PROBLEMS OF FINANCING AND INSURANCE

by

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Introduction

This paper deals with the most important problems of financing and insuring natural disasters like windstorm, flood and earthquakes. This is based on an illustration of the potential impact of these hazards. Direct and indirect consequences are considered. We will show whether and in which way insurance can be involved to mitigate the impact of natural disasters allowing for local and international market conditions, the funds required, and which prerequisites must be met to achieve economical insurance solutions.

General Aspects and Problems Related to Financing

It is common knowledge that the population of the globe has grown dramatically and so have investments and therefore exposed values. Moreover, the type and vulnerability of elements at risk has greatly changed. Specialization and sophistication are generally directly correlated to exposure. The complex risks of today produce disproportionately higher losses than did their simple counterparts of several decades ago. This is true of most modern types of risk, such as factories, chemical plants, power stations, etc., but also buildings. For all these reasons, one can say with almost absolute certainty that damage and losses will increase. This applies not only to the fast expanding industrial regions of the Third World, but also to industrially and technologically advanced countries wherever more complex risks are being introduced.

General experience seems to indicate that damage and losses have increased, and certainly those who were badly affected by Gilbert, Hugo, Daria, Herta, Vivian and Wilke would bear witness to this. The windstorm of winter 1989-1990 caused losses equalling approximately US$ 15,000 million. Moreover, the accumulation of windstorms in the European region should be considered as a serious warning and not just a very rare statistical coincidence. Moreover, even the wind forces of these storms are only a pale copy of what nature has in store.

Turning to earthquakes, about 25 years ago, the average per capita loss was about US$ 1,000 if an earthquake of about M 6.5 hit a modern town in a medium income region. The much smaller San Salvador earthquake (M 5.4) of 1986 caused a loss of US$ 10,000 per inhabitant in the high intensity region. A substantially larger loss would, however, have been possible from an earthquake of this small magnitude. Detailed evaluations show that it would not be at all surprising to find for a large earthquake close to a town in a high income region, a per capita loss exceeding US$ 30,000. Some general examples will illustrate what may be in store. The region of Spitak in Armenia, USSR, was devastated by a M 6.8 earthquake in 1988. Of a population of approximately 600,000 people in the strongly shaken area, 25,542 people were killed and 100,000 injured; 10,000 of these permanently disabled. This earthquake caused losses of approximately US$ 25,000 million although the region was moderately developed.

On October 17, 1989, the Loma Prieta California earthquake of about M 7 occurred approximately 100 km southeast of San Francisco. The shaking was of a substantially shorter duration and lesser intensity than 'normal' for such an earthquake. Still, total proper losses reached US$ 6,500 to 10,000 million. It is stressed that there are many regions in Europe where a M 7 event may occur according to past experience, and a small and therefore fairly probable event can do enormous damage as illustrated by the following case. Newscastle in New South Wales, Australia, was shaken by a M 5.5 earthquake in 1989. Although the focus of the earthquake was not near Newscastle and therefore the intensity of shaking not impressive, the damage amounted to approximately US$ 1,000 million. We leave it to the reader to make a back-of-the-envelope estimate of what the damage from a M 6.5 earthquake can be if its shallow hypocentre is in the region where several million people live. In 1986. metropolitan Newscastle had a population of about 283,000 people of which much less than half lived in the more strongly shaken area.

This synopsis is that the loss potential and therefore the possible demand on financing is very high. It is stressed that for several countries, maximum loss scenarios can be developed which show that natural perils can cause losses equal to the GNP of the country. Moreover, gigantic losses in some of the economically important countries of the world, like the United States of America or Japan can precipitate the collapse of the world economy if occurring at a time of general depression. There are large seismic gaps in the region of Los Angeles and San Francisco and a great earthquake would affect a population of approximately ten million people each. The total direct and indirect economic loss from such a disaster can amount to US$ 300,000 million for one event. Moreover, there is a non-negligible chance that earthquakes could occur in gaps within a few years and that a gigantic flood and/or a devastating hurricane could happen within the same period.

Similarly there is a large seismic gap not far from the general region of Tokyo where a population of approximately 35 million people is exposed. The losses from a great earthquake in this region should not be seen in isolation. In 1703, an earthquake occurred not far from Tokyo which seriously damaged more than 20,000 houses and killed more than 5,000 people. Three years later Mount Fuji erupted. Fuji-san is still a 'young' volcano with a beautifully tapered peak. Should a cataclysm eruption occur after a disastrous great earthquake in the region of Tokyo, like the prehistoric one which generated the Shikotu caldera on Hokkaido, the combined consequences could surpass anything modern mankind has seen. Even worse, should disastrous earthquakes, floods, and/or eruptions affect the USA and Japan within the span of a few years, the financial consequences are bound to be disastrous for the rest of the world as well. In this connection one must consider trends.

