The need to innovate

At the end of 2011 our planet is plagued by huge uncertainties; the world as we know it is not likely to remain the same much longer.

On the one hand natural catastrophes and their aftermath are once more stoking up apocalyptic beliefs; on the other, the worldwide economic situation, especially in Europe, calls into question the future survival of the western socio-economic situation that has brought us to the brink, with a serious downturn, inflation and increasingly worrying unemployment levels. Are we living through the end of an era or is it simply that catastrophes (both natural and manmade) have picked up pace and increased in frequency thanks to the globalised media?

According to the United Nations Population Fund (UNFPA), the worldwide population has just hit the figure of seven billion. This is a daunting figure that encompasses successes, drawbacks and paradoxes. On the one hand we are living longer, feeding ourselves better and working in less arduous jobs. In fact we work far fewer hours than our ancestors did. Growing population does have its upside. Nonetheless, our planet is experiencing climate change and loss of biodiversity and the moot point is how to provide a dignified life for millions of people in a way that is compatible with the very preservation of the Earth.

Past experience shows that society has risen to such challenges and changed direction as necessary in innovative ways. Innovation is the key factor of society's progress and welfare. Investments follow talent rather than chasing the cheapest manpower. The switch of production towards the emerging countries, therefore, behoves us to keep innovating in our managerial systems to enhance competitiveness and thus win back the investors' trust.

The first of the three studies included in this issue presents the thoughts and reflections on the limits of human life, the factors impinging on longevity and life expectancy (now that we have passed the threshold of 7 billion human beings). The author, a professor at Madrid's Universidad Carlos III and a professional of recognised prestige in the insurance sector, analyses the potential impact of long-living persons on life annuity portfolios.

The second study presents the Spanish Insurance Inspector's vision of the Solvency II methodologies for controlling and measuring capital requirements on the basis of the company's specific interest rate risk in the standard formula. It does so by analysing the different methods for calculating the Value at Risk as the basic touchstone for estimating interest rate risk losses.

The last article brings back to our pages the former President of the Federation of European Risk Management Associations (FERMA) and member of our Editorial Board, François Septembrino, who deals with the response capacity to crisis or risk situations. Resilience, he explains, is survival capacity; just as people spend their whole lives adapting themselves to new situations, companies must also be prepared to change and adapt in line with the continually changing environment. In this context the role of the business continuity manager is to ensure the company's ongoing activity.

FUNDACIÓN MAPFRE's 2010 ranking report (Life, Non-Life and Total) of Latin America's insurance groups, of which we here publish an extract, shows how the region's 25 biggest insurance groups accounted for premiums worth over 58bn euros, 28.1% up on 2009, with a 64% share, nearly three points more than the previous year.

Although it seems likely that the grave worldwide economic problems will continue to hover over us in the coming year, this is no time to cling on to the driftwood of past memories but to look to the future, shaping it in terms of the experiences we are currently living through and rising to the sterling challenges we face by dint of creativity and innovation.

Happy 2012

The risk of *longevity*

IN CENTENARIANS

This study uses statistical and forecasting methods to analyse whether the longevity of centenarians is increasing and what impact this might have on the life annuity portfolios.

JOSÉ MIGUEL RODRÍGUEZ-PARDO DEL CASTILLO
Universidad Carlos III de Madrid

The evolution of life expectancy since the beginning of the 20thC has meant that the rate of people becoming centenarians has increased considerably. This is confirmed by a recent report by Britain´s Department for Work and Pensions which refers to the probability of reaching the age of 100:

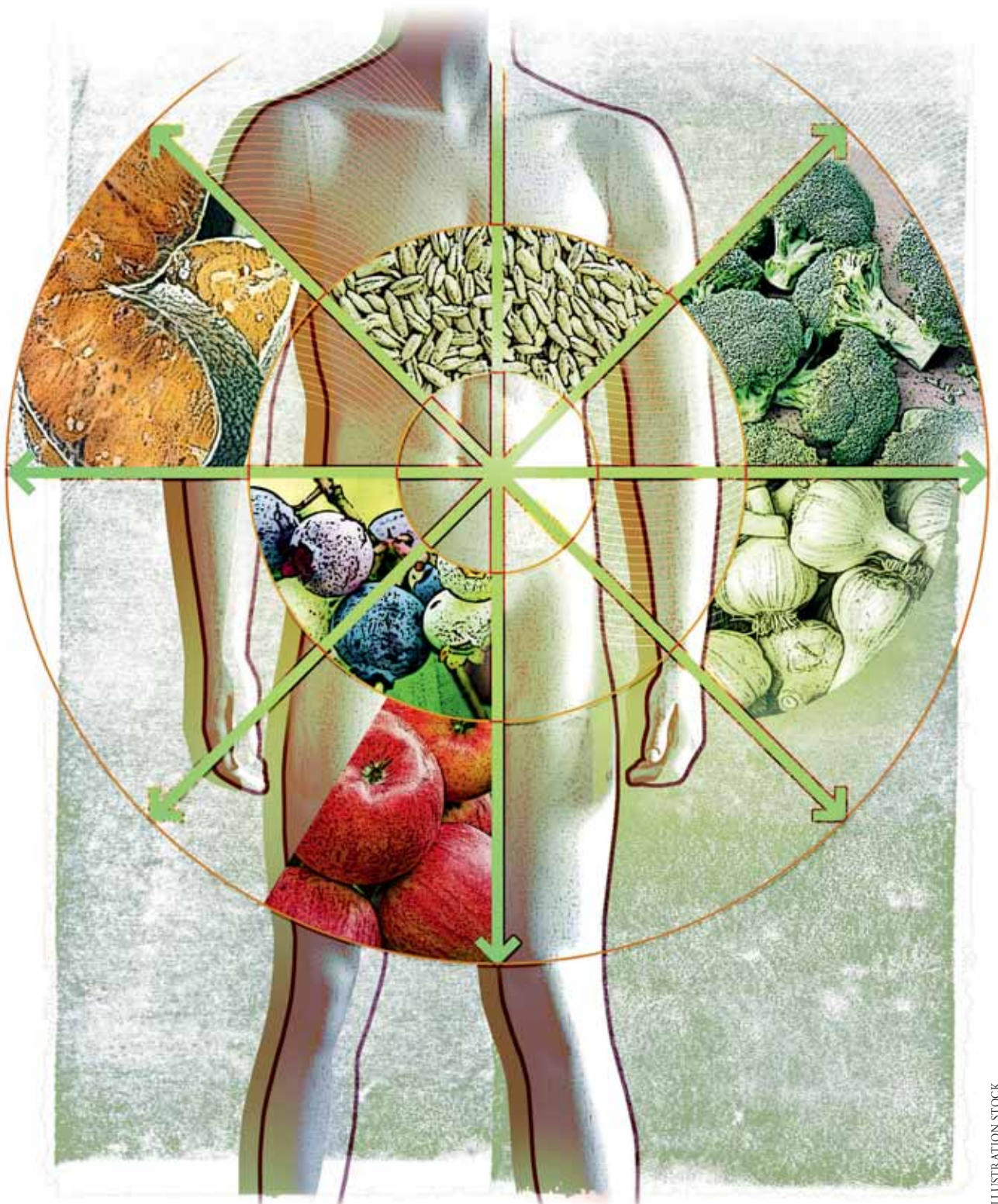| Year	Women	Men
1931	5.1%	2.5%
1961	16.0%	10%
1991	26.5%	19.2%
2011	33.7%	26%

We can see that a child born today has an eight times greater probability of becoming a centenarian than eighty years ago. The British authorities estimate that, by the year 2066, the centenarian population will reach 500.000 inhabitants.

These figures will be surpassed if we take as a reference a study published in *The Lancet* magazine directed by Professor Kaare Christensen, of the Danish Ageing Research Centre, «in which, by analysing what has occurred in the past and what the trends have been, an extraordinary and constant pattern has been observed which shows that in the last 150 years there has been a very consistent increase in life expectancy in rich countries». It concludes: «If we project the current trends into the future, we can say that over 50% of babies born today in developed countries will live a 100 years».

If we look at the estimates of doctor and biophysicist, Roland Moreau, author of the book *Immortality for tomorrow*, which concludes that «by the year 2027 almost all of those born that year will reach the age of 100 and, if that is the case, some will reach 130, therefore exceeding the biological limit of 120 years achievable by the human being» and «if the genetic engineering therapies are materialised, altering the causes of ageing, the maxim limit for life could probably be exceeded». This opinion is in line with that of the scientist Ray Kurzweil, that, thanks to nanotechnology and a greater comprehension of how the human body works, vital organs will be able to be replaced and, in this way, live forever.

The object of this work is to ascertain the rates of survival for people who have become centenarians according to the different estimates from different models that attempt to evaluate longevity looking at the biology of the person associated with life styles. We can call these bioactuarial models.

At the same time, we will analyse the latest advances in biomedicine in relation to the causes that explain longevity and which will help us to understand if we are close, in time, to the possibility of increasing the maximum limit of probable life, which is commonly established at 120 years.

All of the above with the final objective being no other than to try to visualise if there is, or could be, a deficit in the technical reserves of the whole life portfolios for centenarian ages and, thus, substantiate Bertrand Russell's aphorism «Do not feel absolutely certain of anything».

Centenarians y supercentenarians

CENTENARIANS

The number of centenarians has grown considerably since the second half of the 20th Century, although this phenomenon will be a singularity of the present century. Taking US data according to Midrange estimate from Centenarians in the United States, U.S. Census Bureau of 1999, if in the year 2000 the centenarian population was 72,000 persons, by the year 2010 this figure will

THE FRONTIER OF 115 YEARS REPRESENTS AN AUTHENTIC BIOLOGICAL BARRIER FOR THE HUMAN BEING. IN JAPAN, WHICH IS THE COUNTRY WITH THE LONGEST LIVING PEOPLE ON THE PLANET, THE OLDEST PERSON IN THE PERIOD BETWEEN 1992 AND 2009 REACHED THE AGE OF 114
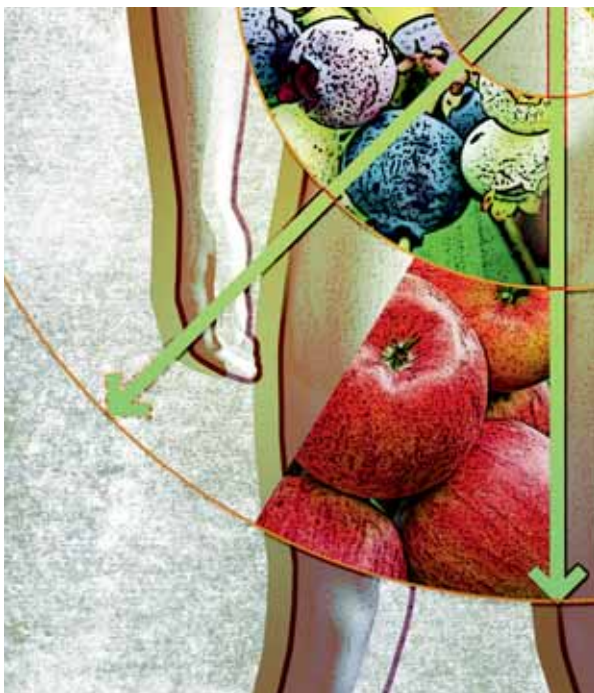
reach 131,000 with a projection for 2050 that 834,000 North American citizens will be over 100 years old.

For the whole of the world population, in the period 2005-2050, a 35% growth in the population is estimated, whilst in the 100 years and over range, the growth will be 746%, which is the highest of all the age ranges, followed by the 85 to 99 age range which will grow 301%. This data is from the U.S. Census Bureau.

