Mutuality and solidarity: assessing risks and sharing losses

DAVID WILKIE

Watson Wyatt Consulting Actuaries and Heriot Watt University, Dennington, Ridgeway, Horsell, Woking GU21 4QR, UK

SUMMARY

Mutuality is the principle of private, commerical insurance; individuals enter the pool for sharing losses, and pay according to the best estimate of the risk they bring with them. Solidarity is the sharing of losses with payment according to some other scheme; this is the principle of state social insurance; essential features of solidarity are comprehensiveness and compulsion. Private insurance is subject to the *uberrima fides* principle, or utmost good faith; each side declares all it knows about the risk. The Disability Discrimination Act requires insurers to justify disability discrimination on the basis of relevant information, acturial, statistical or medical, on which it is reasonable to rely. It could be very damaging to private insurance to abandon *uberrima fides*. However, although some genetic information is clearly useful to underwriters, other information may be so general as to be of little use. The way in which mortality rates are assessed is also explained.

Towards the end of Alasdair Gray's great novel *Lanark*, when the eponymous hero is getting old, a visitor approaches him with a message from a higher authority. 'We have been sent to bestow on you an extraordinary privilege. You will die tomorrow at seven minutes after noon.' Lanark whispered: 'Death is not a privilege'. 'The privilege is knowing when.' I have abbreviated Alasdair Gray's brilliant style (Gray 1981).

I should like you to imagine a world where we all have the privilege of consulting, say, an astrologer, one of a group of individuals who (at least in the opinion of our learned judges) are much more entertaining than actuaries, to find out reliably the date of our death. I am sure that this imagined world would have many features different from our present one, but the feature I want to concentrate on is that it would make life insurance as we know it impossible.

Assume first that everyone had complete information about the prospective dates of death of others. An insurance company could, therefore, look up the prospective date of death of any applicant and charge a premium specifically tailored to his or her prospective lifetime. But this would be just like a savings plan for the specified period, whether the contract was written with a series of premiums and a sum assured payable on death, or a single premium now and a series of payments made until death, like an annuity. The whole point about insurance is that it is our way of dealing with uncertainty.

Consider also a world in which each individual could apply to a higher authority to find out his or her date of death, but where this information was not available to insurance companies. The insurance companies would, of necessity, have to rate cases on the basis of something like their present knowledge, except that they would know that applicants had more knowledge than them. Those who knew that they were going to live a long time would have no need for life assurance and would not apply for it, whereas those who knew that they would die soon would have no need for an annuity. Whatever terms the insurer offered, only those for whom it was a better bargain than direct investment would accept. Insurers would steadily have to move their premium rates to match the experience of those who did apply, and would then find that only those for whom it was still a better bargain would consider insurance attractive. The ultimate position would necessarily be that insurers would have to charge the full sum assured for a life assurance, on the assumption that every applicant was on his deathbed, and would have to sell annuities on the assumption that everyone would live until they were 120, or whatever the highest age ever recorded at the time had been.

If we have perfect information we have no need for insurance. If only one side has perfect information an open insurance market is killed off.

Let us look next at a slightly fictionalized account of the early days of life assurance. Someone thought that life assurance would be a good idea and suggested charging the same premium for all applicants, because all had an equal risk of dying. (The best remark I have heard on this subject was on the radio programme *Radioactive*, in a section about current news: 'Death rates remain constant, at one per person.') However, a doctor who was a friend of the promoters of the company pointed out that not all applicants were in the same state of health, and it might be a good idea to charge premiums depending upon how healthy they were. So applicants had to appear in person before the

