. In option A ('variable TI'), the technical interest rate is updated annually, and the premium is adjusted according to (5).

In both options, the present value of premiums is at the same level over the entire term and the premium is sufficient to cover the benefits along with the interest on ageing provisions. In this simplified example, neither of the two options results in a profit for the insurer.

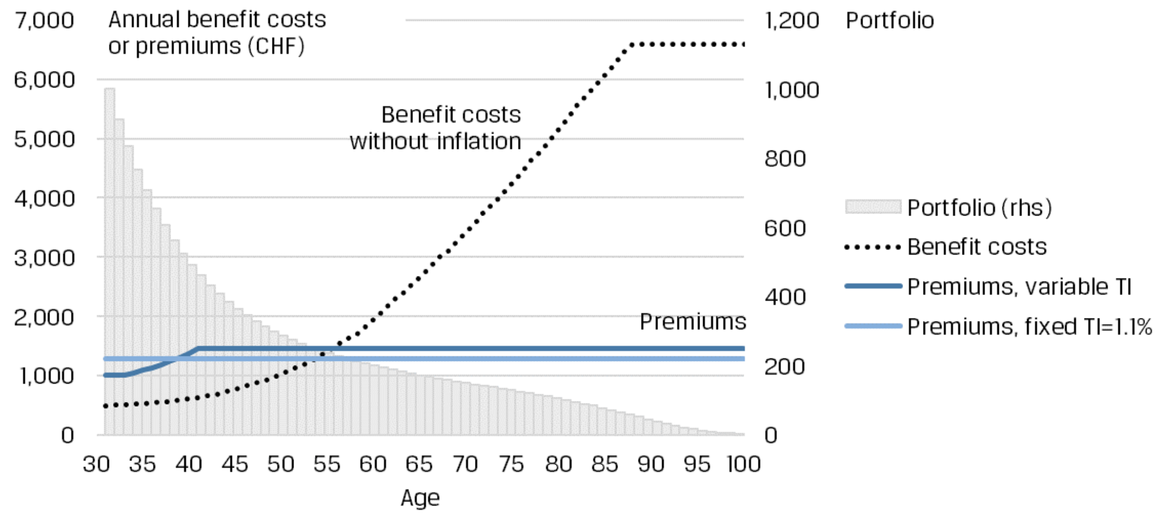

Figure 7: Illustration of effect of declining investment returns (3% in first three years, 0.25% decline p.a. in the subsequent eight years, thereafter constant at 1%) on premium developments with options A and B.

With regard to option B, it must be emphasised that the appropriate level cannot be calculated in advance, since the investment returns prospects are dependent, among other things, on the development of the general interest rate level. Even if, *in the assumed scenario*, a constant technical interest rate of around 1.1% leads to sufficient funding over the entire term, there is still the risk that this scenario is too optimistic. In view of the expansion of the ultra-loose monetary policies conducted by leading central banks in the context of the COVID-19 pandemic, this reservation seems perfectly realistic.

If, for instance, the investment returns decline further after the ninth year from 1% to 0%, there will be a similar supplementary financing requirement as described in section 2.5: a multiple of the annual premium.

It becomes clear from this consideration that, even with option B, tariff adjustments cannot necessarily be prevented, because just as little is known in advance about an appropriate prudential margin on the technical interest rate as about the course of investment returns. In addition, an intentionally selected prudential margin influences the insurer's profit expectations.

Compared to option A, the tariff adjustments in option B occur at different points in time and can vary in magnitude. Consequently, any adjustment of the technical interest rate to reflect changes in investment returns depends on which of the two options is envisaged in the tariff:

- If the tariff is calculated according to option A, then a regular adjustment of the technical interest rate and the premiums pursuant to (5) is necessary. There is no need to take excess returns into consideration, because each year the technical interest rate corresponds to the expected return on investment.
- Under option B, an adjustment of the technical interest rate and the premiums is indicated, even if the then prudent setting of the rate cannot be financed with the expected investment returns and previous excess returns. The specific procedure for determining ΔF in formula (5) is as follows:

  1. Calculate the interest on ageing provisions for preceding years using the effective return on investment instead of the technical interest rate, and determine the difference between the ageing provisions obtained from this calculation to the ageing provisions based on the previous technical interest rate.
  2. Reduce the supplementary financing requirement in accordance with 2.5 by this amount (i.e. subtract the result for step 1 from the right-hand side of (5)). This results in a correspondingly lower tariff adjustment.