SUPERCENTENARIANS

A supercentenarian is someone who has reached the age of 110 years. From the registry of persons that have reached this age, it would appear that this ceiling is reserved for the feminine gender since, of those who reached 110 years, 90% were women, 92% reaching the age of 112 and 95% those who became supercentenarians, i.e. 115 years old.

This name is assigned to persons that have reached the age of 115 years according to the book *Supercentenarians*, coordinated by the Max Planck Institute for Democratic Research, in Rostock (Germany), and only nineteen people have reached this age since 1900, of which only two have been men. The book recalls the words written by Leonard Hayflick, one of the pioneers of modern research on ageing: «There is no evidence that the maximum duration of human life is different to some hundred thousand years ago. It is still around 115».

The longevity record still belongs to a French woman, Jeanne Calment, who is considered to have had the longest life. She died in 1997, when she was 122 years, five months and fourteen days and died on the 4th. August, 1997, beating the previous unquestionable longevity record which belonged to Marta Graham, who lived for 114 years and 180 days, dying in 1958.

Since the registration of supercentenarians began, the oldest reference referred to Thomas Peter, who died in 1857 at the age of 111 and 354 days.

So, we can see from the official registers over 150 years that the longest life span on the planet has been increasing but it is also true that there is a biological limit on the maximum probable length life for human being which, traditionally, has been set at 120 years old.

In fact, it is significant that, if the number of human beings that have lived is calculated at 110,000 million, only one person has reached the age of 120 years.

One of the common characteristics among them is that they were not obese and had not smoked or had smoked very little.

Therefore, the frontier of 115 years represents an authentic biological barrier for the human being. In fact, in Japan, which is the country with the longest living people on the planet, and although the number of centenarians increased from 3,000 centenarians in 1992 reaching 40,000 in 2009, the oldest person in this period reached the age of 114.

This situation is continually repeated in several

countries. The following shows the oldest age registered in different countries:

France	122 years
Great Britain	115 years
Spain	114 years
Italy	114 years
Sweden	113 years

The following graph shows the registry of supercentenarins of the Los Angeles Gerontology Research Group (GRG) Table of Worldwide Validated Living Supercentenarians, where we can observe the growing number of persons that have reached the age of 110 .

Maximum Number of Living Supercentenarians (Data Provided by Louis Epstein)
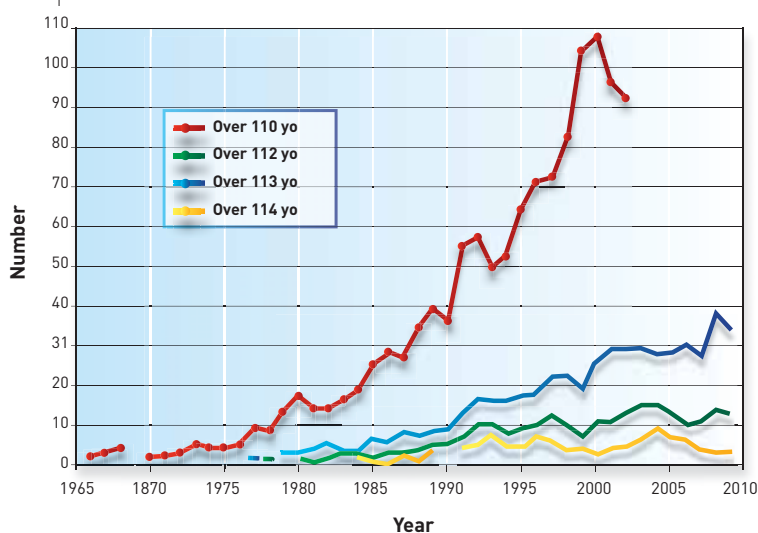
The Los Angeles GRG reports will help us to evaluate the probabilities of death for centenarians.

Life style vs genetics for centenarians

The causes that determine longevity tend to attribute 25% to genetic factors and 75% to factors related to life styles, of which healthy nutritional and diet habits, physical exercise, social relationships and a positive attitude towards life stand out.

At the moment, there is an open debate between the scientific community that is expert in bio gerontology, those that consider that reaching the age of 100 years is a question of genes and those that feel, to the contrary, that life style is the principal cause for reaching extreme ages.
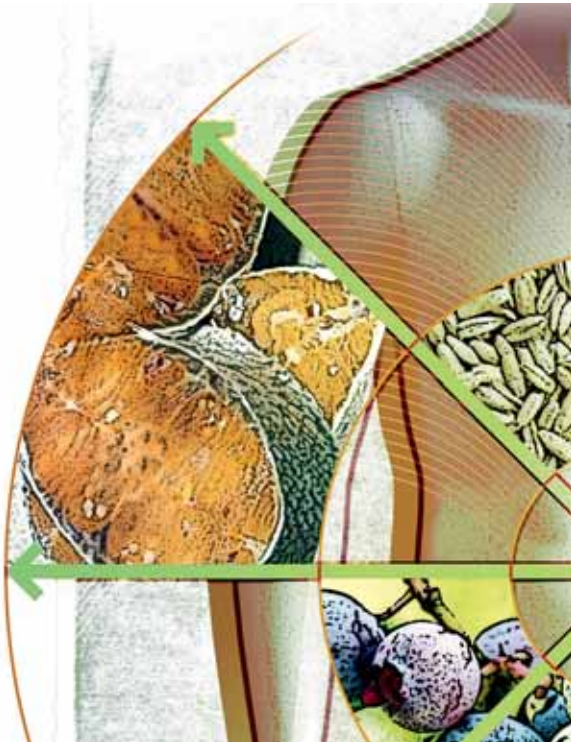
A recent article published in the *Journal of the American Geriatrics Society* concludes that genetics is the principle factor for becoming a centenarian. This study, directed by Nir Barzilai, Director of the Ageing Research Institute of the Medical Faculty of the Yeshiva Albert Einstein University (New York, USA), has been carried out by analysing the life style of 477 Ashkenazi Jews with ages of between 95 and 106 years and that lived independently.

The study is of a retrospective nature in that the participants were asked about their habits 30 years ago, i.e., when they were 70 years old. To evaluate the results, the data of a group of persons that have lived in the same era and that were around 70 years old participated in the NHANCES epidemiological study (National Health and Nutrition Examination Survey).

The conclusions of the report were that the body mass index and alcohol consumption were similar in both groups. Similar conclusions were reached when analysing physical exercise and diet.

Therefore, the study reveals that it is genetics that brings about extreme longevity.

It would seem reasonable to conclude that genes, environment, health habits and medical attention of the health system are the four factors that favour centenarian longevity.

The survival rates of centenarians and supercentenarians

Having considered the foreseeable magnitude of the advent of a centenarian population in the next decades, we should reflect on how to model the risk of survival of this population which, up until now and for two reasons, did not acquire much relevance in the whole life portfolios of life insurance companies.

The first reason is that whole life portfolios insured in the Spanish market present a marked age concentration of around 70 years and, therefore, in general terms, only around 5% of today´s exposed risks will reach 100 years.

The second reason, which is related to the first since the insured portfolio is very distant from the centenarian risk exposure, is that there is practically no experience to evaluate the potential insufficiency of technical reserves and, if there were, the probability flows of these potential ages, discounted to the calculation date of the mathematical reserves, may not be significant today.

In no way should these arguments prevent the insurer from trying to model the risk of survival of the centenarian population in the light of the facts shown by the behaviour of this group in registers such as the Los Angeles GRG (Gerontology Research Group) in the USA and which will enable us to construct mortality trends that differ significantly from those incorporated in the survival tables of countries in general and which are based on a mortality trend that follows the Gompertz model, i.e., mortality grows exponentially with age.

The survival model constructed from the data observed by the GRG, which we would recall

In Spain there are 10,000 centenarians and two thirds of them are women. A study undertaken in Spain on the health of the centenarians describes some of their non-genetic characteristics:

- Half of them are independent, they do not need help to eat or carry out their daily activities.
- They live in a healthy environment.
- They live in an area that has a good medical attention health system.
- They have low cholesterol levels.

The debate remains open and, as biological knowledge of the centenarians advances, the effects of genetics and healthy life styles can be taken into account.

THERE IS AN OPEN DEBATE BETWEEN THE SCIENTIFIC COMMUNITY THAT IS EXPERT IN BIO GERONTOLOGY: THOSE THAT CONSIDER THAT REACHING THE AGE OF 100 YEARS IS A QUESTION OF GENES AND THOSE THAT FEEL THAT LIFE STYLE IS THE PRINCIPAL CAUSE FOR REACHING EXTREME AGES

corresponds to the official census registry data of each country that participated in the work group, reflects the evolution of the supercentenarian population. All in the knowledge, as said, in the actual group, having such little data, it might not have any statistical significance.

As Professor Steve Cole, Director of supercentenarian Research Foundation UCLA Molecular Biology Institute, asks:

«The real question is… do these cases represent a statistical aberration or is there a biological basis in the human genome for these atypical values?

If there is a biological basis for this plateau, ¿Can the phenotype of ageing be conquered by ordinary people?

Could there be a peculiar genetic predisposition to end up being Supercentenarians as from 114, ending at 117 years, in such a way that we should look at the ADN sequence?

*¿Can the genes that determine longevity be discovered and manipulated by genetic engineering?»*

Advancing us the conclusions, the proposed longevity model signifies in words of Dr. Fahy, Director of the Organ Cryopreservation Laboratory at the American Red Cross Jerome Holland Laboratory in Rockville: *«The existence of a belated mortality plateau of life for human beings and other species implies that ageing above a certain age is detained».*

Therefore, we have reproduced the main tables prepared from the available data. They were taken from ww.grg.org.

The analysis commences with the observations of the supercentenarians incorporated in the North American Social Security tables for 2007 and we can see how it follows a completely different behaviour to that proposed by the table.
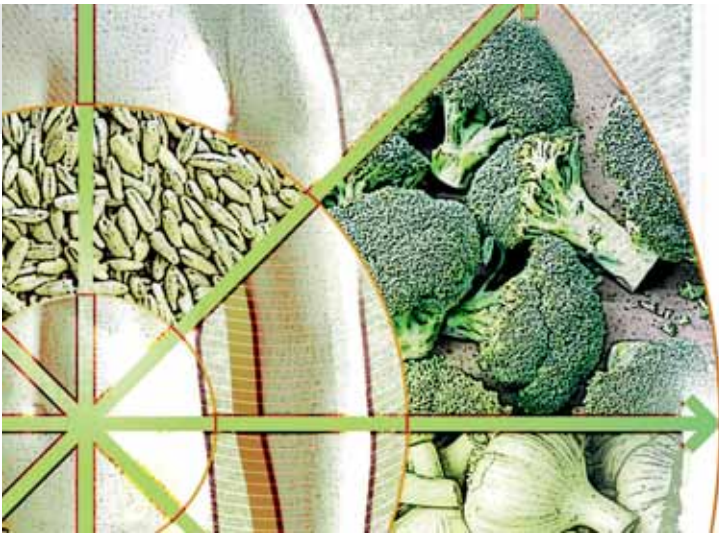

Plot produced by Donald B. Gennery, March 11, 2008
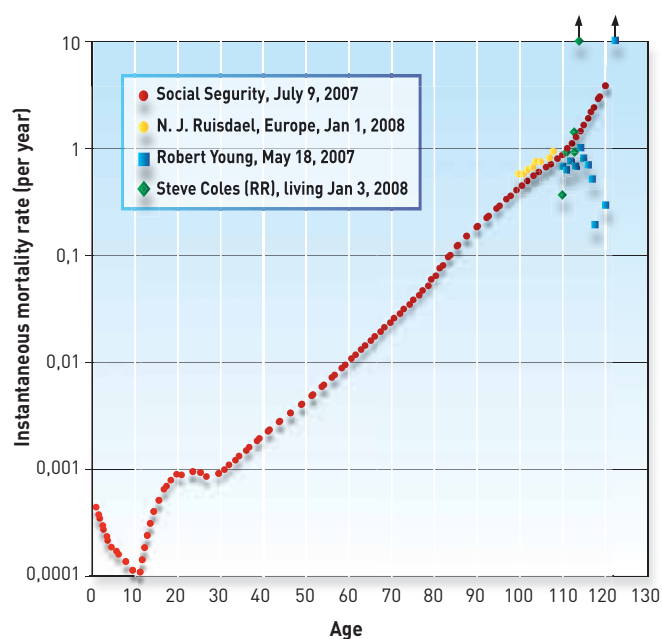
The register of the evolution of centenarians was taken from the following table.