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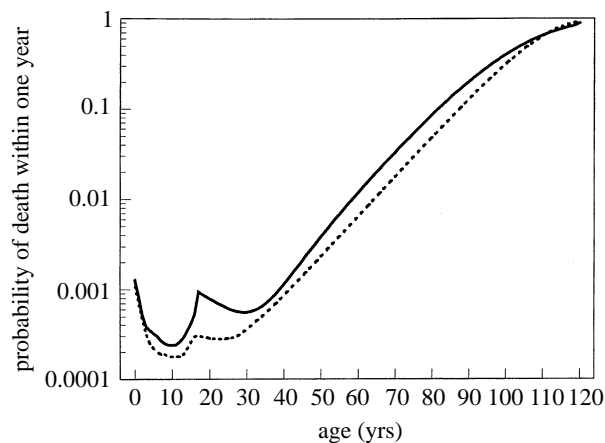*Printed in Great Britain*

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Figure 1. Mortality rates for males (solid line) and females (dotted line) using the AM80 and AF80 tables for assured lives.
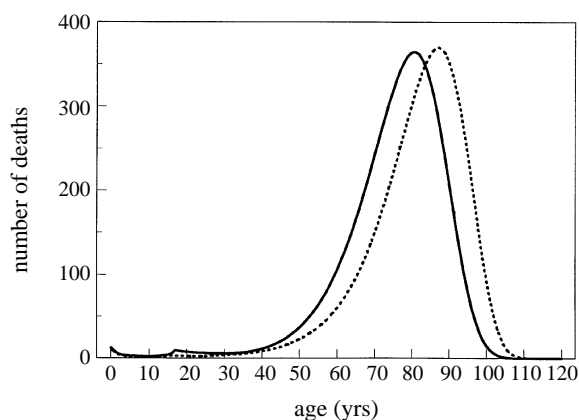

Figure 2. Curve of deaths for males (solid line) and females (dotted line).

Board of Directors, and be examined by the company physician. After a while, a mathematically inclined director suggested that as older people were less likely to be in good health, and were more likely to die sooner, it might be possible to charge premiums according to the age of the applicant and to look less closely at each applicant's precise state of health at the time. The Board agreed, and the modern actuarial profession and modern life assurance were born.

After a time, people noticed that the mortality rates of males and females were not the same. A particular mortality table, for example, for males or females, smokers or non-smokers, at a particular time, consists of a set of numbers, one for each age, showing the probability that a person in that category will die within one year. Figure 1 shows mortality rates for males and females using the AM80 and AF80 tables for assured lives. The rates nowadays are generally below 1 in 1000 at younger ages up to about age 40, and they increase with age thereafter, reaching 1 in 100 at about age 60 and 1 in 10 at about age 90. The rates double with approximately every five years of age, so if one group has double the rate of another group it is equivalent to them being about five years older, or rather, five years nearer death.

Another way of expressing the same information is through the curve of deaths, as in figure 2. This shows

the number of people out of 10 000 births, excluding immediate infant mortality, who are likely to die at each year of age. The peak age at death (81 for males, 87 for females) is where each curve reaches its peak, and it seems to me a more useful measure than the expectation of life at birth, which is unduly affected by infant mortality.

The difference between the mortality rates of the sexes has widened considerably in the past 60 years or so, therefore sex is more important now than it was in earlier periods. This has been reflected in different ways: premiums for annuities were different for the two sexes long before premiums for life assurance were, and it has been standard practice since the beginning of the century to investigate the mortality experience of male and female annuitants separately. However, the difference in premium rates for lives assured used to seem quite small, and offices originally did not differentiate by sex. They then treated females as being equivalent to males approximately four years younger (as many still do), and only relatively recently has the actuarial profession constructed a separate assured lives table for females, based in the UK on the 1975–78 experience.

It is now well known that smokers have poorer mortality rates than non-smokers. Indeed, the difference between them is much the same as the difference between the sexes, equivalent to about six years of age. This has probably been true ever since smoking began, but it was not until doctors started noticing that many people with lung cancer had been heavy smokers that the famous study by Doll & Hill was begun in the 1950s. They must have suspected something, or they would never have started the investigation.

When the early results of the Doll & Hill study came out, many doctors and actuaries believed the results and stopped smoking, or failed to take it up, much sooner than many of their patients did. The evidence was statistical, the social pressures from those who enjoyed smoking considerable. Life insurance companies generally did not start differentiating between smokers and non-smokers until about 1980. I suspect that they may have had to wait until their smoking chief executives, senior actuaries, or medical advisers had retired and a new non-smoking generation had taken over.

