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Introduction and life insurance practice

1.1 Introduction

This chapter provides an introduction to life insurance practice with focus on with-profit life insurance. The purpose is to give the reader sufficient insight to benefit from the remaining chapters. In life insurance, one party, the policy holder, exchanges a stream of payments with another party, the insurance company. The exchanged streams of payments form, in a sense, the basis of the insurance contract and the corresponding legal obligations. When speaking of life insurance practice, we think of the way this exchange of payments is handled and settled by the insurer. We take as our starting point the idea of the policy holder's account. This account can be interpreted as the policy holder's reserve in the insurance company and accumulates on the basis of the so-called Thiele's differential equation. Its formulation as a forward differential equation plays a crucial role, and this chapter explains in words the construction and the elements of this equation and its role in accounting. Note, however, that the policy holder's account is not in general a capital right held by the insured but a key quantity in the insurer's handling of his obligations.

1.2 The life insurance market

In this section we explain the most typical environments for negotiation and contractual formulations for a life insurance policy. We distinguish between *defined benefits* and what we choose to call *defined contributions with partly defined benefits*.

Defined contributions with partly defined benefits cover the majority of life insurance policies. The policy holder agrees with the insurance company about a certain premium to cover a basket of benefits with, for example, a

life insurance sum paid out upon death before the termination of the contract and/or a pension sum paid out upon survival until the termination of the contract. The benefits agreed upon at issuance are set systematically low by basing them on conservative assumptions on interest rates, insurance risk and expenses. As the market interest rates, the market insurance risk and the market costs evolve, a surplus emerges, and this surplus is to be paid back to the policy holder. This typically happens by increasing one or more benefits. This combination of known premiums reflected in guaranteed benefits, which may be increased depending on the development in the market, categorizes the contracts as defined contributions with partly defined benefits.

One construction is to increase all benefits proportionally such that the ratio between, for example, the death sum and the pension sum is maintained. Another construction is to keep the death sum constant or regulated with some price index while residually increasing the pension sum. Only very rarely is the surplus paid out in cash or used to decrease the premium instead of increasing the benefits. Such rare constructions should in principle be categorized as defined benefits with partly defined contributions since then a basket of known benefits is combined with guaranteed premiums which may be decreased depending on the development in the market.

The policies with defined contributions with partly defined benefits are naturally classified as *private, firm-based*, or *labor-based*.

A *private* policy is agreed upon by a private person and the company. The private person is the policy holder and negotiates the conditions in the contract.

A *firm-based* policy is a contract which is part of an agreement between an employer and an insurance company. The employer typically pays a part of the premium but receives no benefits. The total premium paid is typically a percentage of the salary. Although the terms of the contract are typically negotiated between the employer and the company, the employees are still the policy holders. The agreement between the employer and the company may either be compulsory, in which case all employees are forced to participate, or optional, in which case it is up to the employees to decide whether or not to participate. Since the employer has no claims and no obligations besides paying the premium, this premium can in many respects be interpreted as salary.

A *labor-based* policy works in many respects as a firm-based policy except for the fact that the employer and the employees are represented at the negotiation by organizations rather than the employers and employees themselves. These organizations typically take care of people employed in the uniformed services or education. The result is an agreement where the employer is

obliged to participate in the employees' policy on terms agreed upon by the organizations. The policy is then issued by a company taking care of all the employees in a particular organization. Once the agreement has been made and the contract has been issued, it works basically as a firm-based policy with the employer and the employees as payers of premiums and the employees as receivers of benefits. The total premium paid is typically a percentage of the salary. The employees are the policy holders. The labor-based policy is often part of a compulsory agreement, both the employer and the employed are obliged for which to agree to minimum conditions. The premium part paid by the employer can in many respects be interpreted as salary.

The *defined benefit* policies are usually a part of an agreement between a firm and an insurance company, are therefore and comparable with the firm-linked policy described above. The contract is negotiated indirectly by settlement of the agreement. However, instead of sharing the premium defined as a percentage of the salary between the employer and the employees, only the employees' part of the premium is defined as a percentage of the salary. On the other hand, the benefits are also defined as a percentage of the salary. This leaves a risk on the premium side. This risk is split between the employer and the insurance company according to the agreement. If the risk is left to the insurance company exclusively, then neither the employer nor the policy holder participates in the development in the market but leaves all risk to the insurance company. In contrast, if the risk is left to the employer exclusively, the insurance company is pure administrator and takes no risk. As mentioned above, a certain part of the defined contribution policies, where the surplus is redistributed as cash or used to decrease the premiums, can actually be considered as defined benefit policies with partly defined contributions.