Estimated living in Europe, Jan. 1, 2008, N. J. Ruisdael [3]

Age	Number living	Decrease to next age
100	28,679	12,467
101	16,212	6,657
102	9,555	4,158
103	5,397	2,413
104	2,984	1,541
105	1,443	787
106	656	295
107	361	184
108	177	111
109	66	?

Known deaths at each age (data supplied by Robert Young, line fit and plot by produced by Donald B. Gennery, March 14, 2008)
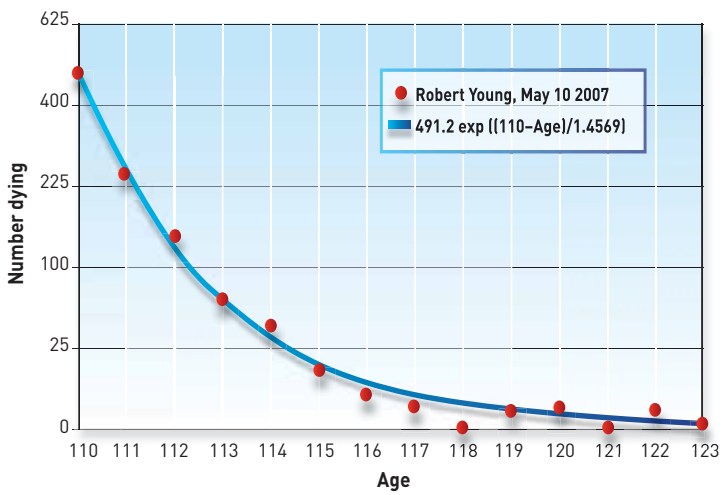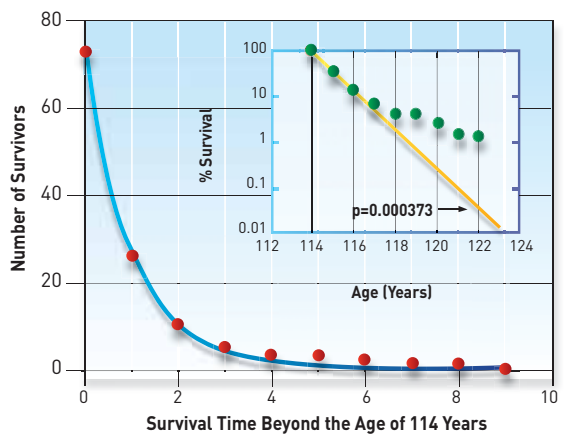

And with regard to the Supercentenarians, the evolution was taken from:

Deaths of validated supercentenarians born before May 10, 1895, as of Jan 3, 2010, Louis Epstein[6]

Age	Number at this age or higher	Number at this age by years
110	679	427
111	491	225
112	266	129
113	137	74
114	63	41
115	22	15
116	7	3
117	4	2
118	2	0
119	2	1
120	1	0
121	1	0
122	1	1
123	0	0

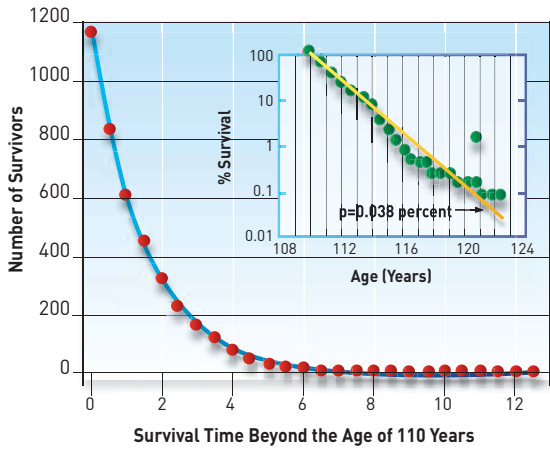It can be seen that the annual death rate remains constant and is around 50% every year.

Subsequently, it is a question of modelling the behaviour of this population, as can be seen in the following graph.

THE INSURER SHOULD TRY TO MODEL THE RISK OF SURVIVAL OF THE CENTENARIAN POPULATION IN THE LIGHT OF THE FACTS SHOWN BY THE BEHAVIOUR OF THIS GROUP IN REGISTERS SUCH AS THE LOS ANGELES GERONTOLOGY RESEARCH GROUP

Figure inset labels: Number of Survivors (y-axis), % Survival, p=0.038 percent, Age (Years), Survival Time Beyond the Age of 110 Years

This model proposed for extreme ages and taking as a basis the aforementioned social security table in which data for up to 90 years of age is used

(according to Robert Young – founding member of the Supercentenarian Research Foundation – the USA Social Security data is probably not reliable for over 95 years) and as from that age a manual adjustment is made which, combining the table and model, is the result proposed by Donald B. Gennery in «Mortility rate as a funtion of age» (19-1-2010).

For the adjustment of the 90 years ages, the data tracking 290 persons that had reached the age of 90 years between 1920-1922 was used and the year in which they died was registered. The last one died at the age of 102 years.
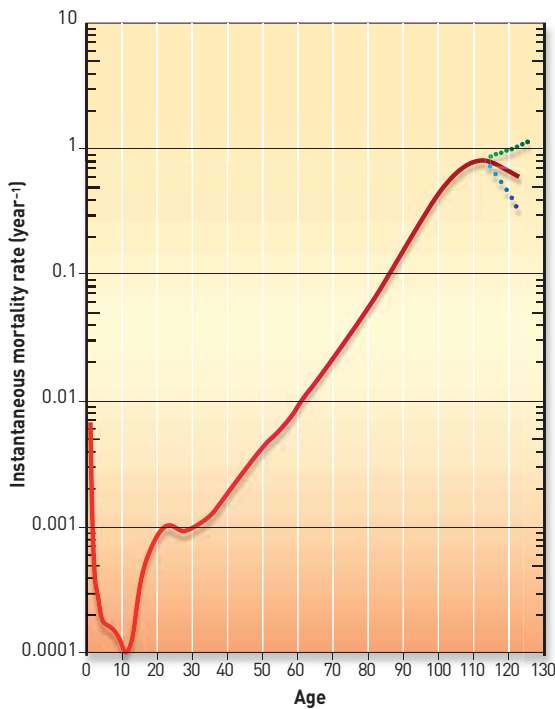
Figure A. Results from Social Security and manual fit spliced together at age 90 (with approximate ± 1σ limits).
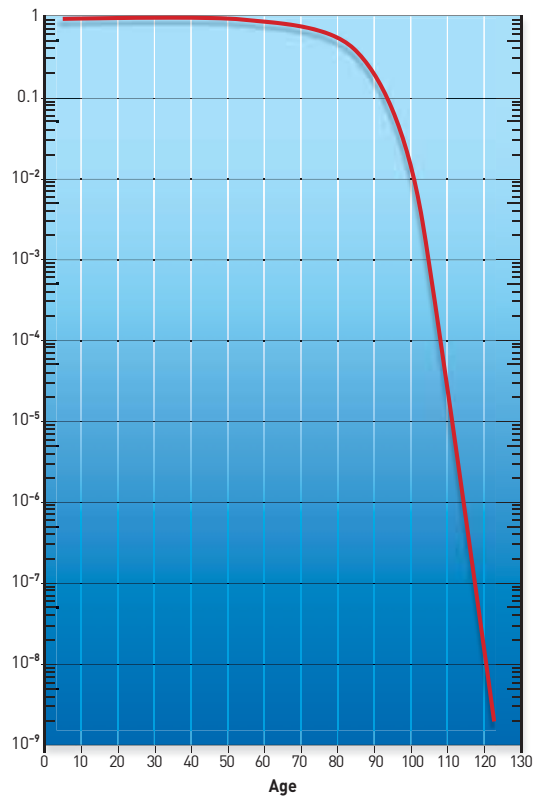

Figure B. Probability of surviving to each age, derived from the curve in figure A.

«THE EXISTENCE OF A BELATED MORTALITY PLATEAU OF LIFE FOR HUMAN BEINGS AND OTHER SPECIES IMPLIES THAT AGEING ABOVE A CERTAIN AGE IS DETAINED», SAYS DR. GREGORY FAHY, DIRECTOR OF THE ORGAN CRYOPRESERVATION LABORATORY

This proposed model of longevity behaviour of the general population, based on the experience of the supercentenarians, enables the extraction of some additional conclusions to the most relevant which is the existence of a mortality plateau on reaching 110 years. These conclusions are from Donald B. Gennery himself: «According to the above table, the probability of reaching this age is 2.11 x 10-9. From an estimation of 300 million births, the expected number of those born today that would reach the age of 122 years would be 0.6333 persons and applying a corrective factor of 5.41 for the current and past mortality differences produces an approximate expected number today of 0.117 of persons that should be 122 years old taking into account the highest mortality rates in the past».

The modelling of centenarian ages taking the form of a plateau is a proposal that we can find in more recent actuarial literature via the bioacturarial and non observable heterogeneity models.

With regard to the first, we would quote the studies of Gavrilov & Gavrilova in *Handbook of the Biology of Aging,* Academic Press, 2006, where,

starting with the theory of the reliability of the systems, they conclude that the risk of error is not necessarily related to age and that it can even be irrelevant. And, on observing the biological behaviour of certain living beings through longitudinal studies, they conclude that in the last stage of maximum probable life there is a deceleration in the increase of the mortality rates, reaching a plateau at a certain age; that is to say that the mortality rate remains constant. Gavrilov calls this process «kinetic mortality, since there is no biological wearing of the human being».

As we commented previously, for this singular behaviour of extreme ages, the Gompertz, or even Weibull, models do not adequately reproduce living being reliability models which, in the case of human beings, can be verified with the behaviour of the evolution of the Swedish population *Mortality of Swedish women for the period of 1990-2000 from the Kannisto-Thatcher Database on Old Age Mortality,* and from the source Gavrilov–Gavrilova *Why we fall apart. Engineering's reliability theory explains human aging.* (IEEE Spectrum, 2004)
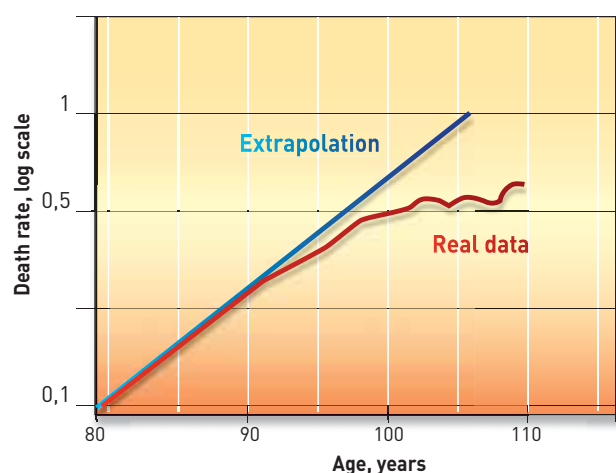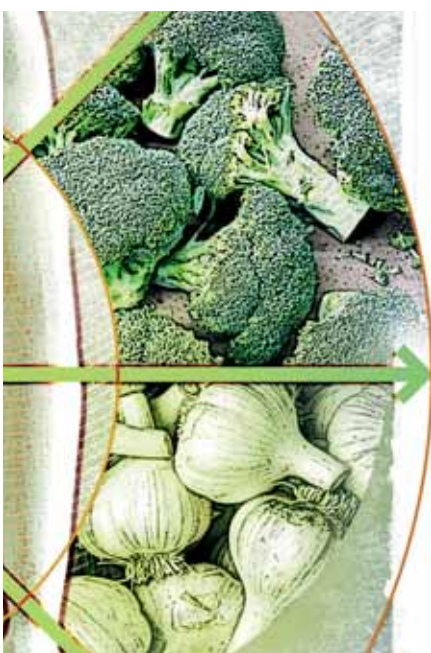
We can see that, as from the age of 90, the survival curve is greater according to the Swedish experience than the proposals from the Gompertz models.