  This mechanism ensures that any excess returns achieved relative to the technical interest rate are included in the calculation.

In addition to options A and B, one other option is theoretically possible:

- Option C: Any changes to the expected return on investment since the rate was initially set are to be financed by the insurer's equity capital; premium adjustments are only permitted in the event of impending insolvency.

This option stems from the view that the risk of annual investment returns is borne by the insurer. Returns in excess of the technical interest rate increase the insurer's equity capital, without benefiting the insured parties. Conversely, one could argue that the insured parties do not have to bear the burden of financing too low a return. However, this option contradicts the aforementioned principle that the cohort finances its own benefits over its lifetime through premiums, along with the interest on ageing provisions. This option is therefore considered inadmissible from an actuarial point of view. Furthermore, option B illustrated how excess returns generated in the past can also be taken into account.

A tariff adjustment in the context of an adjustment of the technical interest rate does not transfer the annual investment risk to the policyholders; this risk remains with the insurer. In option A, for instance, the technical interest rate is adjusted every year to correspond to the expected return on investment. The difference between the effective return and the expected value is to be borne as a risk by the insurer.

The development of the expected return on investment largely depends, among other things, on the development of the general interest rate environment. On the basis of the above derivation, this development forms part of the tariff adjustments in health insurance – in contrast to life insurance. Accordingly, falling interest rates result in tariff increases, while rising interest rates should lead to tariff reductions.

The insurer may intentionally opt for a technical interest rate with a high prudential margin. As a result, the policyholders' initial premiums increase and the insurer can expect an annual excess return on investment income. The level of the prudential margin when selecting the technical interest rate leads to a correspondingly lower or higher profit margin. The appropriate profit margin must be viewed in light of the risk borne by the insurer and assessed as a whole together with the prudential margins applied to other calculation bases. A possible approach is described in the technical appendix (cf. 5.1).

The planned partial revision[3] of the FINMA Circular 2010/3 specifies guidelines on the appropriate profit margin level, albeit without considering the level of the prudential margins for the technical interest rate. Consequently, the profit margin constraint could be circumvented by a prudent choice of technical interest rate.

The regulations based on the revised circular thus allow additional profit margins by way of a prudential margin in the initial premium. For insurers wishing to forego profit margins in favour of lower premiums, the possibility of adjusting premiums in response to a change in the interest rate level is essential.

The question of whether premiums for issue-age products may be adjusted as a result of changes to the technical interest rate is a controversial one in Switzerland and is therefore be discussed in greater detail in the following section.

[3] [FINMA2020].

2.7 Tariff adjustments based on adjustment of technical interest rate

In German private health insurance (PKV), there are only issue-age rates for adults, and the corresponding conditions are clearly regulated. So-called trigger factors for a tariff adjustment are already incorporated into law,[4] namely a sharp rise in insurance benefits or a significant increase in longevity. Thus, a change in the technical interest rate on its own is not enough to prompt a tariff adjustment. By contrast, an adjustment to the tariff involves adjusting *all* the calculation bases, i.e. also the technical interest rate.

This rigid system also has adverse effects: Because the trigger factors are linked to predefined thresholds, an adjustment of the technical interest rate has all the more impact and can lead to abrupt tariff adjustments. The German Association of Actuaries (DAV)[5] and the PKV industry[6] are therefore calling for a review of the trigger factors, with the aim of stabilising the tariff adjustments in the interest of the insured; among other things by means of a trigger factor that is linked to changes in the technical interest rate. Even after a revision of the legal basis, it is indisputable that changes in the technical interest rate will be fully reflected in the tariff adjustments.

Swiss legislation[7] stipulates that FINMA shall verify whether the tariffs subject to approval remain within a range that ensures both the solvency of the individual insurance companies and the protection of the insured parties from unfair treatment.

Supervisory practice is codified by means of circulars.[8] According to the applicable version of the relevant circular, insurance companies evaluate the currently foreseeable technical risks when setting the initial tariff, with the exception of exogenous inflation,[9] which cannot be calculated in advance. An existing tariff may therefore only be adjusted within the context of an 'ordinary adjustment' in the amount of the exogenous inflation that has not yet been taken into account.

