Chapter 2
The Insurer's Perspective: Managing Risks

2.1 The Risk Transfer Process

The transfer of risks from individuals to an insurer implements a "transformation" of the risks themselves. The main aim of this section is to provide the reader with an insight into such a transformation.

2.1.1 The Risks Transferred to the Insurer

A number of definitions have been proposed for the term "risk", some of which belong to common language, whereas others relate to more specific business language, and the language of insurance business in particular.

As far as health-related events are concerned, we can define risk as the financial consequence of any temporary or permanent alteration of the individual's health conditions, which can cause either health care costs or a negative impact on income because of reduced working capacity, or both. Some examples follow:

- expenses for medicines prescribed by a physician;
- expenses for hospital stays;
- expenses for rehabilitative care;
- loss of income because of temporary (or permanent) disability.

As is clear from the examples, the above definition is rather generic. Indeed, several aspects of the possible health-related event should be specified. For instance, the event may last for either a short or a long period of time. In the latter case, the duration of the event can imply recurrent expenses, or a long-lasting loss of income.

We will not go into details in this section. More specific definitions will be provided in later sections when we deal with the various health insurance products which can provide financial protection in the face of health-related events.

E. Pitacco, *Health Insurance*, EAA Series,
DOI 10.1007/978-3-319-12235-9_2

Whatever the specific event, it is evident that the related risk is a *pure risk*, as it necessarily has a negative impact either on the income or on the wealth of an individual.

Health-related risks can be transferred to an insurer, against payment of a premium, or a sequence of periodic premiums. If one of the events specified in the insurance contract occurs, then the insurer pays the benefit, whose amount is determined according to the policy conditions. Various types of (monetary) benefits will be defined in Sect. 3.2.3.

2.1.2 The Risk Transformation

The insurance company acts as an *intermediary* in the risk transfer process. More precisely, a threefold intermediation role is played by the insurer:

- administrative;
- technical;
- financial.

The *administrative* intermediation consists in collecting premiums, issuing the insurance contracts, receiving the applications for benefits, settling the claims, and paying the benefits.

Although the importance of the administrative intermediation should not be underestimated (in particular as regards the claim settlement step), the *technical* intermediation is much more important as regards the management of the pool of risks. The role of the insurer as the technical intermediary consists in managing the mutuality within the pool of risks, namely the *portfolio*, providing the guarantee of paying the stated benefits whatever the number and the amounts of the claims, and hence taking the related risk (for more details, see Sect. 2.1.3).

Further, a *financial* intermediation is carried out when multi-year covers are involved, financed either by level premiums or by a single premium. In these cases, the insurer has to manage the funds over time, i.e. the reserves, originated by collecting the premiums (see Sects. 1.2.3 and 1.2.4).

As regards the technical intermediation, it is worth noting that, by managing the pool of risks, the insurer "transforms" the set of individual pure risks into a *speculative* risk, that is, the net result of the portfolio. The risk transformation can easily be described by referring to one-year insurance covers, e.g. providing medical expense reimbursement.

Let $X_1, X_2, \dots, X_n$ denote the random benefits paid by the insurer to the n insureds who constitute the portfolio, and let $X^{[\mathrm{P}]}$ denote the random total payout, i.e.

$$X^{[\mathrm{P}]} = X_1 + X_2 + \cdots + X_n. \tag{2.1.1}$$

The generic insured j ($j = 1, 2, \dots, n$) is charged a premium Π_j, so that the insurer cashes the amount

$$\Pi^{[P]} = \Pi_1 + \Pi_2 + \cdots + \Pi_n. \tag{2.1.2}$$

Disregarding expenses and the effect of interest over the year, the random net result is defined as follows:

$$Z^{[P]} = \Pi^{[P]} - X^{[P]}. \tag{2.1.3}$$

Assume that each premium contains an appropriate safety loading; then

$$\Pi_j > \mathbb{E}[X_j]; \quad j = 1, 2, \ldots, n, \tag{2.1.4}$$

where $\mathbb{E}[X_j]$ denotes the expected value of the payment to the generic insured j. We then find:

$$\Pi^{[P]} > \mathbb{E}[X^{[P]}] \tag{2.1.5}$$

and finally:

$$\mathbb{E}[Z^{[P]}] > 0. \tag{2.1.6}$$

Hence:

- the expected net result is positive (and is equal to the total safety loading included in the premiums) and constitutes the portfolio profit margin; we denote this profit margin by $m^{[P]}$; thus
$$m^{[P]} = \mathbb{E}[Z^{[P]}]. \tag{2.1.7}$$
- $Z^{[P]}$ can, of course, take either positive or negative values (which respectively represent either *profits* or *losses*) depending on the number and the amounts of claims in the portfolio (see Fig. 2.1).