This hypothesis presents a challenge to the hypothesis that the biological limit of the human being is 120 years since the model leads us to propose the contrary, i.e., that the mortality rate in extreme ages, as it is constant, means that survival has no limit at any specific age. This proposal has many similarities with the conclusion of the model described and elaborated on the experience of supercentenarians.

The line of work based on non-observable heterogeneity models proposed by Olivieri and Pittaco, amongst other renowned actuarial researchers, suggests incorporating the fragility variable into the traditional mortality table. That is, the survival of an individual is affected by his propensity to longevity, which is a variable related to the individual phonotypical strengths that make individuals that survive to very advanced ages have survival rates that tend to take a plateau shape.
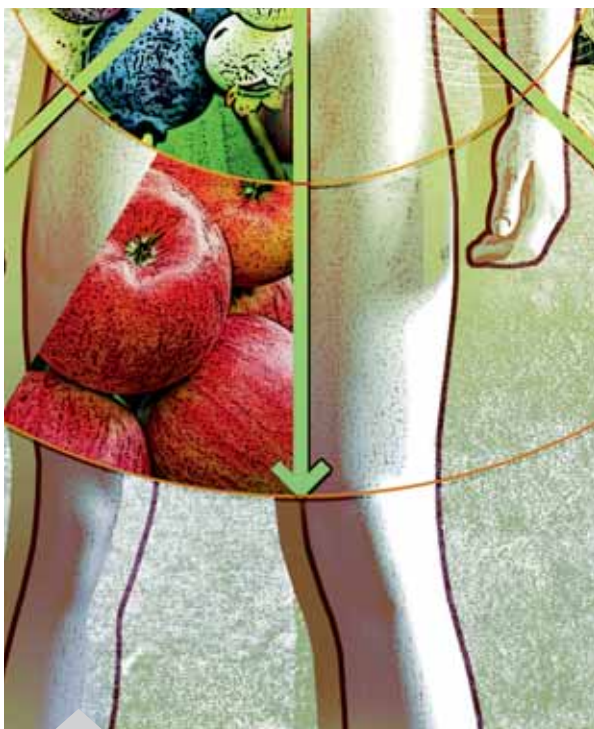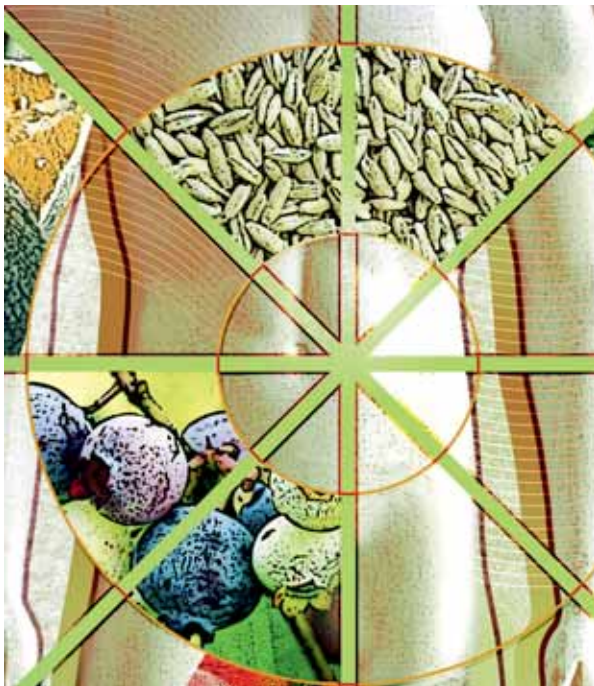
The origin of these models can be found in observations of old age mortalities in developed countries in which a deceleration has been observed in the growth rate of mortality for said ages, Horiuchi & Wilmoth (1998), Zen yi & Vaupel (2003).

In Antonio Fernández Morales´ work (2009), *Graduation of mortality in Andalucía with mortality models with non-observable heterogeneity*, published in the IAE Annals, he refers us to fragility (Zx) variable modelling where individuals with greater probability of death show lower rates of fragility. Gamma or Inverse Gaussian distributions are models, creating a mortality mixture function (Gompertz , Makeham) -fragility (Gamma or Inverted Gaussian distribution).

We can observe that from three different approximations, i.e. register of supercentenarians, bioactuarial and non-observable heterogeneity models, actuarial science is capable of reproducing the behaviour of the longevity of centenarians.

We know, therefore, that for these ages there is a plateau in the mortality rates and, as a result, the actuarial models should be corrected and adjusted to this trend which begins to be quantifiable to the extent that the longevity registers of these ages start to provide consistent data and can substitute mere projection estimates generated from mortality rates of younger ages.

Therefore, based on this knowledge acquired and modelled, it is advisable that companies review their levels of liabilities. Olivieri (2006) says: «To not consider heterogeneity due to non-observable factors in a life portfolio leads to an underestimation

WE CAN OBSERVE THAT FROM THREE DIFFERENT APPROXIMATIONS (REGISTER OF SUPERCENTENARIANS, BIOACTUARIAL AND NON-OBSERVABLE HETEROGENEITY MODELS) ACTUARIAL SCIENCE IS CAPABLE OF REPRODUCING THE BEHAVIOUR OF THE LONGEVITY OF CENTENARIANS

of liabilities, both in the expected value as well as the right hand tail, since the mortality distribution in a heterogeneous population is different to that belonging to a homogeneous group, especially in the more advanced ages».

Knowing that we are faced with a new actuarial model which modifies the central hypothesis of biometrics based on the Gompertz (1820) model, current science has to be capable of proposing the age at which mortality starts to decelerate. All research leads us to propose the range of 90-95 and, on the other hand, evaluate the intensity of the plateau.

With this state of affairs, perhaps the best solution is to accept that this new phenomenon exists and to revise the underestimation of liabilities in the right hand tail of insureds, to adjust reserves as and when the models adapt to known statistical realities and, in the cases of the centenarian population, we should consult international population register sources.

Fenotypical longevity models

Having analysed the response of actuarial science to the phenomenon of longevity in persons of advanced age and, specifically, in centenarians, we will refer to the longevity study from the viewpoint provided by evolutive biodemography that attempts to combine the ageing theories of free radicals and perishable soma. Consider, therefore, that the longevity process is the result of the impulse of the acquisition of energy and its location.

The study *Evaluation of mortality trajectories in evolutionary biodemography*, of Stephan B. Munch, and Marc Mangel PNAS, published online Oct 23, 2006, provides us with a different viewpoint for understanding longevity and its repercussion on extreme ages.

The phenotype model shows us that the mortality trajectories are comprised of two variables depending on the phenotype: one depending on size and the other on damage. For its measurement, specific parameters are taken such as basal metabolism in variable foods in which the individuals regulate growth, the accumulation of damage and the depredation of the risk. All the parameters are assigned with a mechanistic interpretation.
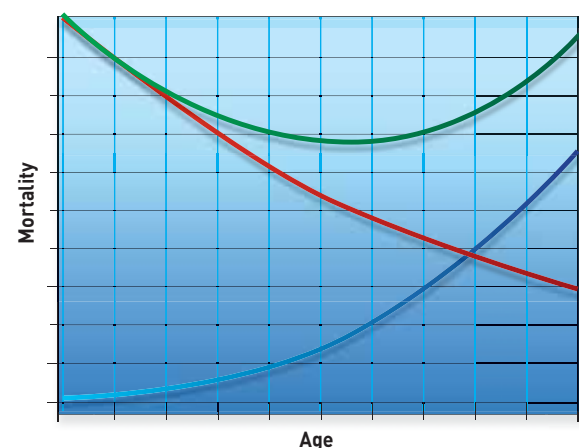
Decomposition of the mortality trajectory into size and damage dependent components. The solid line indicates the total mortality. The dotted line indicates the size-dependent mortality, whereas the dashed line indicates damage-dependent mortality.

As phenotype knowledge advances with deeper biomarkers, this model will provide us with the necessary metrics to understand the phenomenon of extreme longevity.

Continuing with this biomedical argument, we can go a step deeper in the knowledge of MLSP (Maximum Life Span Potential), which represents the maximum number of years for which an individual can live belonging to a specific species.

The maximum life span is determined by the genome which is constant and characteristic for each species. Maximum longevity correlates with resistance to general ageing processes and is

inversely proportional to the maximum ageing speed of the species (Cutler, 1984).

The two biogenetic theories related to ageing are the theories of free radicals and shortening telomeres.

There are numerous studies that show that there is a relationship between free radicals and maximum life span.

José Gómez Sánchez´ analysis in his Doctoral Thesis (2010 UCM –Faculty of Biology), helps us to understand this process and says that the free radicals production rate correlates inversely to the maximum life span of the species, so that this rate is greater in species with a short life span than those with a long life span. (Barja *et al.*, 1994b; Lambert *et al.*, 2007; Robert *et al.*, 2007).

It is on this point where we can introduce aspects of life styles such as diet restrictions related to longevity. Numerous researches have demonstrated that diet restriction is capable of reducing the mitochondrial production of free radicals (Sohal *et al.*, 1994; Sohal & Weindruch, 1996; Gredilla *et al.*, 2001a,b; Barja, 2002a; Drew *et al.*, 2003; Bevilacqua *et al.*, 2004; Judge *et al.*, 2004; Gredilla & Barja, 2005).

The theory ofl shortening telomeres

All of the ageing tests start with the science of telomeres and telomerase, the enzyme which controls the cell´s biological clock. In fact, Jerry Shay of the Southwestern Medical Center in Dallas, in an article published recently in *Science*, tell us that «it is the best biomarker of ageing available today». In the same way

IT IS STILL NOT POSSIBLE TO MEASURE A PERSON'S LIFE EXPECTANCY WITH THE SIZE OF THE TELOMERE BUT IT IS POSSIBLE TO KNOW THE BIOLOGICAL AGE OF SOMEONE IN RELATION TO THEIR CHRONOLOGICAL AGE

as with the free radicals theory, a healthy life style is possible to have longer telomeres again.

It is still not possible to measure a person´s life expectancy with the size of the telomere but it is possible to know the biological age of someone in relation to their chronological age and, as the number of telomere analysis increase, relationships can be established between the life style and the biological clock. It has shown, in fact, that obesity and tobacco addiction involve an accelerated loss in telomeres.

These two biomedical theories that try to explain longevity were not interrelated, although Ronald A. DePinho, M.D. Dana-Farber Cancer Institute, affiliated to Harvard, in a publication in *Nature* in July, 2011, suggests that the shortening of


telomeres is the cause mitochondrial dysfunction and of the reduction of antioxidant defences. Jointly, they reduce corporal energy and lessen the working of organs, two characteristics of ageing and, he continues, «What we have discovered is the main road to ageing that connects various different biological processes with age and that previously were considered to be independent from one another».

The relationship between the two theories will provide significant advances, particularly, in the knowledge and metrics of longevity of centenarians, knowing, as Heraclitus, said «Nature loves to hide itself».