Investment returns are subject to financial market risks, which do not constitute technical risks under the above definition. Furthermore, they are just as difficult to calculate in advance as exogenous inflation – for instance, even half a decade after the 2008 financial crisis, it was not possible to predict that interest rates would persist at such low levels or indeed turn negative. Should the technical result of a product

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[4] Art. 155 VAG (Insurance Supervision Act) and art. 203 VVG (Insurance Contract Act).

[5] [DAV2019].

[6] [PKV2019], p. 11.

[7] Art. 38 VAG/LSA (Insurance Supervision Act).

[8] FINMA Circular 2010/3, margin nos. 10, 38, 41. Partial revision planned, cf. [FINMA2020].

[9] Exogenous inflation is the increase in claims expenses per policyholder less the financial consequences of changes to the portfolio (e.g. change in age structure).

subsequently dip into negative territory for a prolonged period, the insurance company must request an 'extraordinary adjustment' in order to bring the expected technical result (including the investment returns allocated to said product) back to zero at the very least.

This approach is up for discussion in the planned partial revision of the aforementioned circular, as this revision only permits a tariff adjustment in excess of exogenous inflation insofar as developments in supplementary health insurance, unforeseeable in their nature or extent, are such that the tariff poses a threat to the solvency of the insurance company.

This roughly corresponds to option C, which was briefly touched upon in the previous section. An adjustment of the technical interest rate would be covered from the insurer's equity capital. The following arguments speak against this approach:

- It is in breach of the insurance principle that the cohort finances its own benefits over its lifetime through premiums, along with investment returns.
- Section 2.5 demonstrated that, as a result of this principle, a tariff adjustment becomes necessary when the technical interest rate changes. The entire derivation was based on the assumption that the insurer does not make a profit. Therefore, no unfairness can be identified.
- The regulations on unfair tariffs envisaged by the revised circular provide for a limitation of profits. This limitation can be circumvented for issue-age rates by setting a very low technical interest rate and optimising the profit separately from the technical result. Conversely, insurers will be penalised if they select the technical interest rate with a low profit margin in the interest of the policyholder, because without the possibility of tariff adjustments on the basis of a change in the technical interest rate, they can expect a negative result in the current environment.
- In contrast to life insurance, the promised benefits in supplementary health insurance are not nominal, nor is there any interest rate guarantee. On the contrary, the possibility of tariff adjustments is explicitly provided for in contracts. Section 2.6 showed that the tariff can be configured in such a way that fluctuations due to the technical interest rate remain within acceptable limits. To achieve this, it is essential that adjustments can be made on a regular basis, which is already not the case under the current regulations ('extraordinary adjustment'), and will be even less so with the approach envisaged in the partial revision.
- Section 2.5 illustrated that the supplementary financing requirement resulting from a change in the technical interest rate can be considerable. Even a reduction in the technical interest rate of one percentage point amounts to a multiple of an annual premium. If the insurance company's equity capital were used to provide financing, doing so would erode the company's capital base and unilaterally increase the risks for the policyholders in the remaining products. This is unfair in terms of the equal treatment of the insured.

- Waiting until the insurer is faced with the threat of insolvency before providing supplementary financing through premium increases is too late. The increases required under such circumstances can be substantial and come at time when the scope to mitigate their impact is narrowed. This is not in the interest of the insured. In particular, elderly or ailing policyholders cannot switch insurers as a way to evade the increases associated with the threat of insolvency. Meanwhile, the situation could prompt younger or healthy members to terminate their policies. This sort of anti-selection could exacerbate the financing problems, at the expense of the more vulnerable elderly and ailing policyholders. It is therefore essential to take a more far-sighted view of the solvency of the insurer and the protection of the insured.

2.8 Portfolio generalisations

The preceding sections were focused on one single cohort. However, a portfolio is made up of numerous cohorts. Solidarities exist between different cohorts that share the same rate attributes (but, have different issue ages or retention rates, for instance).

By analogy with the findings in [TB2020], the effects described above also apply to portfolios. Table 3 illustrates how, after the launch of a product, these effects increase with the average retention rate of the policyholders and can culminate at a certain point.

There is a supplementary financing requirement due to a reduction in the technical interest rate for both open and closed products.