The transformation of the individual pure risks X_j ($j = 1, 2, \ldots, n$) into the speculative risk $Z^{[P]}$ is formally represented by Eqs. (2.1.1)–(2.1.3).

Despite the safety loading $m^{[P]}$, the probability of a loss, $\mathbb{P}[Z^{[P]} < 0]$, can be rather high (see Fig. 2.1). To lower this probability, several risk management tools are available to the insurer (see Sect. 2.2), besides a raise in the safety loading, provided

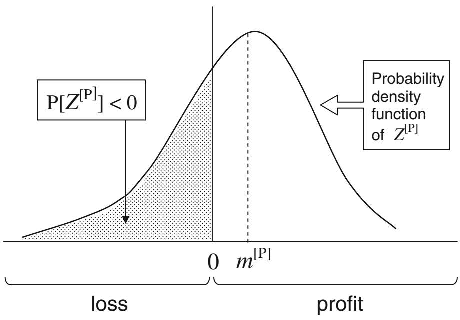


Fig. 2.1 Probability distribution of the net result from the portfolio

that this complies with obvious market constraints. Raising the safety loading (from $m^{[P]}$ to $m'^{[P]}$) determines a shift in the probability distribution of the net result $Z^{[P]}$ (see Fig. 2.2), and of course a decrease in the probability of a loss.

Moving from the individual pure risks X_j to the speculative risk $Z^{[P]}$ is one feature of the risk transformation process. The other important feature is the reduction of the *relative riskiness*. For a generic random variable Y, the relative riskiness can be quantified in terms of the *coefficient of variation*, $\mathbb{CV}[Y]$, also called the *risk index*, defined as follows:

$$\mathbb{CV}[Y] = \frac{\sigma[Y]}{\mathbb{E}[Y]}, \tag{2.1.8}$$

where $\sigma[Y]$ denotes the standard deviation of the random variable Y.

It can be proved that the relative riskiness of the portfolio net result $Z^{[P]}$, expressed by $\mathbb{CV}[Z^{[P]}]$, decreases as the portfolio size n increases, provided that some conditions concerning the random variables X_j are fulfilled. In particular, for a portfolio consisting of just one individual risk X_1, we trivially find $\mathbb{CV}[Z^{[P]}] = \mathbb{CV}[X_1]$, whereas (under appropriate conditions) we have:

$$\lim_{n\to\infty} \mathbb{CV}[Z^{[P]}] = 0. \tag{2.1.9}$$

In other words: the larger the portfolio size, the stronger is the reduction of the relative riskiness, namely the better is the *diversification*.

Remark Independence among individual risks plays an important role in achieving the diversification effect. However, the independence assumption should be questioned when catastrophic events, such as pandemics, are considered. For a more detailed discussion of risk diversification via pooling, in analytical and numerical terms, the reader should refer to the textbooks cited in Sect. 2.4. ■

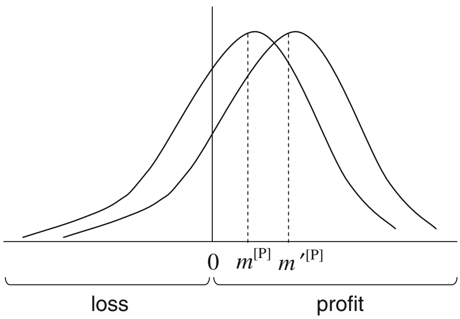


Fig. 2.2 Shift in the probability distribution of the net result

2.1.3 Insurer's Risk: Causes, Factors, Components

For a given type of health insurance cover, the possible outcomes of the random variables X_j (and the related probability distributions) are affected by several *risk causes*, also called *risk sources*. Of course, the outcomes of the X_j's contribute in determining the portfolio net result $Z^{[P]}$. Some examples follow:

- the morbidity among the insureds;
- the policyholders' behavior, and in particular the personal attitude of each policyholder towards health, which impacts on the "utilization" of the insurance cover;
- the mortality of the insureds, particularly relevant in the case of multi-year (and especially lifelong) covers.

Other risk causes directly affect the net result $Z^{[P]}$, for instance:

- the investment performance, in multi-year insurance covers financed via level premiums (or via a single premium) which imply a reserving process and hence the investment of the related assets (see the financial intermediation addressed in Sect. 2.1.2).

The various risk causes (and, in particular, the outcomes of the X_j's) impact on the net result $Z^{[P]}$. However, a more or less severe impact is a consequence of several *risk factors*, which can either raise or lower the effect of some risk causes on the portfolio result.