Therefore, in years to come, biomedical science will be in a position to evaluate, from genetics and lifestyles, the probability of reaching centenarian and, eventually, supercentenarian ages.

 Although actuarial science is starting to incorporate the knowledge acquired from biomedicine, it should go deeper along these lines in order to be able to model the risk of longevity. At the same time, it should evaluate the possibility of the extension of the maximum probable life where life expectancy is close to this indicator, and as one intellectual says, «Growing old is inevitable, the fight against the biological tendency of our genes to grow old has gone from impossible to infinitely unlikely».

In a dynamic demographic structure where centenarians will be the truly new protagonists, the whole life portfolios will involve extreme ages which are an undiscovered territory for insurers. The big advantage is that it is possible to start preparing strategies for periodic adjustment to assigned contingent liabilities in the balance sheet. ▌
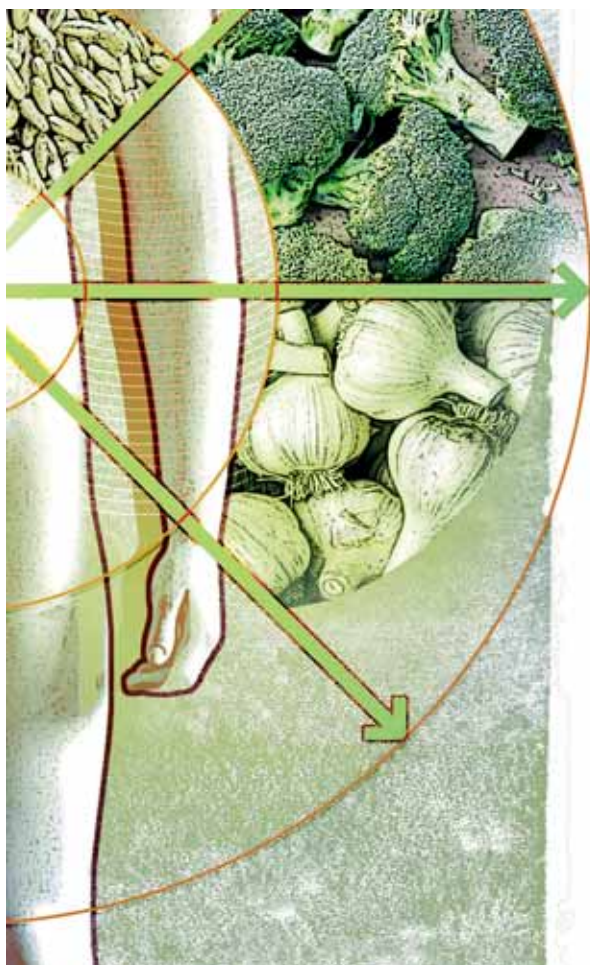
Interest rate risk:

This article looks at the interest-rate risk hedging methods implemented in Spain and describes which methods are now being mooted in the Solvency II project for control and measurement of interest-rate-risk capital requirements in the standard formula.

FRANCISCO CUESTA AGUILAR
State Insurance Inpector
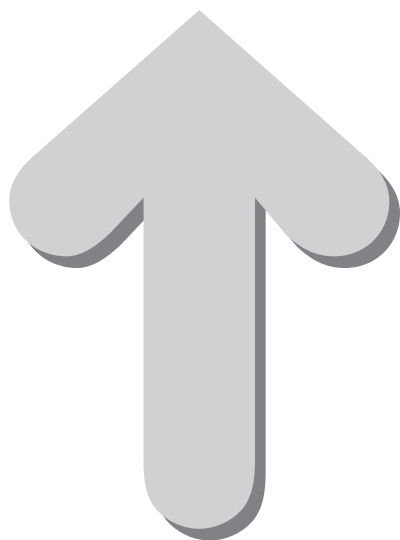
Certain life insurances are operations with a guaranteed interest rate over a very long period. The appearance of lowering interest rate scenarios can generate awkward situations for the insurance company. For that reason, it is very necessary to adopt strategies to cover the interest rate risk.

The risk of interest rates is, without doubt, one of the financial risks which have most preoccupied scientific doctrine.

It is now almost one decade since Spanish regulations incorporated financial immunity as methodologies for covering interest rate risks. The experience is borne out by the excellent role that they have

Spanish experience and

ILLUSTRATION STOCK

Solvency II

played in the control of the risk of interest rates by insurance companies that operate in the life branch.

This paper looks at the study of both systems (cash-flow matching and immunization by duration matching) from an eminently practical perspective, introducing firstly, some necessary basic financial concepts for adequate comprehension.

The study concludes with a basis description of the methodologies that are currently being considered under the Solvency II Project for the control and measurement of capital requirements for the interest rate risk with a standard formula. The chapter ends with an analysis of the different methods for calculating the Risk Value (VaR) as a basic measurement calibration used to estimate the losses from the risk of interest rates.

FINANCIAL IMMUNIZATION SYSTEMS: SPANISH EXPERIENCE

Through the application of such systems, the Spanish regulations allow the calculation of mathematical reserves at an interest rate obtained from the return on assigned assets, always provided that certain minimum requirements that minimise the interest rate risk are complied with.

With the cash-flow matching system, an adequate coinciding is required, in time and amount, for receipts and payments. If each time that the insurer has to affront the payment of a specific commitment it has the necessary financial balance, then the interest risk is minimum.

Basically, the Spanish regulations have the following requirements:

■ That the collection flows are real, regardless of the credit risk. In this way, certain assets are excluded, such as shares.

■ That the credit risk does not exceed a certain threshold. In particular, the asset must have a BBB minimum rating.

■ That the assets are suitable to cover the technical reserves. The liquidity requirement is significant.

■ That measures are adopted following a prospective analysis of the surrender rights in order to prevent the market value of the investments from diminishing below the guaranteed surrender value.

■ That payment flows are computed for the payment of benefits, expenses and, if applicable, profit sharing.

■ That the final balance of the operation is positive or nil.

■ That the monthly financial balances are positive or, if negative, that they do not exceed certain limits.

The immunization by duration system seeks compensation between the variations in assets and liabilities generated by any variation in the market interest curve.

The corrected duration is a measurement of the sensitivity to the current value of cash inflows with regard to a variation in the market interest. If the structure of inflows and outflows is such that the corrected durations of assets and liabilities are equivalent, when there is a variation in the value of the market interest, the variation in the value of the assets will be compensated with the variation (opposite sign) of the liabilities.

In addition to the requirements mentioned in the previous system for inflows and outflows, the Spanish regulations add the following new requirements for the immunization system by duration matching:

■ That the value of the assets is higher than that of the liabilities.

■ That there is an equivalent of the corrected durations of the assets and liabilities. Technically, this requirement only guarantees the compensation for the variations when the interest curve is flat and varies in a parallel and infinitesimal way.

■ That the current asset and liability variations compensate each other in the case of scenarios of partial and non infinitesimal variation of the market interest curve. This is a requisite, the incorporation of which is necessary to control the risk omitted in the prior requisite.

By way of relevant peculiarity of the duration immunization system, it should be underlined that the use of equity market assets is admitted. As a basic premise, it is considered that these assets should provide a greater return in the long term compared to fixed interest investments. The system ends with requirements concerning liquidity, diversification and risk, amongst others.

As described, both financial immunization systems allow the use of financial assets with credit risks. However, if any asset experiences default, the insurance company cannot stop paying its obligations. In other words, in principle, the credit risk of the assets cannot be transferred to the insureds. On the basis of this premise, it is advisable to calculate what would be the value of certain investments (without the credit risk) that generate certain inflows similar to those that the company´s investments (with the credit risk) generate. The first value is higher than the second and the difference between the two measures the amount that the insurer would have to pay to eliminate the credit risk from its investment portfolio. The mathematical

BY WAY OF RELEVANT PECULIARITY OF THE DURATION IMMUNIZATION SYSTEM, IT SHOULD BE UNDERLINED THAT THE USE OF EQUITY MARKET ASSETS IS ADMITTED

reserve is made to coincide exactly with that value (the value of the investments adjusted to incorporate the credit risk).

Solvency II

With the current position of the Solvency II Project, the life insurance reserves are determined by discounting the outflows at a rate free of risk adjusted with a non-liquidity premium.

To support the interest risk, like any other risk, the insurer must have certain levels of capital.

Through the different impact studies (QIS), the methodology used to quantify the capital requirement for interest rate risk has varied according to the standard formula as well as the resulting calibration parameters. The two methodologies used were the analysis by scenarios and corrected durations which are similar systems to those described in the Spanish system of immunization by durations.

The standard capital requirement (SCR) can also be determined by means of authorized internal models. Since the value at risk has been the calibration measure chosen for determining losses, it is advisable to analyse their principal characteristics:

■ Calculation hypothesis. All measures of loss estimate are incomplete if no mention is made of the period of time and the level of confidence for which it is calculated.

■ Variance–covariance method. It considers that the distribution of losses is normal, which requires corrective adjustments to reflect thick tails.

■ Historical simulation method. This considers that the past behaviour adequately replicates future behaviour.

■ Montecarlo simulation method. This estimates the probability distribution of the losses through the generation of random numbers and statistical samples.

■ Volatility. Without doubt, this is the principal variable that most influences the estimate of losses.

■ Stress testing. The initial estimate must be complemented with the analysis of losses from extraordinary events.

■ Back testing. Any method used will not be adequate if it does not replicate real losses.

■ Tail VaR. This is a measure that analyses the distribution of losses once the VaR level has been reached. ∎

Bibliographic references

- BIERWAG, G. O. (1991). *Analysis of the duration. Management of the interest rate risk.* Alianza Editorial
- Various CEIOPS: SEC-34/10, CP-40/09, FS-14/07, CP-47/09, DOC-66/10, CP-70/09
- CEIOPS and EUROPEAN COMMISSION. QIS3 (2007), QIS4 (2008) y QIS5 (2010)
- CFO FORUM y CRO FORUM. QIS *Technical Specification. Risk-free interest rates*
- HULL, J. C. (2002). *Options, futures, and other derivatives.* Prentice Hall
- JORION, P. (2007). *Value at risk.* Mc Graw Hill
- J. P. MORGAN (1996). *RiskMetrics, technical document*
- KNOP, R., ORDOVÁS, R. and VIDAL, J. (2004). *Measurement of market and credit risks.* Ariel
- LAMOTE, P., LAROCHE, P. and CARRANCEJA, A. (1990). *How to manage interest rates. Management and cover of the interest rate risks.* Editorial and Expansion Area.
- LOZANO, R. (1999). *Practical analysis for the regulations on assets for insurance companies.* Centre for Insurance Studies.
- MAESTRO, J. L. (2000). *Technical-financial guarantees for insurance companies.* Winterthur Group.
- MARTÍNEZ, E. y GUASCH, J. (2002). *Fixed return portfolio management.* McGraw-Hill
- MENEU, V., NAVARRO, E. y BARREIRA, M. T. (1992). *Analysis and interest risk management.* Ariel Economy.
- OTERO, L. (2003). *The activity of life insurance companies in the framework of asset and liability risk management.* MAPFRE FOUNDATION Studies.
- EUROPEAN PARLIAMENT AND COUNCIL. Directive 2009/138/CE
- PEÑA, J. A. (2002). *Market and credit financial risk management.* Prentice Hall
- REDINGTON, F. M. (1952). *Review of the Principles of Life-Office Valuations.* Journal of the Institute of Actuaries
- SUÁREZ, A. (1998). *Optimum investment decisions and finance in business.* Pirámide.

Risk Management

Resilience,
again and again…

It is not so long ago that people first dared to include this somewhat curious and little-expected notion in the Risk Management scheme. In fact this notion is bound up with a principle that is usually lacking from all the manuals, which tend to pin the whole Risk Management process on a necessary risk identification. This done, these manuals then set out to ascertain what is to be done about the risks thus identified, whether to retain them, suppress them if possible or at least mitigate them or make due arrangements for passing them on to someone else. If we can benefit from modelling, all the better, for then Risk Management becomes a scientifically based discipline endorsed by one and all… But if we delve further into this subject, look what happens!