The classification given above is fairly broad. When discussing details, there may be a lot of differences in the concrete formulations of the various agreements and contracts. Policies belonging to different classes may also be mixed within an agreement and within a contract. In the following, we concentrate on defined contributions with partly defined benefits. Although most of the ideas presented in Chapters 2–5 may be applied to defined benefits as well, all examples and interpretations take the defined contributions with partly defined benefits policy as a starting point. as:eksist It should be mentioned that in addition to the life insurance market described above, there may exist a set of public insurance schemes. For instance, in Denmark the national pension scheme is a pay-as-you-go scheme where present retirement pensioners are covered by present tax payers. In addition, the Danish state regulates a couple of particular funded pension schemes for people who work.

1.3 The policy holder's account

In our setting, the policy holder's account or the technical reserve and its dynamics are the technical elements in the handling and administration of life insurance contract. We classify the changes of the technical reserve in two different ways. The first way classifies the changes of income and outgo. The other way classifies the changes in what was agreed beforehand in a particular sense and additional changes made by the insurance company at the discretion of the company.

The technical reserve can in certain respects be interpreted as a bank account. The income on a bank account consists of capital injections and capital return provided by the bank from capital gains on investment of the account. The outgo on a bank account consists of capital withdrawals. Correspondingly, the income on an insurance account consists of premiums paid by the policy holder and return provided by the insurance company from capital gains on investment of the account. And, correspondingly, the outgo on an insurance account consists of the benefits paid to the policy holder. However, two additional terms add to the change of the account. One term is an outgo and covers the expense to the insurance company to administrate the policy. Administration expenses on the bank account must also be paid, but these are charged indirectly by a reduction of the return. The other additional term which adds to the change of the account is the so-called risk premium, which can be considered as an income or an outgo depending on its sign.

The risk premium is a premium that the policy holder pays from their account; it may be positive, in which case it can be considered as an outgo, or negative, in which case it can be considered as an income. The risk premium is paid to cover the loss to the insurance company in case an insurance event takes place in some small time interval. The amount of the potential loss is also spoken of as the sum at risk. The premium for this coverage is set to the expected value of this loss. Considering a so-called term insurance paying out a sum upon death, the loss to the insurance company in case of death equals the death sum which has to be paid out minus the technical reserve which, on the other hand, can be cashed. The expected value of that loss is the difference between the death sum and the technical reserve times the probability of dying in some small time interval. The death sum exceeds the technical reserve such that the risk premium is positive and can be considered as an outgo. Considering instead a pure endowment insurance, the insurance company cashes the technical reserve upon death and has no obligations. The expected value of this gain is the technical reserve times the probability of dying in a small interval. This results in a negative risk premium, and the

risk premium may be considered as an income. In addition, the bank account can be interpreted as an insurance contract where the technical reserve is simply paid out upon death. This gives a potential loss upon death of the technical reserve paid out minus the technical reserve cashed, whereby the risk premium equals zero.

The term insurance and the pure endowment insurance are simple insurance contracts. If we introduce such things as disability annuities, premium waiver and deferred benefits, the picture becomes more blurred, but the underlying idea is basically the same. Apart from the real incomes and outgoes in form of premiums, returns and benefits, the policy holder pays or gains, depending on the sign of the risk premium, for the risk imposed on the insurance company.

Another way of classifying the changes of the technical reserve is firstly to identify the technical change which conforms with the guaranteed payments and then identify the additional changes made by the insurance company at the discretion of the company. When an insurance company issues an insurance policy, it guarantees a minimum benefit which is based on a technical return. Furthermore, the minimum benefit is based on a certain technical probability of the insurance event, for example the probability of dying in a small time interval. Finally, it is based on a technical amount for administration expenses. Basically, it simply guarantees to pay out a benefit which is "fair" under a certain set of assumptions on return, insurance risk and expenses. However, this set of assumptions is meant to be set so conservatively that a surplus emerges over time. This surplus is provided by the policy holder due to conservatism in assumptions and has to be paid back as the real market conditions evolve. This is achieved by adding dividends to the policy holder's account.

The law states that the surplus must be paid back to those who created it. The usual way of allocating the dividends is to change the account, not in correspondence with the technical assumptions, but in correspondence with a set of assumptions that is more favorable to the policy holder. Then, we can classify, element by element, the technical change and the additional change. Concerning the return, the insurance company firstly pays the technical return. Secondly, it pays the difference between the more favorable return and the technical return. Concerning the mortality, the insurance company firstly collects a risk premium in correspondence with the technical probability of death. Secondly, it pays back the difference between the risk premiums in correspondence with the more favorable probability and the technical probability. Concerning the expenses, the insurance company firstly withdraws the technical amount for expenses. Secondly, it pays back the difference between the more favorable amount and the technical amount for expenses. The use of the favorable assumption is that, element by element, the policy holder

should not be put into a worse position than if the technical assumption had been used.