The actuarial profession could not start its investigations into the experience of smoking and non-smoking lives assured until after life offices had begun to differentiate and treat smoking category as a relevant rating factor. The first investigation published by the Continuous Mortality Investigation Bureau (CMIB) began only in 1988, and the results were not made public until 1992. They confirmed what had been known from the Doll & Hill study, and from earlier medical and insurance studies in the United States and elsewhere.

This is a useful case study of how, first, suspicion of the relevance of a rating factor is raised, preliminary investigations are carried out, social changes allow insurance companies to introduce relevant questions, commercial pressures lead insurance companies to

discriminate and, finally, substantive evidence, which justifies the discrimination, is produced.

Sometimes the story goes wrong. Many years ago there was a tariff among the major insurers for motor insurance. The premium depended mainly on the type of car the driver had, and very little on the characteristics of the driver. Then in the 1960s some smart people thought that if the characteristics of the driver, their age, experience and so on, were taken into account, the risks could be better selected. Alpha Insurance was a small company that did this successfully. Then the tariff broke up and all companies started moving towards rating the driver as well as the car. But one company thought it was possible to make money in motor insurance just by charging lower premiums, and undercutting the market. Vehicle & General got a great deal of business, but found that it did not have enough money to pay its claims, and went into liquidation. The reasons for its insolvency are more complicated than I have stated, but bad rating was a contributory factor.

Another example is household insurance in recent years. Long ago there was a flat tariff for household insurance of something like five shillings per cent for contents, and two shillings and sixpence per cent for buildings. Then companies noticed that burglary and theft were much higher in some districts than others, and they started changing their premium rates to reflect this. At a later date companies noticed that subsidence claims were much worse in certain districts than in others, and again started to change their premium rates to reflect this. But all they could do in the first place was to use the broad area postcode, rather than the full postcode including the last three characters. But these broad postcodes are not based on geology. It was those on clay soil who suffered from subsidence, whereas those on other soils did not. It took more investigation, and a few years of competition, with customers changing from one company to another, before companies sorted out what the right rating factors were. Householders knew what soil their house was built on even if the companies did not.

In life insurance we have recently seen the introduction of a certain amount of rating by 'lifestyle', partly in connection with the risks of HIV and AIDS, and also the introduction of 'preferred lives' premiums for those who can pass a stiffer medical examination. This new term 'preferred lives' deserves an explanation. It can be applied in two ways. One way is that the insurance company uses a number of rating factors, besides age and sex, to assess the premium; these may include occupation, social class, locality and some medical factors, rather like the way in which motor car insurance is rated. The other way is that only those who come out in the best category under such a system are accepted, what is called 'cherry-picking'.

The eighteenth-century doctor who was supplanted by the actuary was perhaps right, though before his time, because he did not have the information on which companies could base more accurate premium ratings. But even now, companies who introduce 'preferred lives' schemes may be basing their premiums more on judgement and small-scale statistical surveys than on comprehensive and reliable statistics. This is natural: any single insurance company or even insurance companies collectively cannot carry out a mortality investigation to estimate the effect of some factor unless they have the data; they won't get the data unless they ask for it; and there is no point in asking for it unless it is being used to assess the premium in the first place.

However, if the preferred lives system does lead to a great many more categories of ratings for life assurance and the disappearance of the ordinary rates system, is this a bad thing? It has already happened in motor insurance and household insurance.

Insurance has for many years been a contract of *uberrima fides* or utmost good faith, as opposed to *caveat emptor*, or let the buyer beware. Both sides in an insurance contract are obliged to declare all that they know. Usually the proposer knows much more about the circumstances than the insurance company does, so they have more to declare. Occasionally, however, it might be the other way round, when an insurer knows that the ship on which the proposer has just bought some cargo has already sunk. This principle of *uberrima fides* has been modified over the years in that courts have held that it was up to the insurance company to give some indication by their questioning of what sort of data were relevant, rather than expecting the proposer to provide an entire life history.