FRANÇOIS SETTEMBRINO
FERMA Risk Manager

Let's try to define this term «resilience» and find out what it entails. The life of companies, politicians and even everyday life, observed with due humility, shows that the future can never be encompassed in essence. Wish as we might, do what we will, the future stays resolutely uncertain. It is therefore overweening to believe that Risk Management, insofar as it addresses the future, will allow us to move therein with utter calm. However shrewd the means employed, reality might differ greatly from the expectations of even the best conducted Risk Management procedures.

This does not mean that the procedure has no intrinsic value; far from it. The more we learn from experience, the more successful it will be, for there is no more instructive and salutary lesson than analysing what went wrong and correcting it for the future. The problem is that bygones are bygones and the past never holds all the keys to the future. If we base our procedure only on the past and a perfect identification of the risks, then the whole procedure will be undermined by the risks we overlooked or simply neglected in good faith since they are not yet identifiable. Witness that terrible disease, AIDS, which was never brought into actuaries' calculations simply because no one suspected its existence.

We can now zoom in what this term «resilience» means… It is quite simply the ability to bounce back from any unforeseen event; in the life of any company, how should we confront any damaging unforeseen event, an all too frequent occurrence. The same goes for individuals; all of us need to train and sharpen our wits to be able to tackle and overcome, as far as possible, any

uncertainties the future might hold in store for us. One oft-quoted example of resilience can be understood by one and all; a fitness fanatic has chosen running as his discipline. He trains every day and is extremely content… But one day he is confronted by a situation that might turn dramatic; a serious fire breaks out nearby and our super fit hero legs it away from there at top speed. Of all the people present he is the only one to escape unscathed; his salvation came from his fitness but he never envisaged putting it to this use; this is resilience!

A great proponent of resilience, Boris Cyrulnik, has studied the experiences of children from war-torn areas, including those who managed to survive the concentration camps; the vast majority drew strength from this experience

showing extraordinary qualities of resilience in their lives thereafter. The title chosen for B. Cyrilnik's book describing his findings, *Un Merveilleux Malheur* (A Marvellous Misfortune) (Poche 2002), in itself speaks volumes. Human resilience, especially in childhood, is analysed in depth by a scientist, doctor, psychologist and psychiatrist.

One of the Risk Management professionals, the Business Continuity Manager, knows just how difficult this task is. Since his future is nothing more than uncertainty, he can work only in terms of scenarios, i.e., hypotheses of the biggest problems that may crop up and stymie his company. To ensure that the company keeps going, come what may, is his overriding responsibility. Failing a crystal ball, his task is already difficult enough, but knowing just how few managers grant the task due importance… Here are two examples:

A US firm makes excellent sports shoes with a tip-top reputation; the models are excellent and the style is irreproachable. One fine day management decides to offshore manufacture to an emerging country of Asia. Market selling prices do not change but the operation has almost tripled profits, none the less. Shareholders are over the moon. Then comes a day when a top-level sportsman with great brand loyalty sues it for bodily damage caused by the shoes, affording medical evidence in support of his case. As often occurs in the US the claimed sums are colossal but the firm manages to keep a lid on the affair and preserve its good name. Shortly afterwards another sporting celebrity weighs in with the same type of compensation claim, for even more astronomical sums, which he obtains without much difficulty. «Never two without three», as the French proverb goes, and sure enough a third claim is made with the same consequences. It turns out there was a grave manufacturing problem and quality control did not come quite up to scratch. Many directors moot the repatriation of the manufacturing process to keep it under closer control. The idea seems logical but the response was withering: the factories and machines have been sold off and the skilled staff have disappeared off the face of the earth. Starting from scratch would have been an almost superhuman effort and the cost would have been crippling. The only alternative was to send abroad, at great expense, a team to take charge of quality control, defraying all the costs of travel, accommodation, children's school fees and regular return journeys to the mother country.

The other example is today's burning news. Certain Peugeot factories have had to be shut down for lack of certain parts made in Japan. They have to tread water, because an urgent relaunch of factories in Europe would be a pipedream, while selling faulty vehicles is unthinkable. And Peugeot is not the only victim of these circumstances …

In both cases all resilience was rendered impossible. Whatever the advantages (financial or otherwise) of offshoring, this does not exempt the firm from thinking about the future with a bit more realism. Failing that, resilience became quite impossible to organise and no one knows any longer where the true cost-benefit ratio lies in the abovementioned impasses. Into the mix comes the liability of managers, moral at first, towards personnel, clients and the public at large and then civil liability for responding to any action that may be brought. Will these examples change the managers' mindset? Probably not judging from their behaviour, blinkered by the short term and failing to take the future into account either ethically or socially.

If we come back to the Business Continuity Manager, his role is to keep the firm going, but this can soon turn into a nightmare. A fire, theft, social upheaval and –for any offshored firm– the possibility of a change in the powers that be, democratically, dictatorially or by force of arms… all these factors need to be weighed up and assessed. But nowadays our man also has to take into account public health problems, new random or man-made ills, hurricanes, volcanic clouds, more and more devastating earthquakes, floods and even tsunamis…

Risk Management theories have already furnished him with more or less valid responses, such as spreading the eggs in more than one basket, maintaining relations with several suppliers rather than just one, making sure that personnel are as interchangeable as possible… The sources of resilience are countless but you never really know when or how you will need to call on them. In any case, studying alternatives before having need of them is the surest way of endowing yourself with a certain resilience, if only on the strength of permanent training. A brief example here will help us understand what is at stake. A bank based in a fifteen-story tower block sets up a Risk Management office. This deals at first with the best known risks; in the case in hand the fire risk looms large. This firm does nothing by halves, so insurers and firefighters are invited to assess the situation. Their engineers find a well-designed and well-built edifice, fitting with a sprinkler system fed by a rooftop tank. They come to the conclusion that a fire would damage at most two floors, one due to the means of extinguishment used and another floor, or rather two half-floors damaged by the water
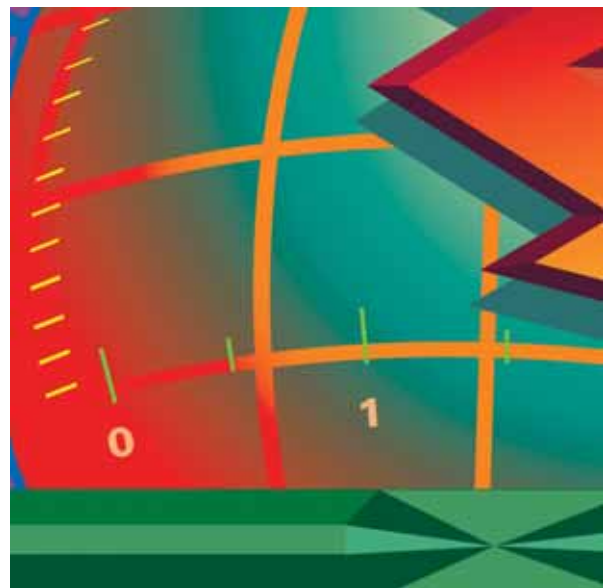
and smoke. To be sure of leaving nothing out of the equation, a team is asked to assess needs in the event of a fire of the size envisaged by the «specialists». Reports also have to be drawn up for the authorities, a security perimeter is set up round the site and an inventory is even produced of the material to be bought. Conscientiously, suppliers are approached and informed of the probable situation, The buying of two hundred desks, chairs, telephones, computers is not as easy as may be thought; relations are nurtured, regular contacts are organised and everyone thinks they have thought of everything. Unfortunately, one day, just for the hell of it, some children decide to cook some sausages on a hearth made out of packing cases in an empty plot that once housed a recently demolished supermarket hard by the bank. It was while playing in the empty plot that the children came across some forgotten boxes of cans of sausages. Some burning scraps of cardboard are wafted up into the hot air above the fire and sucked into the air-conditioning inlets of all the building's floors, starting a fire in the whole building at once. Happily it was a nonworking day so there are no victims to lament. But what role has resilience played in this case? Quite simply in the fact that a working team already had feelers out almost everywhere so they could soon set to work. This was no easy task, because procuring 2,000 desks, chairs, etc., is a bit trickier than obtaining 200, but the supply deadlines were considerably shortened. On the strength of its operations the bank won itself widespread fame for resilience, the computer systems already having been connected up between the different offices, forestalling the worst.

Do you think all these lessons will be learned? Judging from the performance of the finance world and banks in particular the only possible response is No. They have tried to outwit fate by setting up a Financial Risk Management so well conceived that nothing could happen to them; we have seen what that led to. But hardly is each disaster assimilated than the selfsame mistakes are made. Underneath this, perhaps, lies a certain cynicism; why bother about resilience if the state steps in to help banks if things go wrong. It is therefore the taxpayers who pick up the bill. And since they are also often clients, they even have to cough up twice.

The moral of this story is that certainty does not exist and never will; fatalists will tell you that zero risk does not exist and realists will say that even when everything has been done to avoid a risk, you are never sure that nothing will happen. Look at Japan's plight; the only constructions that withstood the earthquake were wealthy buildings constructed to quake-proof standards. The modest buildings have

STUDYING ALTERNATIVES BEFORE HAVING NEED OF THEM IS THE SUREST WAY OF ENDOWING YOURSELF WITH A CERTAIN RESILIENCE, IF ONLY THE STRENGTH OF PERMANENT TRAINING

disappeared. If we then factor in the damage caused by the tsunami, the result is wholesale horror. There is little left to say about the ordeal of the nuclear power plant, only that it was designed to withstand an earthquake of less severity than the one that actually happened, and that both building and equipment have greatly suffered. While a new Chernobyl was forestalled, it will no means be easy to bring the site back under control in the near future. The tsunami, for its part, swept away houses, boats and inhabitants with incredible fury; we have all seen the harrowing video footage. What many forget is the meaning of the Richter scale, beyond vague memories from primary school. Many believe that a value of 9 is almost double that of 5. In fact the scale is exponential and each step of 1 corresponds to a thirty-fold increase of the energy and a tenfold increase of the movement. Truly a terrifying statistic.

As for the resilience shown by the Japanese authorities, this would seem to be particularly shaky. At KobE it took three days for rescue operations to be set in motion; over here it was a bit quicker. Eighty thousand soldiers were rapidly shipped off to help find any survivors and remove the bodies from amongst the rubble. For the survivors, on the contrary, the resilience was practically nil. At a time when helicopters and planes are used for any bagatelle, food and warmth-giving supplies could easily have been parachuted to the hardest hit even well off the beaten track, but apparently this was not done. It must also be said that the authorities' transparency was also found wanting; information, heavily censured, came in dribs and drabs.

All this represents an unprecedented fund of feedback and experience to be tapped into by Risk Management practitioners, but it will all go to waste if company directors and politicians do not make good use of it. Only the future will tell whether they do or not.

THE JAPAN EXPERIENCES REPRESENT AN UNPRECEDENT FUND OF FEEDBACK TO BE TAPPED INTO BY RISK MANAGEMENT PRACTITIONERS, BUT IT WILL ALL GO TO WASTE IF COMPANY DIRECTORS AND POLITICIANS DO NOT MAKE GOOD USE OF IT

RANKING
of insurance groups in Latin America

For the ninth straight year, FUNDACIÓN MAPFRE presents its ranking of the 25 largest insurance groups in Latin America by premium volume, this time for 2010. Three rankings have been compiled –Overall, Life and Non-Life– and separate information is included on local and multinational insurers.