3 Conclusion and outlook

The preceding sections yield the following key findings:

- For supplementary health insurance products with redistribution over time, the technical interest rate plays a key role both in determining prices and for calculating provisions. It is linked to the actual investment returns prospects.
- The ultra-loose monetary policy conducted by leading central banks since the global financial crisis in 2008 as well as the continued expansion of the low interest rate policy in Switzerland since 2015 have considerably reduced the returns achievable with low-risk investment strategies. The financial and monetary policy measures taken in connection with the COVID-19 pandemic do not suggest a reversal of this trend any time soon. As a consequence, supplementary health insurers have to lower the technical interest rate.
- For issue-age policies, this interest rate adjustment results in a difference between the existing and required ageing provisions. Even a moderate reduction in the technical interest rate gives rise to a supplementary financing requirement that amounts to a multiple of an annual premium.
- Based on the principle that policyholders cover their own benefits through premiums, along with investment returns, over the entire term of a policy, this supplementary funding should be secured via a tariff adjustment. Any excess returns achieved in the past compared with the previous technical interest rate have a mitigating effect.
- It is in the interest of the insured person that premium adjustments be made on a consistent basis. For this reason, premium increases necessitated by a reduced technical interest rate should not be deferred. Waiting until the insurer is faced with the threat of insolvency is both imprudent and unfair.
- In Switzerland, preventive tariff supervision monitors whether tariffs are unduly high. In this regard, tariff increases due to a change in the technical interest rate are generally not permissible. At the same time, the validity of generating a profit by choosing a low technical interest rate is not questioned. It is debatable whether this approach is consistent.

The conclusions above apply not only to issue-age products, but in general also to products with redistribution over time, which can arise, for instance, as a result of premiums being kept constant beyond a certain age.

Premiums have to be adjusted in the event of an actuarial change to the technical bases, such as to the technical interest rate, provided the insurer can demonstrate that any surpluses achieved in the past compared with previous technical bases are not sufficient to fully close the funding gap caused by the change.

4 Sources and references

Abbreviation	Description
[BfS2017]	Swiss Federal Statistical Office: "Gesundheitskosten nach Alter und Geschlecht (Schätzung)" (in DE and FR only) https://www.bfs.admin.ch/bfs/de/home/statistiken/gesundheit/kosten-finanzierung/kosten.assetdetail.12567519.html
[DAV2019]	German Association of Actuaries (DAV): "Aktuare unterstreichen Reformbedarf in der privaten und gesetzlichen Krankenversicherung" (in DE only), 22 May 2019 https://aktuar.de/politik-und-presse/pressemeldungen/Pressemitteilungen/2019_05_22_PM_PKV_JPK_final.pdf
[FINMA2020]	FINMA: "Anpassung vom FINMA-Rundschreiben 2010/3 'Krankenversicherung nach VVG' vom 18. März 2010, Anhörung vom 1. September 2020 bis 02 November 2020" (in DE and FR only), 1 September 2020 https://www.finma.ch/de/~/media/finma/dokumente/dokumentencenter/anhoerungen/laufende-anhoerungen/20200901-krankenzusatzversicherung/e_aenderlass_rs_10_03_anh20200901.pdf?la=de
[PKV2019]	German Association of Private Health Insurers (PKV): "Rechenschaftsbericht 2018/19" (in DE only), June 2019 https://www.pkv.de/fileadmin/user_upload/PKV/c_Verband/PDF/2019_rechenschaftsbericht-2018-2019.pdf
[SNBspot10y]	Swiss National Bank https://data.snb.ch/en/topics/ziredev#!/chart/rendeidglfzch
[SSTHealth2020]	FINMA: "Standardmodell Versicherungen, Technische Beschreibung für das SST-Standardmodell Krankenversicherung" (in DE and FR only), 31 October 2019
[TB2020]	A. Troxler, R. Bodenmann: "Berücksichtigung der Teuerung bei Krankenzusatzversicherungen mit Tarif nach Eintrittsalter" (in DE only), 20 October 2020 https://www.azenes.ch/assets/Dateien/files/2020%20Azenes%20Teuerungsanpassung%20Eintrittsaltertarif%20v100%20final.pdf

5 Technical appendix

5.1 Profit expectations and prudential margins in calculation bases

In the following formula (13), the insurer's result for issue-age products is broken down for a contract into its constituent parts, which can be allocated to the technical bases (premiums, expenses, benefits, investment result, mortality and lapse). This breakdown is used to determine how prudential margins on individual technical bases affect the insurer's result.