Some examples of risk factors follow (see also Fig. 2.3):

- a larger portfolio size improves the diversification effect, by reducing the relative riskiness of the portfolio result (as mentioned in Sect. 2.1.2);
- a small number of policies with (relatively) very high limit values, or sums assured, can jeopardize the diversification effect, at least to some extent; hence, the distributions of sums assured affects the riskiness of the portfolio net result;

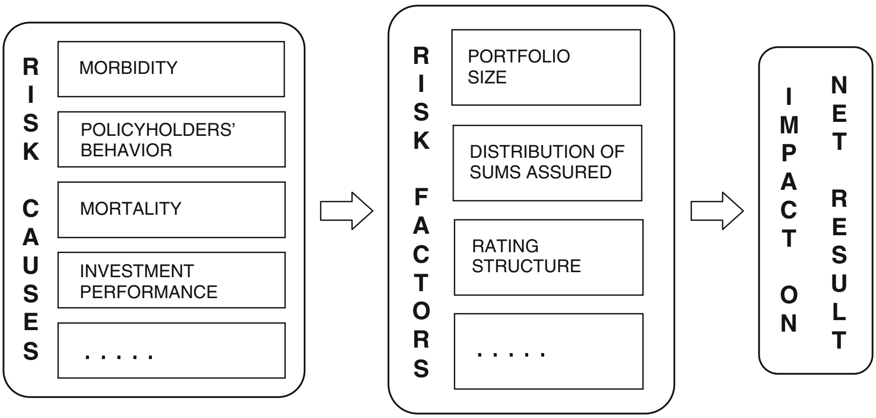


Fig. 2.3 From risk causes to portfolio net result

- of course, the rating structure adopted for premium calculations has a direct impact on the premium inflow $\Pi^{[P]}$ and hence on the net result $Z^{[P]}$.

As noted in Sect. 2.1.2, the net result $Z^{[P]}$ can take values far (and even very far) from its expected value $\mathbb{E}[Z^{[P]}] = m^{[P]}$, that is, the expected profit. In order to understand the reasons which can lead to a result significantly different from its expected value, an in-depth analysis is required.

For simplicity, we refer to fixed amount benefits provided by accident insurance in the case of total and permanent disability (see Sect. 3.3). We also assume that the sum assured, x, is the same for all the n policies in the portfolio. It follows that the total payout can be expressed as follows:

$$X^{[P]} = Kx, \tag{2.1.10}$$

where K denotes the random number of claims in the portfolio. Further, we suppose that the same probability of accident, p, is assigned to all the individuals. The expected value of the total payout is then given by:

$$\mathbb{E}[X^{[P]}] = \mathbb{E}[K]\,x = npx. \tag{2.1.11}$$

Let k denote the actual number of claims in the portfolio. If $k = np$, or, in terms of (relative) frequency, if $\frac{k}{n} = p$, the outcome of the total payout is given by npx, and hence coincides with its expected value. The portfolio result is then a profit, exactly equal to the expected profit $\mathbb{E}[Z^{[P]}] = m^{[P]}$ (see Eqs. (2.1.5)–(2.1.7)).

This (ideal) situation is represented by Fig. 2.4, in terms of the behavior of the (relative) actual frequency $\frac{k}{n}$ throughout time.

Conversely, we may find that $f \neq p$, at least in some years, and clearly our concern is for the case $f > p$. Figure 2.5 sketches three portfolio stories in which we find that, in various years, we have $f \neq p$. Reasons underlying this inequality may be quite different in each of the three stories.

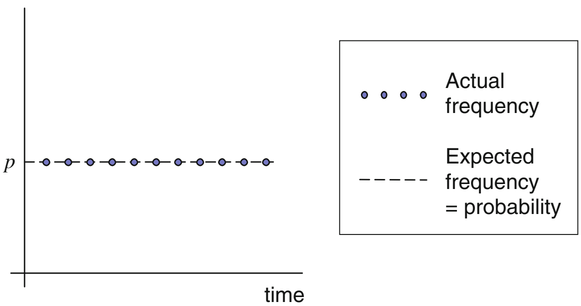


Fig. 2.4 Behavior of the relative frequency: the "ideal" situation

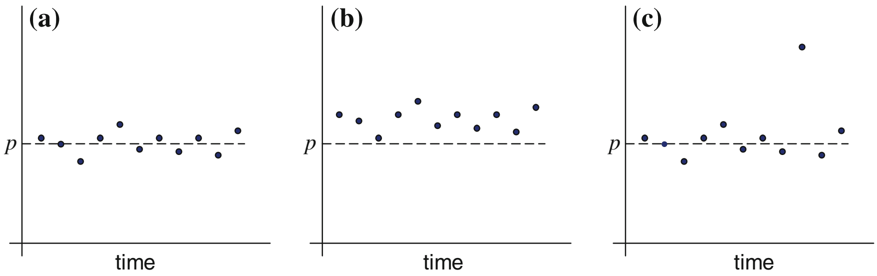


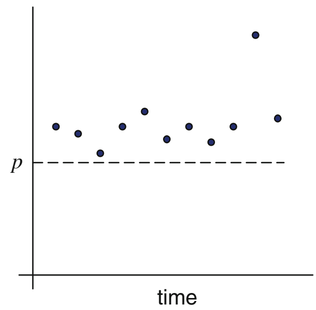
Fig. 2.5 Behavior of the relative frequency: more realistic situations