FUNDACIÓN MAPFRE
CENTRO DE ESTUDIOS

	RANKING OF INSURANCE GROUPS IN LATIN AMERICA IN 2010 OVERALL						
N°	GROUPS	COUNTRY	Premiums millions of €		%▲	Market share	RANKING
			2009	2010		2010 %	2009
1	BRADESCO SEGUROS	BRAZIL	5.834	8.014	37,3	8,9	1
2	MAPFRE[1]	SPAIN	4.284	6.705	56,5	7,4	3
3	ITAÚ/UNIBANCO HOLDING	BRAZIL	4.741	5.351	12,9	5,9	2
4	METLIFE[2]	UNITED STATES	2.527	3.575	41,5	4,0	4
5	BRASILPREV[3]	BRAZIL	1.528	3.258	113,1	3,6	-
6	SANTANDER	SPAIN	2.311	3.239	40,2	3,6	7
7	PORTO SEGURO	BRASIL	1.858	3.090	66,3	3,4	8
8	LIBERTY MUTUAL	UNITED STATES	2.317	2.351	1,4	2,6	6
9	CNP	FRANCE	1.527	2.085	36,5	2,3	9
10	ALLIANZ	GERMANY	1.267	1.712	35,1	1,9	16
11	G. NACIONAL PROVINCIAL	MEXICO	1.417	1.657	17,0	1,8	11
12	AXA	FRANCE	1.393	1.589	14,1	1,8	13
13	MCS	UNITED STATES	1.112	1.541	38,6	1,7	21
14	TRIPLE-S	PUERTO RICO	1.411	1.513	7,2	1,7	12
15	HS BC	UNITED KINGDOM	1.216	1.504	23,7	1,7	17
16	ZURICH	SWITZERLAND	1.328	1.500	12,9	1,7	14
17	SUL AMÉRICA	BRAZIL	1.489	1.338	-10,1	1,5	10
18	GENERALI	ITALY	1.146	1.309	14,3	1,4	19
19	BBVA	SPAIN	1.278	1.188	-7,0	1,3	15
20	SURAMERICA	COLOMBIA	805	1.116	38,6	1,2	24
21	MMM HEALTHCARE	UNITED STATES	947	1.007	6,3	1,1	22
22	AIG	UNITED STATES	1.213	994	-18,1	1,1	18
23	ACE	UNITED STATES	656	882	34,4	1,0	26
24	RSA	UNITED KINGDOM	629	830	31,9	0,9	28
25	INBURSA	MEXICO	1.143	781	-31,6	0,9	24

Total for top 10			28.196	39.380	39,7	43,6	
Total for top 25			45.379	58.131	28,1	64,4	
Total for sector			75.769	90.316	19,2	100	

[1] Includes BrasilVeículos and Aliança do Brasil.

[2] Includes the companies of ALICO.

[3] Stakes held by Banco do Brasil and Principal, in earlier rankings its premiums were included under Banco do Brasil.

RANKING OF INSURANCE GROUPS IN LATIN AMERICA IN 2010 NON-LIFE							
N°	GROUPS	COUNTRY	Premiums millions of €		%▲	Market share	RANKING
			2009	2010		2010 %	2009
1	MAPFRE	SPAIN	3.371	4.969	47,4	10,5	1
2	PORTO SEGURO	BRAZIL	1.752	2.944	68,0	6,2	3
3	LIBERTY MUTUAL	UNITED STATES	2.238	2.252	0,6	4,7	2
4	BRADESCO SEGUROS	BRAZIL	1.435	1.972	37,4	4,2	5
5	ITAÚ/UNIBANCO HOLDING	BRAZIL	1.728	1.611	-6,8	3,4	4
6	ALLIANZ	GERMANY	1.101	1.454	32,1	3,1	7
7	AXA	FRANCE	1.062	1.215	14,4	2,6	8
8	SUL AMÉRICA	BRAZIL	1.338	1.127	-15,8	2,4	6
9	G. NACIONAL PROVINCIAL	MEXICO	912	1.050	15,2	2,2	11
10	ZURICH	SWITZERLAND	956	1.031	7,9	2,2	9
11	GENERALI	ITALY	846	979	15,7	2,1	13
12	AIG[1]	UNITED STATES	809	942	16,5	2,0	14
13	ACE	UNITED STATES	553	746	34,9	1,6	18
14	TALANX	GERMANY	526	740	40,7	1,6	19
15	RSA	UNITED KINGDOM	609	705	15,7	1,5	17
16	MERCANTIL	VENEZUELA	912	692	-24,2	1,5	10
17	QUÁLITAS	MEXICO	467	589	26,0	1,2	20
18	CNP ASSURANCES	FRANCE	405	563	38,9	1,2	22
19	INBURSA	MÉXICO	864	534	-38,2	1,1	12
20	SANTANDER	SPAIN	337	523	55,0	1,1	28
21	SANCOR	ARGENTINA	415	495	19,1	1,0	21
22	BBVA	SPAIN	389	450	15,7	0,9	23
23	METLIFE	UNITED STATES	293	428	46,4	0,9	31
24	CHUBB	UNITED STATES	337	428	27,0	0,9	27
25	SURAMERICA	COLOMBIA	317	423	33,2	0,9	29

	2009	2010		
Total for top 10	15.893	19.625	23,5	41,4
Total for top 25	23.973	28.859	20,4	60,8
Total for sector	42.889	47.460	10,7	100

[1] Includes Chartis.

N°	GROUPS	COUNTRY	Premiums millions of €		% ▲	Market share	RANKING
			2009	2010		2010 %	2009
1	BRADESCO SEGUROS	BRAZIL	4.399	6.042	37,3	14,1	1
2	ITAÚ/UNIBANCO HOLDING	BRAZIL	3.013	3.741	24,2	8,7	2
3	BRASILPREV[1]	BRAZIL	1.528	3.258	113,1	7,6	-
4	METLIFE	UNITED STATES	2.235	3.147	40,8	7,3	3
5	SANTANDER	SPAIN	1.974	2.717	37,6	6,3	5
6	MAPFRE	SPAIN	913	1.736	90,2	4,1	10
7	MCS	UNITED STATES	1.112	1.541	38,6	3,6	8
8	CNP	FRANCE	1.122	1.523	35,7	3,6	7
9	TRIPLE-S	PUERTO RICO	1.294	1.392	7,6	3,2	6
10	HS BC	UNITED KINGDOM	829	1.083	30,7	2,5	12
11	MMM HEALTHCARE	UNITED STATES	947	1.007	6,3	2,4	9
12	BBVA	SPAIN	889	738	-17,0	1,7	11
13	SURAMERICANA	COLOMBIA	488	693	42,2	1,6	14
14	G. NACIONAL PROVINCIAL	MEXICO	505	607	20,2	1,4	13
15	HUMANA	UNITED STATES	483	591	22,3	1,4	15
16	NEW YORK LIFE	UNITED STATES	473	549	16,0	1,3	16
17	BANAMEX	MEXICO	375	531	41,6	1,2	19
18	ZURICH	SWITZERLAND	372	469	25,9	1,1	21
19	FIRST MEDICAL HEALTH PLAN	UNITED STATES	373	427	14,5	1,0	20
20	PMC MEDICARE CHOICE	PUERTO RICO	386	387	0,1	0,9	18
21	AXA	FRANCE	331	374	13,0	0,9	22
22	CONSORCIO	CHILE	242	340	40,7	0,8	28
23	GENERALI	ITAY	300	330	10,3	0,8	23
24	CARDIF	FRANCE	285	318	11,6	0,7	26
25	ING	NETHERLANDS	286	315	10,1	0,7	25

RANKING OF INSURANCE GROUPS IN LATIN AMERICA IN 2010 — LIFE

	2009	2010	%	Market share
Total for top 10	18.418	26.179	42,1	61,1
Total for top 25	25.154	33.856	34,6	79,0
Total for sector	32.880	42.856	30,3	100

[1] *Stakes held by Banco do Brasil and Principal, in earlier rankings its premiums were included under Banco do Brasil.*

Ranking of local and multinational groups

RANKING OF LOCAL INSURANCE GROUPS IN LATIN AMERICA IN 2010 OVERALL

| N° | GROUPS | COUNTRY | Premiums millions of € | | % ▲ | Market share | RANKING |
			2009	2010		2010 %	2009
1	BRADESCO	BRAZIL	5.834	8.014	37,3	8,9	1
2	ITAÚ/UNIBANCO HOLDING	BRAZIL	4.741	5.351	12,9	5,9	2
3	BRASILPREV	BRAZIL	1.528	3.258	113,1	3,6	-
4	PORTO SEGURO	BRAZIL	1.858	3.090	66,3	3,4	4
5	G. NACIONAL PROVINCIAL	MEXICO	1.417	1.657	17,0	1,8	6
6	TRIPLE-S	PUERTO RICO	1.411	1.513	7,2	1,7	7
7	SUL AMÉRICA	BRAZIL	1.489	1.338	-10,1	1,5	5
8	SURAMERICANA	COLOMBIA	1.143	1.116	-2,4	1,2	8
9	INBURSA	MEXICO	1.143	781	-31,6	0,9	9
10	MERCANTIL	VENEZUELA	936	708	-24,4	0,8	10

	Total for top10		21.502	26.827	24,8	29,7	
	Total for sector		75.769	90.316	19,2	100	

RANKING OF MULTINATIONAL INSURERS IN LATIN AMERICA IN 2010 OVERALL

| N° | GROUPS | COUNTRY | Premiums millions of € | | % ▲ | Market share | RANKING |
			2009	2010		2010 %	2009
1	MAPFRE	SPAIN	4.284	6.705	56,5	7,4	1
2	METLIFE	UNITED STATES	2.527	3.575	41,5	4,0	2
3	SANTANDER	SPAIN	2.311	3.239	40,2	3,6	4
4	LIBERTY MUTUAL	UNITED STATES	2.317	2.351	1,4	2,6	3
5	CNP	FRANCE	1.527	2.085	36,5	2,3	5
6	ALLIANZ	GERMANY	1.267	1.712	35,1	1,9	9
7	AXA	FRANCE	1.393	1.589	14,1	1,8	6
8	HS BC	UNITED KINGDOM	1.216	1.504	23,7	1,7	10
9	ZURICH	SWITZERLAND	1.328	1.500	12,9	1,7	7
10	GENERALI	ITALY	1.146	1.309	14,3	1,4	12

	Total for top10		19.316	25.569	32,4	28,3	
	Total for sector		75.769	90.316	19,2	100	

The consolidation of economic recovery in most countries of Latin America in 2010 was reflected in the insurance sector, which posted growth in all markets, in local currency and at current prices. Premium volume expressed in euros rose 19.2% compared to the previous year and totaled 90,316 million[1]. This growth was favored by the rise in most local currencies against the euro, mainly the Brazilian real and the Colombian peso. On the other hand, the devaluation of the bolivar in January 2010 caused a 35% drop in premium volume in euros in the Venezuelan insurance market, in contrast with a 23% increase when measured in local currency.

Brazil, which has Latin America's largest insurance market, grew 17% in local currency and 39% in euros. This expansion was fueled yet again by the class of insurance known as *Vida Gerador de Benefício Livre* (VGBL), a product distributed mainly by banks and which offers tax incentives. In Mexico, the second largest market, the rise in the sector (excluding Pensions) was 1% in local currency and 14% in euros. The performance of Non-Life branches was negative, as the renewal of the overall multi-year policy held by Petróleos Mexicanos (PEMEX) took place in 2009 and in 2010 it was not issued.