For this purpose, the following assumptions are made:

- The result is not influenced by a change in the calculation bases. In keeping with the notation in section 2.3, the upper index is omitted.
- The administrative costs are included as a percentage discount $(1-\kappa)$ in the present value of premiums.
- The retention rate takes the mortality and lapse rates into account.

To start with, the one-year retention rate p_x is introduced and, from this, the t-year retention rate of an insured person at age x, is then derived:

$$ {}_tp_x = p_x \cdot p_{x+1} \cdot p_{x+2} \cdot \ldots \cdot p_{x+t-1} \tag{6} $$

This results in the following for a t-year retention rate of an insured person at age $x+1$:

$$ {}_tp_{x+1} = p_{x+1} \cdot p_{x+2} \cdot \ldots \cdot p_{x+t-1} \cdot p_{x+t} = \frac{p_x \cdot p_{x+1} \cdot p_{x+2} \cdot \ldots \cdot p_{x+t-1} \cdot p_{x+t}}{p_x} = \frac{{}_{t+1}p_x}{p_x} \tag{7} $$

The present value of a future annual payment of the constant amount 1 is obtained from the following formula, where $v := 1/(1+i)$ is the discount factor of the technical interest rate i and ω is the maximum age:

$$ \ddot{a}_{x+m} = \sum_{k=0}^{\omega-x-m} v^k \cdot {}_kp_{x+m} \tag{8} $$

The following results from (7):

$$ \begin{aligned} \ddot{a}_{x+m+1} &= \sum_{k=0}^{\omega-x-m-1} v^k \cdot {}_kp_{x+m+1} = \sum_{k=0}^{\omega-x-m-1} \frac{v^{k+1} \cdot {}_{k+1}p_{x+m}}{v \cdot p_{x+m}} = \frac{1}{v \cdot p_{x+m}} \sum_{l=1}^{\omega-x-m} v^l \cdot {}_lp_{x+m} \\ &= \frac{1}{v \cdot p_{x+m}} \left(\sum_{l=0}^{\omega-x-m} v^l \cdot {}_lp_{x+m} - 1 \right) = \frac{1}{v \cdot p_{x+m}} \left(\ddot{a}_{x+m} - 1 \right) \end{aligned} \tag{9} $$

The same applies for the present value of future benefits, where L_x is the benefit of a person at age x:

$$A_{x+m} = \sum_{k=0}^{\omega-x-m} v^k \cdot \ {}_k p_{x+m} \cdot L_{x+m+k} \tag{10}$$

$$\begin{aligned} A_{x+m+1} &= \sum_{k=0}^{\omega-x-m-1} v^k \cdot \ {}_k p_{x+m+1} \cdot L_{x+m+1+k} = \sum_{k=0}^{\omega-x-m-1} \frac{v^{k+1} \cdot \ {}_{k+1} p_{x+m} \cdot L_{x+m+1+k}}{v \cdot p_{x+m}} \\ &= \frac{1}{v \cdot p_{x+m}} \sum_{l=1}^{\omega-x-m} v^l \cdot \ {}_l p_{x+m} \cdot L_{x+m+l} \\ &= \frac{1}{v \cdot p_{x+m}} \left(\sum_{l=0}^{\omega-x-m} v^l \cdot \ {}_l p_{x+m} \cdot L_{x+m+l} - L_{x+m} \right) = \frac{1}{v \cdot p_{x+m}} \left(A_{x+m} - L_{x+m} \right) \end{aligned} \tag{11}$$

Next, the change in the ageing provisions over a calendar year is set out:

$$\begin{aligned} V_{x+m+1} - V_{x+m} &= A_{x+m+1} - P \cdot (1-\kappa) \cdot \ddot{a}_{x+m+1} - V_{x+m} \\ &= \frac{1}{v \cdot p_{x+m}} \left(A_{x+m} - L_{x+m} \right) - P \cdot (1-\kappa) \cdot \frac{1}{v \cdot p_{x+m}} \left(\ddot{a}_{x+m} - 1 \right) - V_{x+m} \\ &= \frac{1}{v \cdot p_{x+m}} \left(V_{x+m} + P \cdot (1-\kappa) - L_{x+m} \right) - V_{x+m} \\ &= \frac{1+i}{p_{x+m}} \left(P - \kappa \cdot P - L_{x+m} \right) + \frac{1+i}{p_{x+m}} \cdot V_{x+m} - \frac{p_{x+m}}{p_{x+m}} \cdot V_{x+m} \\ &= \frac{1+i}{p_{x+m}} \left(P - \kappa \cdot P - L_{x+m} \right) + \frac{i}{p_{x+m}} \cdot V_{x+m} + \frac{\left(1 - p_{x+m}\right)}{p_{x+m}} \cdot V_{x+m} \end{aligned} \tag{12}$$