- In Fig. 2.5a, we see that the observed claim frequency randomly fluctuates around the probability, namely around the expected frequency p. This possibility is usually denoted as the *risk of random fluctuations*, or the *process risk*, or the *idiosyncratic risk*.
- In contrast, Fig. 2.5b depicts a situation in which, besides random fluctuations, we see "systematic" deviations from the expected frequency; this likely occurs because the assessment of the probability p does not capture the true nature of the insured risks. This possibility is usually called the *risk of systematic deviations*, or the *uncertainty risk*, referring to the uncertainty in the assessment of the expected frequency.
- In Fig. 2.5c, the effect of a "catastrophe", which causes a huge number of claims in a given year, clearly appears. This possibility is commonly known as the *catastrophe risk*.

Finally, Fig. 2.6 shows the combined effect of random fluctuations, systematic deviations and catastrophe risk.

Hence, three *risk components* have been singled out. All the components impact on the portfolio net result. However, the severity of the impact strongly depends on the portfolio structure, and the portfolio size in particular (as anticipated in Sect. 2.1.3).

Fig. 2.6 Behavior of the relative frequency: combined effect



- The severity of the risk of random fluctuations decreases, in relative terms, as the portfolio size increases. This feature is a direct consequence of the risk pooling (see Sect. 2.1.2), and thus is commonly known as the *pooling effect*.
- The severity of the risk of systematic deviations is independent, in relative terms, of the portfolio size. Indeed, the systematic deviations affect the pool as an aggregate. Conversely, the total impact on portfolio results increases as the portfolio size increases.
- The severity of the catastrophe risk can be higher due, for example, to a high concentration of insured risks within a geographic area; as regards accident insurance in particular, a high concentration may refer to a group insurance policy (see Sect. 3.10) related to a large number of workers operating in the same workplace.

2.2 Risk Management Issues

The chapters dealing with (basic) actuarial models for health insurance (namely Chaps. 5 and 6) will focus on the traditional equivalence principle for premium and reserve calculations. However, models which are more complex than those based on the equivalence principle are needed for pricing insurance products that provide the policyholders with significant guarantees (hence charging the insurer with the related risks), and, more generally, for managing these products.

Actually, allowing in explicit terms for the impact of risks on portfolio results and the consequently needed "actions" implies the use of stochastic models and, in particular, of quantities like the Value at Risk (VaR) and the Tail Value at Risk (TVaR). While going into details regarding these issues is beyond the scope of this textbook, a glance at the main ideas underlying risk management principles can constitute a useful complement to one's knowledge of health insurance technical issues.

Remark In what follows we focus on some specific aspects of risk management. A wider perspective can be achieved by adopting the Enterprise Risk Management (ERM) approach, which provides guidelines for the management of risks, with an extensive range of applications (banking, insurance, commerce, industry, etc.). Actually, ERM is a holistic management process applicable in all types of firms and institutions. For a more in-depth analysis, with particular reference to the health insurance area, the reader can refer to the papers and reports listed in Sect. 2.4. ■

2.2.1 The RM Process

The implementation of the risk management (RM) principles takes place via the RM process.

The RM process essentially consists of the following steps (see Fig. 2.7).

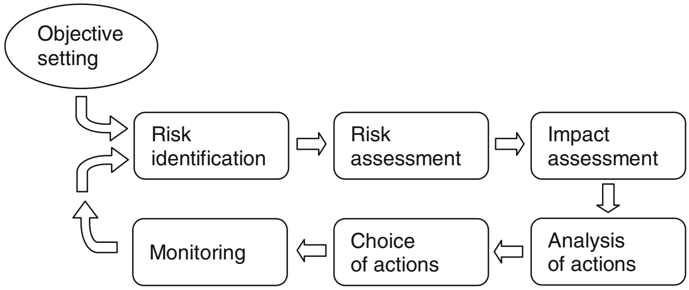


Fig. 2.7 Steps in the RM process

1. *Objective setting*. Any line of business (and hence health insurance portfolios in particular) aims at achieving given targets; some examples follow:
   - profit
   - value creation
   - solvency
   - market share
   - …

   We will pay special attention to solvency and value creation in Sect. 2.2.2.
2. *Risk identification*. In this step risk "causes" (morbidity, disability, mortality/longevity, expenses, etc.) and risk "components" (random fluctuations, systematic deviations, catastrophic risk) are singled out (see also Sect. 2.1.3).
3. *Risk assessment*. Risk causes and risk components are expressed in quantitative terms via appropriate stochastic models (viz probability distributions).
4. *Impact assessment*. The impact of risk causes and risk components on results of interest (portfolio net result, cash-flows, profits, assets, etc.) is quantified in terms of probability distributions of results, and related typical values (expected values, variances, VaRs, etc.).
5. *Analysis of actions*. Costs and benefits related to possible insurer's actions (pricing of the products, reinsurance, capital allocation, etc.) are compared.
6. *Choice of actions*. Usually an appropriate mix of actions is chosen (e.g. combining reinsurance and capital allocation).
7. *Monitoring*. This step should involve both the results achieved by managing the insurance products and the statistical bases (e.g. morbidity, mortality/longevity) adopted when pricing the product.