I do not think that either insurers or the medical profession are very good at keeping their side of the bargain. Information has been obtained confidentially by insurers from medical examiners, and occasionally from other insurers, without this information being made readily available to the applicant, at least until the Access to Medical Information Act. If all the information was made available it would be much harder for the public to accuse insurers of acting on the basis of whim or prejudice. An impartial investigator— an ombudsman for rejected applicants, say—could come to a decision on the basis of all the evidence available, which should be available to all sides.

It is not my intention to defend insurance companies, and in this respect I think they have let their case down. But the recently published Regulations under the Disability Discrimination Act come to my aid here. Insurers may continue to discriminate on the grounds of disability if 'the less favourable treatment is … based upon information (for example, actuarial or statistical data or a medical report) which is relevant to the assessment of the risk to be insured and is from a source on which it is reasonable to rely; and' is 'reasonable having regard to the information relied upon and any other relevant factors'. I would have used the words 'objectively determined'. As insurers may now be challenged by any disabled person to whom they had given less favourable treatment, they will have to ensure that any unfavourable treatment is objectively determined, and they will have to keep evidence for every proposal to them, whether accepted or not, to justify their decision. If a case came to court they would have to disclose that evidence and justify it. Even a small number of cases reaching court will ensure that insurers start to get this right, rather than relying on

the judgement or whim of the underwriter and hoping that they can come up with a good enough defence later. As the information on which insurers will have relied would have to be produced before a court later, I see no reason why it should not be disclosed in the first place if required by the proposer.

However, the Disability Discrimination Act applies only to people who are disabled, and this might not include those who have a genetic propensity but are not currently disabled. I would wish to go further and suggest that all premium rating of individuals by insurance companies, for whatever reason, should have to be objectively determined, and be challengeable.

The title of this paper includes two words, 'mutuality' and 'solidarity', that are probably unfamiliar in this context, even to British actuaries. However, they are familiar terms in the Romance languages. 'Mutuality' is the normal form of commercial insurance, whether or not it is run by a mutual insurance company or one owned by shareholders. Applicants contribute to the pool through a premium that relates to their particular risk at the time of the application, perceived as well as it can be at that time on the basis of all the facts that are available and relevant, with or without application to any astrologers. The pooled funds then pay those insured who suffer losses in accordance with the scale of their losses for things like fire, household and marine insurance, or in accordance with the agreed sum assured for life insurance.

'Solidarity' is a concept that has some similarity to mutuality, but also a profound difference. The similarity is that losses are paid according to need, and the difference is that contributions are made not in accordance with the risks that each applicant brings in with him, but perhaps according to ability to pay, or just equally. Solidarity is the basis of what goes under a variety of names, such as social security, social insurance or national insurance. The word insurance is often borrowed, but in each case it is modified by a word like social or national, which implies some measure of universality and some measure of compulsion. In Britain the term 'national insurance' is still used to describe the system whereby everyone at work is required to pay contributions, and those who are retired, unemployed, sick or whatever receive benefits according to a prescribed scale. Usually it is necessary that contributions have been paid, but there may be no direct relationship between the amount of contribution and the amount of benefit. Nowadays, the contributions are typically a proportion of income, and the benefits mostly are flat rate. There are separate benefits payable according to need through the social security scheme, which is financed primarily from taxation, which in turn is presumably related to ability to pay.

A defined benefit pension scheme, where employees pay the same percentage contribution regardless of age, has many features of solidarity in it; in this case solidarity between the generations. A defined contribution pension scheme, on the other hand, is usually designed like an individual savings plan until retirement, and then the member purchases whatever pension or annuity his personal savings will provide.

The mutuality concept comes into play after retirement, but before then only in so far as the member may invest in a pooled investment vehicle. In the UK this is called a managed fund or unit-linked fund, but in the USA it is called a mutual fund, using the mutuality concept.