The fall in premiums in Venezuela made Puerto Rico's the third-largest insurance market in the region, with premium volume of 7,943 million euros. That revenue was up 6% compared to the previous year, thanks to growth in Health insurance (10%). The other three largest markets, Chile, Argentina and Colombia, saw increases of 37%, 10% and 29%, respectively, when measured in euros.
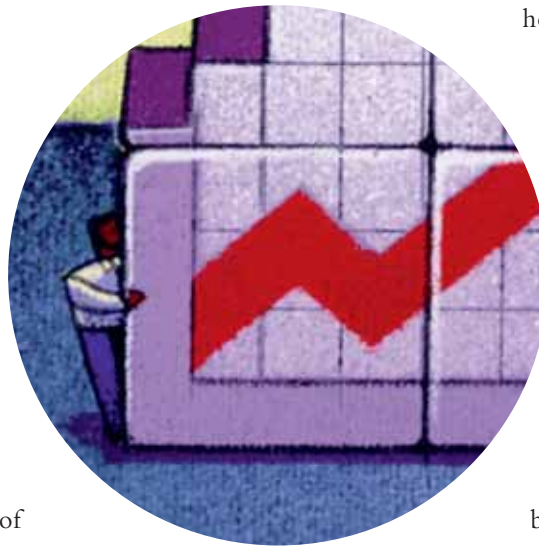
OVERALL RANKING

In 2010, the 25 largest insurance groups in Latin America posted revenue of 58,131 million euros, a rise of 28.1% from the previous year, and accounted for 64.4% of premiums in the region, an increase of nearly three points from 2009.

IN 2010, THE 25 LARGEST INSURANCE GROUPS IN LATIN AMERICA POSTED REVENUE OF 58,131 MILLION EUROS, A RISE OF 28.1% FROM THE PREVIOUS YEAR

Among the top 10 groups that concentration has risen five points to 43.6% and this is closely linked to the performance of the Brazilian insurance market: four of the 10 largest groups are Brazilian and the other six have units in that country. Premium growth in the Brazilian market was enhanced significantly because of the rise of the Brazilian real against the euro. Another factor that contributed to the increased concentration at the top of the ranking was a series of business transactions that took place in 2010, such as the agreement signed by MAPFRE and Banco do Brasil, and the acquisition by MetLife of the Life insurance unit of AIG, American Life Insurance Company (ALICO).

For yet another year the ranking was led by the Brazilan group Bradesco with premium volume of 8,014 million euros. In 2010 the group boosted its revenue by 37.3% and its market share by just over a point to 8.9% (compared to 7.7% in 2009). Next was the MAPFRE group, which climbed one spot in the ranking and increased its market share by 1.7 points, thanks to the accord reached with Banco do Brasil. The deal was carried out by creating two holding companies (BB-MAPFRE, for Life and Agricultural insurance, and MAPFRE-BB, for Automobile and General Insurance). The insurance units that both companies have in Brazil will be part of these two holding companies.

Itaú went from second to third place[2] and MetLife held on to fourth place, while boosting its market share seven-tenths of a point. Brasilprev[3], in which stakes are held by Banco do Brasil and the Principal group, held fifth place in the ranking thanks to a huge rise in premiums from sales of its VGBL product.

In general, besides the mergers and acquisitions that took place in 2010, the main causes of the changes in positions on the ranking are those mentioned earlier: the strong rise in local currencies against the euro, especially the Brazilian real and the Colombian peso. This favored the growth of groups with units in those countries. The influence of the rise in the Mexican peso was also positive, if we take into account the fact that Mexico's is the second largest market in the region. However, although the Venezuelan market continues to grow when measured in local currency, the devaluation of the bolivar at the beginning of the year had the opposite effect to the one described earlier.

THE 25 LARGEST INSURANCE GROUPS IN THE NON-LIFE BRANCH HAD A MARKET SHARE OF 60,8% COMPARED TO 58% IN 2009

The biggest rises were those of MCS, a company that specializes in Life and Health insurance in Puerto Rico, which climbed eight spots after taking over the Health portfolio of Cooperativa de Seguros and that of Allianz –which rose from 16th to 10th place thanks to growth in all of the markets where it operates, mainly Brazil, Colombia and Mexico. But Sul América fell from 10th to 16th after selling its 60% stake in Brasilveículos to Banco do Brasil. Spanish group BBVA dropped four spots as a result of a decline in premiums from its units in Mexico and Colombia.

Finally, we should mention that the Venezuelan groups Mercantil and La Previsora fell off the ranking, which they had joined in 2009. Taking

their place were the U.S. company ACE and the British one RSA. The U.S. group rejoins the ranking after dropping off the previous year.
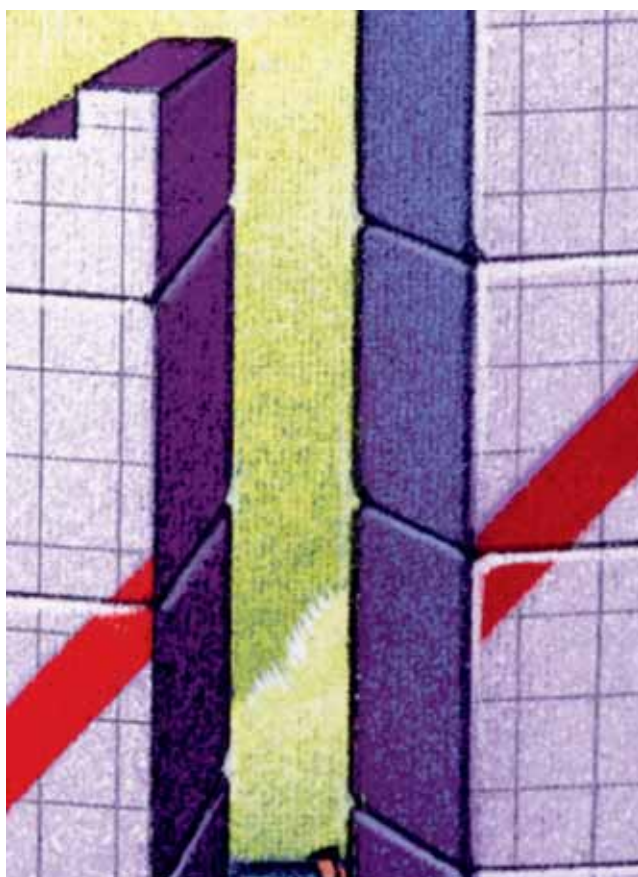
Non-Life Ranking

The 25 largest insurance groups in the Non-Life branch had a market share of 60.8% compared to 58% in 2009. Concentration rose the most in the top 10 groups, whose market share increased four points to 41.4%. The main reason is the one discussed in the previous section: influence from the Brazilian insurance market and the agreement between MAPFRE and Banco do Brasil. Unlike in 2009, the contribution from Mexican companies was positive, and favored by the rise of the Mexican peso against the euro.

With growth of 47.4%, MAPFRE continued to lead the Non-Life ranking and accounted for 10.5% of the premiums in this line of insurance, or 4,969 million euros, 2.6 points more than in 2009. The reasons for this growth were a strong performance by all of its units in the región and the fact that it included revenue from BrasilVeículos and Aliança do Brasil, as a result of the alliance formed in 2010 with Banco do Brasil.

The accord signed by Itaú/Unibanco and Porto Seguro in 2009 continued to fuel growth for Porto Seguro, which overtook Liberty to occupy second place in the ranking. Bradesco, with premium volume of 1,972 million euros, slipped to fourth place and sent Itaú/Unibanco down to fifth.

As for other changes, we note the decline of the Venezuelan group Mercantil, due to the devaluation of the bolivar (its premiums rose 11% in local currency), and of Inbursa, which holds the multi-year policy of PEMEX. Other highlights include the incorporation of Santander, MetLife,

Chubb and the Colombian group Suramericana (Grupo Sura) onto the ranking.

LIFE RANKING

The 25 groups that make up the Life ranking took in 33,856 million euros in premiums, 34.6%

THE 25 GROUPS THAT MAKE UP THE LIFE RANKING TOOK IN 33,856 MILLION EUROS IN PREMIUMS, 34.6% MORE THAN IN THE PREVIOUS YEAR

more than in the previous year. Concentration increased slightly (six-tenths of a point) in the 25 largest groups, and just over three points among the top 10.

The first three spots on the list are still held by Brazilian groups, led once again by Bradesco, which in 2010 posted premium revenue of 6,042 million euros. Next came Itaú/Unibanco, although at a considerable distance behind, with revenue of 3,741 million euros. Brasilprev[4] posted spectacular growth of 113.1% (79% in local currency) thanks to growth of its VGBL product, which took it to third place, ahead of MetLife, which also saw a major rise in revenue thanks to its purchase of the Life insurance branch of AIG.

The changes with respect to the ranking of 2009 were not very significant. Those most noteworthy include the rise of MAPFRE, which went from 10th place to sixth for the reasons discussed earlier, and that of Zurich, which gained three spots, thanks to growth in all of its units, especially its Chilean company. Othe-r novelties are that the Chilean company Consorcio and the French firm Cardif joined the ranking, while AIG dropped off of it following the sale of ALICO to MetLife, as did the Colombian group Bolívar.

RANKING OF LOCAL AND MULTINATIONAL GROUPS

The ranking of local groups did not change. Bradesco remained the leader, distancing itself further from its most immediate competitor, Itaú/Unibanco, which is also Brazilian.

MAPFRE continued to lead the ranking of multinational groups in Latin America, followed by MetLife and Santander. With growth of 40.2%, the Spanish banking-insurance group surpassed the premium volume of Liberty Mutual and took over third place. BBVA's dropping off the ranking as a result of a decline in its premiums in Colombia and Mexico allowed Generali to join the list, thanks to across-the-board growth by the group's companies operating in the region, especially Argentina and Mexico.

METHODOLOGY

In the preparation of this study, the same methodology was used as in earlier versions. The data come from information published by the insurance regulatory bodies in the various countries, and the premium volume of each group is the sum of the premiums issued in each country. In calculating data, we have taken into account the mergers and acquisitions announced in 2010.

One must also note that in carrying out this kind of study, a complication arises because of the different makeup of the Life and Non-Life branches in each country. In general, and wherever possible, Health and Accident insurance have been included in the Non-Life branch. But it was not possible to apply this criterion to Puerto Rico, for instance, where the Disability line (Health) is considered part of Life insurance. In fact, the largest insurers of Life and Health in Puerto Rico are mainly Health insurers. Some of them are among the top 25 Life insurance groups in Latin America.

Also, in Brazil, contributions from Previdencia Privada, or private pension plans, were not included, nor were Health insurance premiums because they are under the control of the Agência Nacional de Saúde Suplementar (ANS). In Argentina, life annuities and retirement insurance are not included and in Mexico pensions are excluded[5].

To convert data expressed in other currencies into euros, we used the average exchange rate for the year. Growth rates are calculated using revenue in euros.

The rankings can be obtained from the electronic publications section of the Institute of Insurance Sciences at FUNDACIÓN MAPFRE, at **www.fundacionmapfre.com/cienciasdelseguro**. ∎

[1]Does not include Health insurance in Brazil, Life Annuities and Retirement insurance in Argentina, or Pensions in Mexico.

[2]In 2009 Itaú/Unibanco and Porto Seguro signed an agreement to merge their Automobile and Homeowner's insurance lines, creating a new company called Itaú Seguros de Auto e Residência, which is controlled by Porto Seguro.

[3]In earlier editions of this ranking, this company´s premiums were included under Banco do Brasil.

[4]In earlier editions of this ranking, this company´s premiums were included under Banco do Brasil.

[5]For this reason, and due to the differences in the makeup of the Life and Non-Life branches, the figure on total Life and Non-Life premiums in this study is different from the one published in the FUNDACIÓN MAPFRE's study «The Latin American Insurance Market».

responds to the sense of social responsibility which is a basic principle behind MAPFRE's business activities. It was founded in 1975.

The Insurance Sciences Institute of FUNDACIÓN MAPFRE was created to promote educational and research activities concerned with the world of insurance and risk management.

Gerencia de Riesgos y Seguros