It should be noted that the RM process is "never-ending". In fact, the monitoring step aims at checking the results of the adopted actions, and possibly suggesting a revision of the previously performed steps.

The RM process, as described above, refers to a given insurance product (or set of products), whose features (policy conditions and, in particular, guarantees and possible options) have already been defined in detail. When the insurer aims at launching a new product, the product design of course constitutes the first step

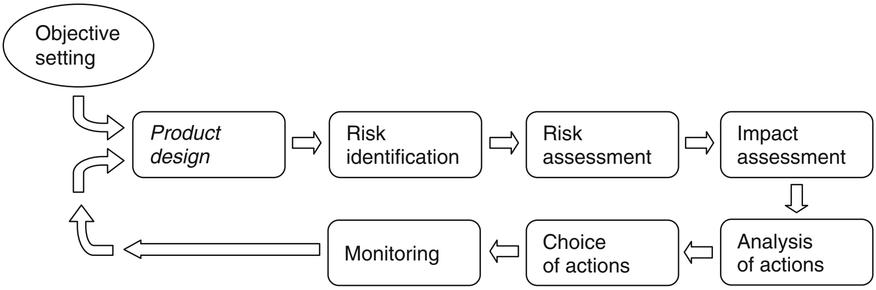


Fig. 2.8 Steps in the RM process, including product design

in the RM process (see Fig. 2.8). Then, the risk assessment and impact assessment steps might reveal a heavy risk exposure because of the product features, so that it is appropriate to include a possible re-design of the product among the actions.

Even for a given insurance product, the results provided by the monitoring phase can suggest a re-design of the product, e.g. in order to change some policy conditions and hence lower the related impact. Also in this case, it is appropriate to include the re-design of the product among the available actions.

Product design (and re-design as well) constitutes a critical step in the management of some health insurance products. An interesting example is provided by long-term care insurance (LTCI) covers (see Sect. 3.6) whose benefit structure suggests a product design involving an appropriate packaging of the specific LTCI benefits with lifetime-related benefits (some examples will be given in Sect. 3.6.3).

2.2.2 Capital Allocation: Solvency Versus Value Creation

RM principles are frequently understood as simply aiming at "risk mitigation" and, to the extent that risk impact cannot be further reduced, at finding appropriate tools to cover possible losses produced by a line of business, protecting the whole business against specific critical situations.

This interpretation is particularly inappropriate when applied to private insurance activity, given that its purpose is to gain profits by managing risks taken from other subjects, and this must be supported by a convenient amount of "risk appetite".

Indeed, a more appropriate interpretation of the RM principles and process should be driven by the objects of the activity (the insurance activity in particular) to which RM principles are applied, as clearly appears in the graphical representation of the RM process in Figs. 2.7 and 2.8.

All the objectives of the insurance activity should be carefully accounted for in the choice-of-actions step, which, as already noted, should consist in a convenient mix of "basic" actions.

Capital allocation is one of the basic actions, which aims at providing funds to cover possible portfolio losses. As is well known, capital allocation is mandatory to the extent that it is imposed by a specific solvency regime.

On the one hand, the higher the capital allocation, the higher the insurers' degree of solvency (which is, of course, one of the targets of the insurance risk management). On the other hand, allocating capital obviously implies a cost to the shareholders. The cost of shareholders' capital does not contribute in determining the insurer's profit. Conversely, *creation of value* relies on the possibility of covering all the cost, the cost of shareholders' capital included. Hence, the cost of capital allocation (besides the solvency requirements) should be carefully assessed when choosing the mix of RM actions.

2.3 Risks Inherent in the Random Lifetime

In the framework of risks related to the management of health costs, special attention should be placed on risks arising from the randomness of individual lifetimes. These risks should be carefully considered by both the individuals in the context of the household wealth management, and the insurers as regards the portfolio management when multi-year covers financed by level premiums are involved.

In what follows, we first focus on the so-called individual longevity risk (Sect. 2.3.1), then move on to the aggregate longevity risk (Sect. 2.3.2), which in particular arises from the uncertainty in future mortality trends (and thus constitutes an example of uncertainty risk, see Sect. 2.1.3). Finally, we address some issues concerning the management of lifetime-related risks (Sect. 2.3.3).