It is important not to get the concepts of mutuality and solidarity mixed up. Both involve the sharing of losses, but only mutuality involves the assessment of risks. Solidarity requires comprehensiveness or compulsion; a private commercial insurance market requires mutuality.

But what does all this mean for genetics? The investigations into genetics, genetic testing and so on allow a better specification of risks for life assurance than was available previously. In some cases the mathematics of the risk are simple. For example, with autosomal dominant inheritance diseases that have a late age of onset, such as Huntington's disease or adult polycystic kidney disease, someone in their twenties might show no symptoms whatever and yet, if affected, be fated to die in their forties or fifties. If the insurance underwriter does not ask about family history or does not know his facts, applicants may well be accepted at normal premium rates. If the underwriter asks about the family history and identifies that one parent suffers or has died from the disease, an applicant is likely to be treated as 'uninsurable', though strictly speaking he or she is probably quite insurable but only at a premium rate that the insurance company thinks would be unacceptably high.

If applicants have undergone a genetic test, then, on average, half will be shown to be completely clear of the disease and would be acceptable for life insurance at normal rates, whereas the other half would be insurable only at even more unacceptably high premium rates. Whether those at risk would consider the information a privilege is a quite different social matter, which is probably far more important to the individual and the medical and genetic advisors than any insurance implications. But, purely from the insurance point of view, information about genetic testing for such autosomal dominant diseases would benefit half of those at risk while doing no harm to those found to be affected. No harm, in an insurance sense, because they were previously unacceptable to the insurer, and would remain so.

In these simple cases the statistics are tolerably well known, but many cases seem to be very much harder to assess. It seems that some people have a propensity to develop heart disease or cancer. What, numerically, is 'a propensity'? To give an indication of numbers, annual mortality rates for smokers are more than twice those for non-smokers. Annual mortality rates for males are more than twice those for females. Both show differences that are large enough to be worth taking into account. Yet, on a geographical basis, the most healthy parts of the country have mortality 20% lower than the national average and the worst areas have mortality some 30% higher. These are differences that insurers generally do not find worth taking into account for ordinary life assurance, quite apart from the difficulty of tying someone down to a particular

location when insurance is for life. It is quite different with insurance of a house, because you know where the house is, and it stays there.

In general, extra mortality that is below 40% or so extra does not attract an increased premium. Mortality two or three times the standard rate attracts an appropriate extra premium. Mortality that is more than four times the normal rate would generally be considered uninsurable. Thus a propensity needs to be significantly large, and also needs to be adequately justified statistically, before insurers can, in practice, take it into account. And mortality investigations take time. We start with a group of people, and count when they die. We need sufficiently many deaths if we are to say that those who fall into a particular category have significantly worse mortality than others. The medical profession is often dealing with people who are ill and therefore likely to die, and as a result many medical statistical investigations can work with relatively small numbers of people and be conducted fairly quickly. But insurance company investigations start out with people who are well and it takes quite a long time before enough of them die for it to be possible to say anything about their mortality rates.

In 1982, the CMIB started a study of impaired lives, that is, people who suffer from some medical impairment but are still acceptable for life insurance. The first year's data were too small to use, so the investigations started seriously in 1983. In the first eight years, 1983–90, a reasonable number had died—1500 males and 500 females—but they were spread across a large number of different impairments. It is only for common impairments, such as hypertension, ischaemic heart disease, diabetes and severe respiratory disorders, that the data are significant. For many disorders there is too little information yet to draw any conclusions. The investigation was begun knowing that it might well take 20 years before significant results were produced. The trouble to insurance companies is considerable, and it does require life insurance companies to ask the right questions at the time of the proposal.

So, I suspect, it will be with genetic propensities. It will take a long time for reliable statistical evidence to be accumulated, and in some cases it may never be possible to find out the effect on mortality rates of a particular genetic feature. For example, if it were suggested that eye colour might be an important rating factor, those with blue eyes perhaps having better mortality than those with brown eyes, who would take this suggestion sufficiently seriously to get an insurance company to ask the eye colour of all proposers, carry out an investigation and then charge differential premium rates? Perhaps tongue-rolling ability or whether your ears have lobes or not are also relevant to mortality rates, but I do not think that we shall ever find out.