The favorable development of the account including dividends may be used to reach a higher value to be paid out as a pension sum at the termination of the contract. However, the policy holder may also wish that this favorable development provides capital for an increase of benefits and/or a decrease of premiums throughout the term of the policy. This has a feedback effect on the dynamics of the account, since premiums, benefits and risk premiums need to be adjusted in the light of such a change of payments. One construction is to let the death sum and the pension sum increase proportionally, such that the ratio between the two benefits is constant. However, the most typical constructions are to let the death sum be constant or regulated by some price index and then use the residual dividends to increase the pension sum.

We should mention an alternative application of dividends which has gained ground in recent years. Instead of increasing benefits and/or decreasing premiums, one may keep the guaranteed payments and instead change the underlying technical assumptions. In this way, dividends are added to the policy holder's account without changing the guaranteed payments. One may then ask: where did the money go and does allocation of dividends really put the policy holder in a better position? The point is that paying out dividends leads to what seems to be less favorable technical conditions. However, the guaranteed payments are not changed and can therefore not be less favorable. Furthermore, the consequence of less favorable technical conditions is higher surplus contributions in the future. And since these surplus contributions eventually have to be redistributed and reflected in payments, the position is indeed favorable. By this construction, allocation of dividends in a way postpone the increment of guaranteed benefits without postponing the increment of the account.

1.4 Dividends and bonus

The premiums agreed upon at the time of issuance of an insurance policy are "too high" compared with the benefits that are guaranteed at the time of issuance. This disproportion is the source of surplus, and it is stated by law that this surplus should be paid back to those policy holders who created it. In practice, this happens in two steps. Firstly, the surplus is distributed among the owners of the insurance company and the group of policy holders, and, secondly, the surplus distributed to the policy holders is distributed among the policy holders.

So, why should the owners of the company take part in the surplus that was created by policy holders? The problem is that "too high" may not be high enough. The insurance company is allowed to invest not only in fixed income assets, but also in stocks. Investment in stocks is, however, a risky business, and the insurance company may end up in a situation where it is not possible to increase the policy holder's account by the technical interest rate by means of capital gains. In that situation the owners of the insurance company must still provide capital for the technical increments of the technical reserve. Also, concerning mortality and expenses the insurance company may experience a situation worse than that considered as the worst possible case at the time of issuance. Concerning mortality and other kinds of insurance risk, medical, sociological and demographic uncertainties play a different role. The insurance company may need to help by injecting capital in the technical reserve in order to live up to the technical conditions. The owners of the insurance company must eventually cover the loss on the insurance portfolio.

The risk that things may go wrong, leading to the owners having to pay, is the reason why they, when things go right, deserve a share in the surplus created by the insurance portfolio. However, the distribution of surplus between owners and policy holders has to be fair in some sense. One of the purposes of this book is to provide the insurance companies with tools and ideas to make distributions that, to an increasing extent, are fair.

The part of the surplus distributed to the policy holders is deposited in the so-called undistributed reserve. That is, this reserve is distributed to the policy holders as a group but is not yet distributed among the policy holders. The distribution among policy holders takes place by deciding on the favorable set of assumptions introduced above. This mechanism transfers money from the undistributed reserve to the individual policy holder's account. As was required from the distribution between owners and policy holders, the mutual distribution between policy holders is also required to be fair. Fairness is here given by the statement that the surplus should be redistributed to those who earned it. A redistribution of the surplus to those who earned it has two consequences.

The first consequence is that the insurance company is not allowed to grow "large" undistributed reserves. This would systematically redistribute surplus from the past and present policy holders to the future policy holders. Thus, the insurance company needs to assign the undistributed reserve to the individual technical reserves "in due time." Here, "due time" is, of course, closely connected to the risk of the insurance company owners to eventually suffer a loss on the portfolio, which again connects to the owner's share in

the surplus. If the undistributed reserve is high, then this reserve can take a big loss before the owners have to take over. Then the insurance portfolio pays a small, possibly zero, premium to the owners for taking risk. If the undistributed reserve is low, then this reserve may easily run out, and the insurance portfolio must pay a larger premium to the owners. This shows that the solution to a fair distribution of the surplus between the owners and the policy holders interacts substantially with the solution to a fair mutual redistribution amongst policy holders over time.