The result can now be broken down as follows, where 'IR' is the investment result and 'rv' denotes real variables:

$$\begin{aligned} \text{Result} &= P^{\text{rv}} - K^{\text{rv}} - L_{x+m}^{\text{rv}} - \left(V_{x+m+1} - V_{x+m} \right) + IR^{\text{rv}} \\ &= P^{\text{rv}} - K^{\text{rv}} - L_{x+m}^{\text{rv}} \\ &\quad - \left(\frac{1+i}{p_{x+m}} \left(P - \kappa \cdot P - L_{x+m} \right) + \frac{i}{p_{x+m}} \cdot V_{x+m} + \frac{\left(1-p_{x+m}\right)}{p_{x+m}} \cdot V_{x+m} \right) + IR^{\text{rv}} \\ &= \left[P^{\text{rv}} - \frac{1+i}{p_{x+m}} \cdot P \right] + \left[-K^{\text{rv}} + \frac{1+i}{p_{x+m}} \cdot \kappa \cdot P \right] + \left[-L_{x+m}^{\text{rv}} + \frac{1+i}{p_{x+m}} \cdot L_{x+m} \right] \\ &\quad + \left[IR^{\text{rv}} - \frac{i}{p_{x+m}} \cdot V_{x+m} \right] + \left[- \frac{\left(1-p_{x+m}\right)}{p_{x+m}} \cdot V_{x+m} \right] \\ &= \underbrace{\left[P^{\text{rv}} - \frac{1}{p_{x+m}} \cdot P \right]}_{\text{"Pemium result"}} + \underbrace{\left[-K^{\text{rv}} + \frac{1}{p_{x+m}} \cdot \kappa \cdot P \right]}_{\text{"Expenses result"}} + \underbrace{\left[-L_{x+m}^{\text{rv}} + \frac{1}{p_{x+m}} \cdot L_{x+m} \right]}_{\text{"Benefit result"}} \\ &\quad + \underbrace{\left[IR^{\text{rv}} - \frac{i}{p_{x+m}} \cdot \left(V_{x+m} + P - \kappa \cdot P - L_{x+m} \right) \right]}_{\text{"Net investment result"}} + \underbrace{\left[- \frac{\left(1-p_{x+m}\right)}{p_{x+m}} \cdot V_{x+m} \right]}_{\text{"Mortality and lapse result"}} \end{aligned} \tag{13}$$

The result can therefore be split into five parts:

- Premium result: The deviation of the real premium income from the premium income forecast using the previous year's calculation bases.
- Expenses result: The deviation of the real operating costs from the operating costs forecast using the previous year's calculation bases.
- Benefit result: The deviation of the real cost of benefits from the cost of benefits forecast using the previous year's calculation bases.
- Net investment result: The difference between the investment returns and the interest on ageing provisions based on the selected technical interest rate.
- Mortality and lapse result: It is assumed here that the insured person is in the portfolio at age $x + m + 1$ and has thus outlived age $x + m$, even though the calculation bases assume a retention rate p_{x+m}. For this reason, there is a negative mortality and lapse result. Looking at the portfolio as a whole, some policyholders leave, while others remain. The difference between the valuation based on the policyholders remaining in the portfolio and the valuation based on the projected retention rate yields the portfolio's mortality and lapse result. Since the actual portfolio also has an influence on the further results, the factor p_{x+m} is included there too.

The insurer's result depends on the level at which a prudential or risk margin is taken into account and for which components. For instance, the expense ratio in the valuation may be intentionally chosen to be a few percentage points higher than the expected operating expense ratio. Based on this margin, the outcome is a positive expenses result. Furthermore, prudent mortality and lapse assumptions or a prudent benefits curve for the estimated future benefit costs can be selected. Alternatively – or additionally – the technical interest rate may be chosen prudently. The profit margin depends on the overall margins considered in the calculation bases.