2.3.1 The Individual Lifetime

The lifetime of any given individual is, in mathematical terms, a random variable. Random fluctuations of the outcomes of individual lifetimes around the life expectancy (consistent with a given age-pattern of mortality) constitute the apparent consequence of this randomness.

The randomness in the individual lifetime is usually called the *individual longevity risk*. From a wealth management perspective, a consequence of the individual longevity risk is the risk of outliving the resources in the post-retirement period, in particular if an appropriate life annuity/pension is not available to the retiree.

As regards health-related costs, a lifelong insurance cover can face the impact of the individual longevity risk, provided that the insurance cover is financed in advance via a sequence of temporary periodic (possibly level) premiums (see Fig. 2.9). In this case, the insurer takes the risk inherent in the choice of the mortality assumption. This issue will again be addressed in Sect. 4.2.2.

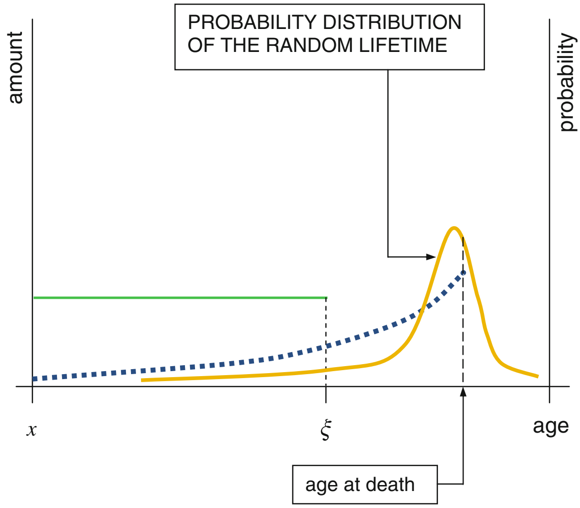


Fig. 2.9 Level premiums, natural premiums, and random lifetime

Various models have been proposed for the representation of the age-pattern of mortality, in terms of a life table or a survival function, which constitutes the mortality component of the *biometric assumptions*, also including, in the health insurance area, hypotheses about morbidity, disability, recovery, etc.

The age-pattern of mortality can be represented by various parametric models. In particular, the *Heligman–Pollard laws* take into account, thanks to their three terms, infant mortality, young-adult mortality, and senescent mortality. The first Heligman–Pollard law is given by the following expression:

$$\frac{q_x}{1-q_x} = \underbrace{A^{(x+B)^C}}_{\text{infant mortality}} + \underbrace{D e^{-E\,(\ln x - \ln F)^2}}_{\text{young-adult mortality}} + \underbrace{G H^x}_{\text{senescent mortality}}, \tag{2.3.1}$$

where x denotes the attained age and q_x the probability of dying between age x and $x+1$ for an individual aged x. The quantities $\frac{q_x}{1-q_x}$ are called the mortality odds.

Thanks to the numerous parameters, a high degree of flexibility is allowed by the law (2.3.1), so to represent a broad range of possible mortality assumptions. This law will be adopted in the numerical examples in Chaps. 5 and 6.

Example 2.3.1 Consider the Heligman–Pollard law with the following parameters:

$$\begin{array}{llll} A = 0.00054 & B = 0.017 & C = 0.101 & D = 0.00013 \\ E = 10.7200 & F = 18.67 & G = 1.464\times 10^{-5} & H = 1.11000 \end{array}$$

We find in particular:

- life expectancy
  - at the birth: $\overset{\circ}{e}_0 = 79.412$
  - at age 40: $\overset{\circ}{e}_{40} = 40.653$
  - at age 65: $\overset{\circ}{e}_{65} = 18.352$
- Lexis point: $x^{[L]} = 85$

In Figs. 2.10 and 2.11 the probabilities q_x of dying between age x and $x+1$ for a person aged x, and their logarithms, are respectively plotted. Conversely, Fig. 2.12 shows the probabilities ${}_{x|1}q_0$ of dying between age x and $x+1$ for a newborn. □

2.3.2 *The Longevity Dynamics*

In many countries, mortality experience over the last decades shows some aspects affecting the shape of curves representing mortality as a function of the attained age. Figure 2.13 illustrates the moving mortality scenario for the Italian male population, in terms of curves of death, i.e. in terms of the number of people dying at age x, d_x, according to the usual demographic and actuarial notation; Fig. 2.14 provides the same information in terms of survival curves, i.e. in terms of the number of survivors at age x, ℓ_x, out of a notional cohort consisting of 100 000 newborns. The survival curves and the curves of deaths relate to various period mortality observations from 1881 to 2002 ("SIM t" refers to period observations on Italian males centered on calendar year t). Obviously, experienced trends also affect the behavior of other quantities expressing the mortality pattern, such as the life expectancy and the one-year probabilities of dying.