In the 1960s there were many immigrants into Britain, particularly from certain West Indian islands and from the Indian subcontinent, and the life insurance companies began to notice increased numbers of applicants born in these overseas territories. The CMIB carried out investigations to the extent that

it could. The questions about immigrants they wanted answered were: do they bring their mortality with them?, which might be the case for certain genetic diseases or propensities; or do they acquire the mortality of the country to which they go?, which might be the case for deaths influenced by environmental causes. However, migrants are generally healthy at the time of migration; those who are ill or disabled are less likely to be migrants. Therefore, investigating the mortality of migrants might not give a good indication about the mortality of their children. In a few cases, there was anecdotal evidence of migrants finding difficulties because of a failure to adapt to their new life, for example, children of immigrants getting rickets because they got much less sunshine than at home and this was not made up for with the right diet.

The CMI Committee studied the mortality rates of the countries from which the migrants came. Although infant and childhood mortality were not that good in either the West Indies or Pakistan (at the time there were no good figures for India at all), the mortality rates at adult ages in these countries seemed quite good, and were not very different from those in Britain. The recommendation of the CMI Committee was that it was not worth while going to the trouble of carrying out an investigation into the mortality of migrants, especially as it was not possible to be sure of the extent to which successive generations would have the same mortality.

The thought at the time was that one should underwrite by race. Migrants with white faces merged into the general population; migrants with brown or black faces were at the time thought of as potentially different. This was before the Race Relations Act had come into effect, but the social feeling against racial discrimination was rising, so it would have been awkward for insurance companies to ask the race of applicants.

The CMI Committee decided not to undertake any investigation, insurers did not ask the race of applicants and we simply do not know whether those with black faces from the West Indies or Africa, or those with brown faces from India or elsewhere, or their children, wherever they were born, have mortality that is in any way different from that of the general population of the UK. In this respect ignorance is bliss.

The same could be said to apply to the genome project. There are those who suggest that insurance companies, and perhaps others like employers, should not have access to any genetic information that individuals may know. I hope that this paper has explained how this thought goes against the principles of insurance, and if it were carried too far it could destroy an open market in life insurance. There are those who feel that genetic information should not be used. Perhaps they really ought to be arguing that genetic information should not be obtained, and that it would be advantageous to society not to have the information that might be available. Knowing when may be a privilege we can do without.

Conversely, it may be argued that genetic information will allow doctors to treat those with adverse genetic features so that they will be able to live longer,

healthier and happier lives. Where this is really the case the argument in favour of ignorance would fail. But in how many cases is it true? There seems to be no treatment at all for Huntington's disease, far less a cure. There is treatment for the symptoms of adult polycystic kidney disease, but no cure. How can there be a cure for a feature that is genetically imprinted in every cell of the body? Perhaps we shall discover this later.

It may also be argued that one can do intrauterine tests on foetuses and offer selective termination of those affected. This may well be a good way to reduce the frequency in the population of harmful genetic features, but one has to consider whether it is universally beneficial. There is some slight evidence that Mozart may have suffered from adult polycystic kidney disease; both he and his mother died in their thirties, apparently from some kidney problem. Although Mozart's case is unproven, the folk singer Woody Guthrie certainly had Huntington's disease. How many unborn cases of APKD are worth trading for Mozart or cases of Huntington's for Woody Guthrie? I leave you to think about that.

REFERENCES

CMI Committee 1995 The mortality of smokers and non-smokers, 1988–1990. *Continuous Mortality Investigation Reports Number 14*, 79–84. Institute of Actuaries and Faculty of Acturies.

Doll, R. & Hill, A. B. 1950 Smoking and carcinoma of the lung. Preliminary Report. *British Medical Journal*, 1950; **2**; 739–748.

Gray, A. 1981 *Lanark, a life in 4 books*. Edinburgh: Canongate Press.