Trends in Climatology, Meteorology, and Hydrology

In connection with rain, flood, windstorms, drought (crop failure, fire risk to forests, etc.), trend parameters, and exposure resulting herefrom must be considered as such trends can shift (aggravate the event probability distribution in a significant manner). These trends may also influence the probability of multiple events and specific exposure herefrom. Recurring events like "El Nino" (Southern Oscillation) can, in addition to long-term trends, pose additional problems. Here one must not only study its influence on rains, floods, and windstorms, but on drought which may not only be a direct menace but enhance the fire risk, e.g. in forests. Moreover, trends in general parameters which influence the exposure (demographic, economical, and vulnerability) must be allowed for. The last aspect is more important than is generally recognized.

Trends in Seismic Activity

There are not only regional seismic gaps, i.e. zones where earthquake energy has accumulated for an alarmingly long period, but global seismic trends where periods of above average worldwide activity alternate with others during which far fewer earthquakes occur. Since about 1911, global earthquake activity has dropped significantly. It is stressed that the notion that this "global seismic gap" was closed, by the 1960 Chile earthquake is ill-founded. Historical catalogues and reasoning show that this trend will one day be reserved. During the more active periods, frequency can be several times higher than it has been in recent decades. These facts must be considered in catastrophe probability assessment. Japan, for instance, experienced far more great earthquakes of a magnitude of M 8 and above in the years 1891 to 1906 than in the course of the 85 years since then.

According to a preliminary evaluation of periods of high seismicity since 358 AD, the author found that such phases appear to have a return period of approximately 139 years, one standard deviation amounting to 48 years. The last period of high seismicity started in 1852. It comprised of 2 peaks, lasting from 1852-1872 and from 1894-1911. Even if such preliminary evaluations must be interpreted with care, the extreme exposure of humans and the colossal accumulations of values suggest that we should consider not only local seismic gaps but also global seismic gaps, i.e. trends, which may increase the hazard enormously. According to a study which we completed recently, there appear to be about 19 great earthquakes (M 8 and above) missing in the respective gaps of the global seismic zones. A correlative evaluation of volcanic eruptions by the author showed that phases of high volcanic activity are correlated with periods of high seismicity. The peak of volcanic activity follows the seismic peak as to be expected according to geophysical reasoning. The average time shift amounts to 7.5 years and one standard deviation is 3.7 years. This correlation of independent events, i.e. seismicity and volcanism, supports the deduction of seismic trends.

Problems Related to Insurance

The purpose and the general principle of insurance is risk spreading. But simply this may be achieved in such a way that premium income and losses paid in a large region are balanced to such an extent that the surplus from several regions is adequate to compensate a severe loss at one particular place. It may also operate in such a way that in a region which is not large enough to spread premium income and exposure sufficiently, spreading or balancing of income and losses over a number of years may be attempted. In the later case, a severe loss in one year is recovered from the profits during profitable years.

It becomes evident that if such prerequisites are not met, no balanced portfolio can be developed. Such a situation will sooner or later lead to considerable difficulties or even to a collapse of the system. Moreover, it is extremely important to realize that even a balanced system where losses are met by adequate premium income may not represent an economic solution for a society. Losses after all still remain losses even if they are paid for by insurance. One only shifts the losses from the society in general to a segment of it. Therefore, losses amount to wasted investments, and moreover, much money must be accumulated to pay for them. This money is not available for other projects and/or developments. Therefore, in addition, a detailed cost benefit analysis must be employed to show to which level elements at risk must be improved to reduce the drain of capital and wasting of national resources and to make insurance economically feasible.

The technically required risk rate (X) in permille (% 0) can be calculated for a single event using the following formula.

$$X = LE \cdot f \cdot u \cdot P \cdot 1{,}000/R \cdot V$$

That is, the risk rate X in %0 (per mile) for a single event is the product of the Loss Expected (LE) times the overhead factor (f) times the uncertainty (u) which can be considered a safety factor, times the period of exposure (P = years), and divided by the return period (R in years) and the value at risk (V) which should be the new replacement value. Considering now a second important prerequisite we must consider the capacity and the solvency of insurance marks in the light of the maximum losses to be expected. Assuming a high "insurance density" that is an insurance cover in force for the most elements at risk there is little doubt that in the field of natural disasters insurance cannot be the salvation, at least at present with the loss potential overwhelmingly larger than all assets. All this shows that the only safe and economic way to "manage" disasters more correctly to reduce their impact is to pay far more attention than hitherto to risk optimization, that is to reduce the loss potential.

This does not signify that there is no place for insurance in handling disasters. Quite the contrary, well-trained inspectors of insurance companies can provide much assistance in implementing safer concepts of design and construction and help assure that the execution follows the intentions of the design. To achieve this, modern assessment and rating tools must be introduced. At any rate, in order to make insurance one of the important and reliable pillars of disaster management, the level of exposure must be reduced to such an extent that attractive insurance rates result. Once this has been achieved local and foreign insurers and reinsurers will feel confident to risk considerable sums for rare to very rare events, i.e. for the residual risk. Applying insurance rates which are commensurate with the exposure is an important tool to motivate people to reduce exposure and thereby protect the wealth of the country. Moreover, well-trained insurers can assist engineers, contractors, builders, and owners in arriving at economic solutions.