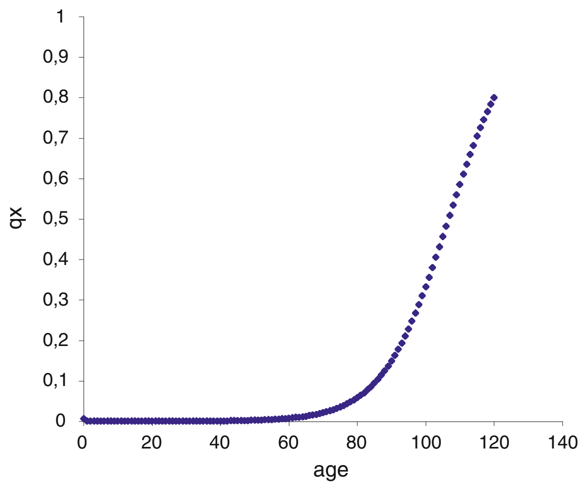


Fig. 2.10 The first Heligman–Pollard law: q_x

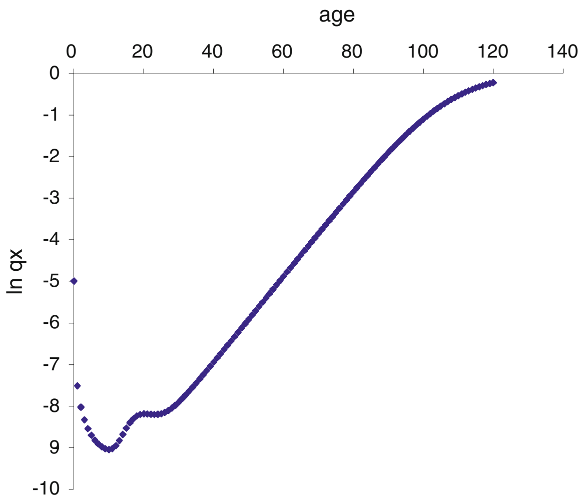


Fig. 2.11 The first Heligman–Pollard law: $\ln q_x$

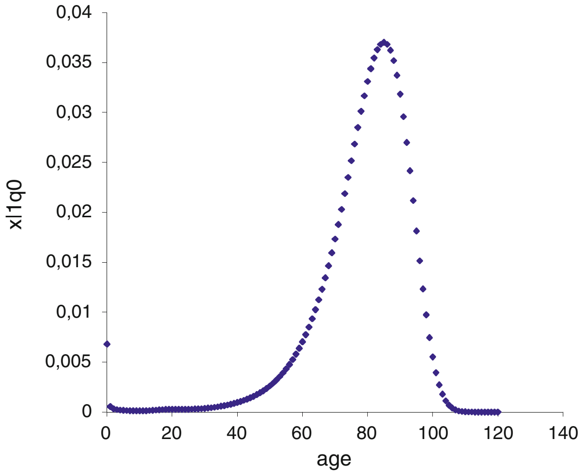


Fig. 2.12 The first Heligman–Pollard law: ${}_{x|1}q_0$

In particular the following aspects can be pointed out:

1. an increase in the life expectancy (at the birth as well as at old ages);
2. a decrease in the infant mortality, and in one-year probabilities of dying, q_x, in particular at adult and old ages.

Further, as regards the shape of the survival curves and the curve of deaths, the following aspects of mortality, common to many countries, can be singled out:

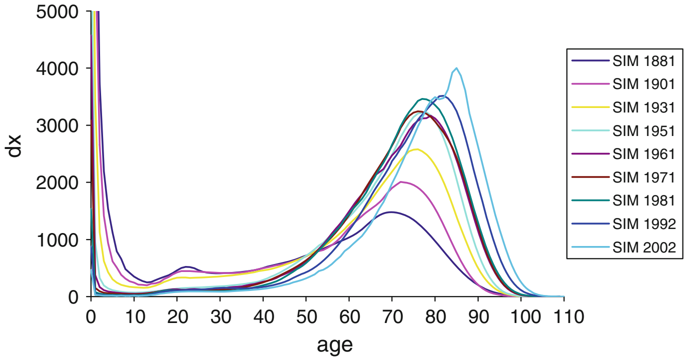


Fig. 2.13 Curves of death

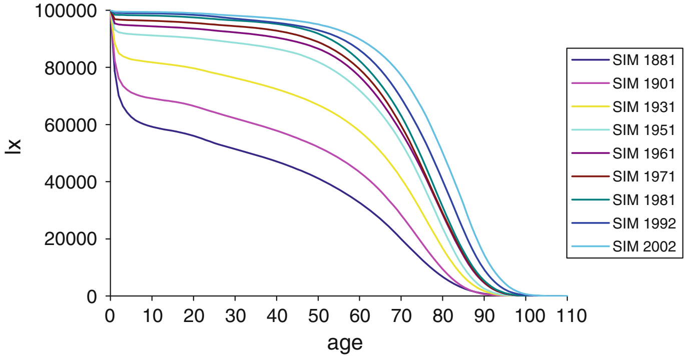


Fig. 2.14 Survival curves

3. an increasing concentration of deaths around the mode at old ages (that is, the Lexis point) of the curve of deaths is evident; so the survival function moves towards a rectangular shape, whence the term *rectangularization* to denote this aspect;
4. the mode of the curve of deaths (which, because of the rectangularization, tends to coincide with the maximum attainable age ω) moves towards very old ages; this aspect is called the *expansion* of the survival function;
5. higher levels and a larger dispersion of accidental deaths at young-adult ages (the so-called *young mortality hump*) have been observed more recently.