The second consequence is that, given a redistribution to the present policy holders, this must happen in a way that reflects which present policy holders have contributed a lot to the surplus and which have contributed less. Such a mechanism can be imposed by favorable assumptions on interest rates, mortality and expenses. The return is proportional to the technical reserve, the risk premium is proportional to the sum at risk, and the expense is typically formalized as a part of the premium. Therefore the individual technical reserve, the sum at risk and the premium determine the individual share in the total distribution. Once a redistribution from the undistributed reserve among the policy holders is elected to happen now instead of later, the set of favorable assumptions must to some extent reflect the present policy holder's contributions to the undistributed reserves.

Depending on the bonus scheme, the policy holder may experience the redistribution in different ways. The typical construction is to increase the benefits proportionally or to increase the pension sum residually, for example, after a price index regulation of the death sum. The redistribution may also be paid out as cash.

The redistribution of the surplus between the owners of the company and the policy holders and the mutual redistribution between policy holders are regulated by law and overseen by the supervisory authorities. Thus, they are not directly specified in the contract. However, they make up a part of the legislative environment in which the contract has been agreed upon, and therefore they can be considered, in many respects, as part of the contract itself. On the other hand, the conversion of dividends into payments on the individual policy is a part of the individual policy conditions. Therefore, this conversion is directly negotiable between the insurance company and the policy holder or, in the case of a firm-linked or labor-linked contract, between the company and the firm or labor organization, respectively. It is important to realize how the legislative environment and the contract, in combination, make up the conditions for all changes that are made over time by the insurance company to the premiums and benefits agreed upon at issuance. Firstly, the distribution between owners and policy holders (regulated by law);

secondly, the distribution mutually among policy holders (regulated by law); and thirdly, by changing the terms in the individual policy (regulated by the contract).

1.5 Unit-linked insurance and beyond

Several features characterize the participating policy as explained above. The policy holder participates in a mutual fund, so to speak, together with the other policy holders and together with the owners of the insurance company. The legislative environment sets the conditions for this cooperation. However, it may be difficult for the individual policy holder to understand whether the conditions are followed, in particular concerning the several layers of fair distributions. Even by representation of their ambassadors in the cooperation in the form of the supervisory authorities, this may be a difficult task. One way of avoiding the problems with fair distribution is that each and every single policy holder forms their own individual fund. This is what happens in unit-linked insurance.

In a unit-linked insurance contract, the policy holder does not participate in a mutual fund but decides on their own investments to some extent. The participating policies hold a very strong position in many countries and the unit-linked market has been long in coming, but since the beginning of the twenty-first century life insurance companies in these countries have started to offer unit-linked insurance contracts. The unit-linked insurance contract can be decorated with many different kinds of guarantees, and insurance companies have shown some creativity on that point. However, the market is still young, and there is still a lot of space for new developments and improvements.

When giving up the investment cooperation and entering into unit-linked contracts, policy holders typically also give up certain features of the participating policy. By working with an undistributed reserve, one achieves a smoothing effect of the market conditions. The undistributed reserve protects the underlying technical reserves, and hereby the guaranteed payments, from shocks in the market conditions. The technical reserves then only experience a smoothed effect from such shocks. However, it is important to realize that these smoothing effects do not rely particularly on the policy holders' participation in an investment cooperation. There is, in principle, no problem in maintaining the smoothing effect in a unit-linked insurance policy. This is only a matter of a proper definition of the unit to which the payments of the contract are linked. Some insurance companies have introduced advanced

unit-linked products which maintain the smoothing effect. When speaking of such products as unit-linked contracts, our characterization of unit-linked products is that the investment game is an individual matter. If the investment game is individualized, then the unit-linked contract stays unit-linked, no matter the complexity of the unit, even when including any kind of smoothing effect.

One may argue that a unit-linked insurance contract endowed appropriately with smoothing effects and guarantees is close, both in spirit and in payments, to a participating policy. On the other hand, one may also argue that it makes a huge difference whether the conditions for smoothing effects and the guarantees are stated in the contract and individualized or are given in the legislative environment by somewhat more vague statements on fairness. One challenge is to incorporate the participating policies in an environment of finance theory, as has successfully been achieved for unit-linked policies. However, a proper description of unit-linked products in terms of finance theory requires an enlargement of this environment. Furthermore, an appropriate enlargement of this environment is definitely needed to deal with the complex nature of participating contracts and the special conditions of the life and pension insurance market in general. One of the aims of the remaining chapters of this book is to provide the reader with a box of tools that can be applied for working with this challenge with theoretical substantiation.