The progressive decline of human mortality, witnessed by a number of population statistics, suggests the rejection of the hypothesis of "static" mortality, which would lead to biased actuarial evaluations. Then, trends in mortality imply the use of "projected" life tables or mortality laws, for several purposes in life and health insurance, especially when long-term insurance products are concerned, for example life annuities and lifelong health insurance covers. A forecast of future mortality trend underpins the construction of projected life tables and mortality laws.

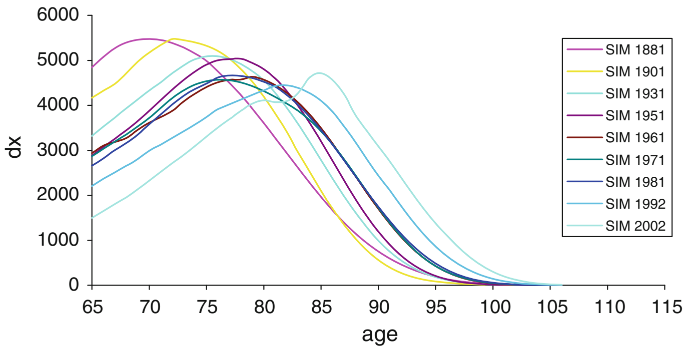


Fig. 2.15 Curves of death conditional on attaining age 65

It is also worth noting that an increasing dispersion of the individual lifetime conditional on attaining a given adult age (say, 65) has been observed in many countries, in contrast to the rectangularization over the whole lifespan. This aspect is shown in Fig. 2.15, in terms of numbers of people dying out of a notional cohort of people alive at age 65.

Whatever projected life table (or parametric law) is assumed for actuarial calculations, the future trend in mortality is random. The risk then arises that the average lifetime in a population (or portfolio) is larger than what has been expected according to the projected life table. This risk is called the *aggregate longevity risk*.

2.3.3 Managing the Longevity Risk

The individual longevity risk (see Sect. 2.3.1) and the aggregate longevity risk are the two components of what is named the *longevity risk* for short, that is, the risk that an individual lifetime or the average lifetime (in a given population) is higher than expected.

Splitting the longevity risk into the two components is important especially from the insurer's point of view. Indeed, the following features of the two components should be stressed.

- It is well known that the individual longevity risk (which is a "process risk", see Sect. 2.1.3) can be diversified via pooling. Referring to the total payout of an insurance portfolio, the relative impact of this component, which can be quantified by the risk index (or coefficient of variation), decreases as the size of the portfolio increases. If this size cannot be increased, (traditional) reinsurance transfers help in managing the individual longevity risk.
- The relative impact of the aggregate longevity risk is independent of the portfolio size (whereas the absolute impact on the portfolio payout increases as the portfolio size increases). Hence, no diversification is possible thanks to the pool

size or the traditional reinsurance arrangements. Alternative risk transfers must be implemented, as this risk component may have a dramatic impact on long-term products, viz life annuities and pensions, and on lifelong health insurance covers in particular.

An in-depth analysis of the longevity risk is beyond the scope of this book. The reader can refer to the relevant bibliographic suggestions in Sect. 2.4 and, as regards lifelong sickness insurance, in Sect. 5.6. Further, specific issues regarding the dynamics of disability-related life expectancy will be addressed in Sect. 6.16.3, and relevant bibliographic suggestions will be provided in Sect. 6.18.

2.4 Suggestions for Further Reading

General aspects of risk transfer to a pool and the specific role of the insurer in the pooling process are analyzed in Olivieri and Pitacco (2011).

The role of Enterprise Risk Management (ERM) in insurance and pensions is discussed in IAA (2009, 2011), whereas Orros and Smith (2010) and Rudolph (2009) specifically deal with ERM in the health insurance area; Orros and Howell (2008) in particular focusses on creation of value in health insurance.

Longevity issues (and the longevity risk in particular) are addressed in Pitacco et al. (2009); the interested reader should also refer to the numerous citations therein.

Springer

http://www.springer.com/978-3-319-12234-2

Health Insurance
Basic Actuarial Models
Pitacco, E.
2014, XII, 162 p. 77 illus., 14 illus. in color., Softcover
ISBN: 978-3-319-12234-2