

**GLOBAL FORUM**  
*for* **LONGEVITY**

**CONFERENCE  
PROCEEDINGS  
FROM INITIAL  
MEETINGS**

**MARCH 28, 2011**



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# CHANGE THE WAY WE LOOK AT LONGEVITY

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# LONGEVITY: WHAT IS IT ALL ABOUT?

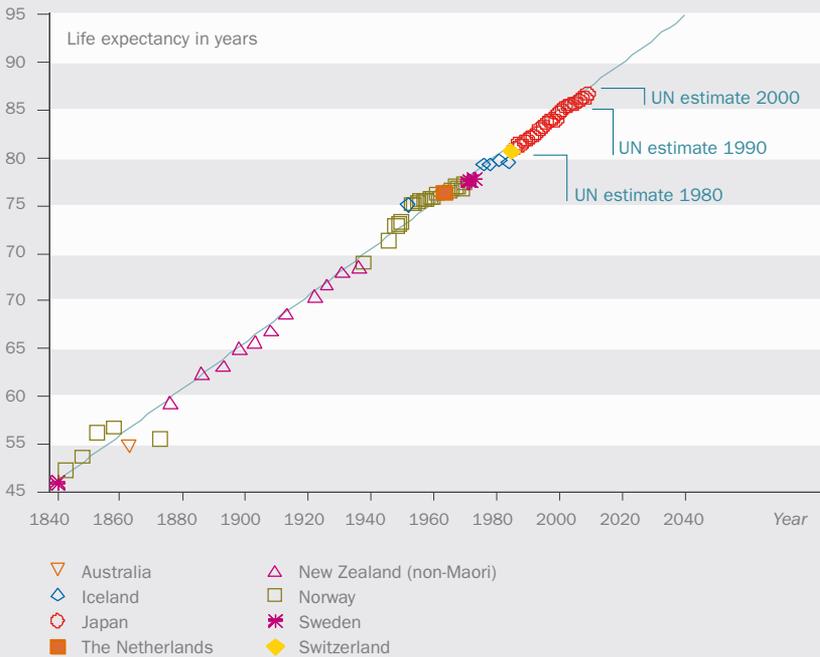
*“Most children born in France, Germany and the US since 2000 will celebrate their 100<sup>th</sup> birthdays.”*

Pr. James W. Vaupel

IN 150 YEARS, THE WORLD POPULATION WILL HAVE GAINED MORE THAN 30 YEARS OF LIFE EXPECTANCY AND FOR THAT TREND THERE IS NO END IN SIGHT.

## Increase in life expectancy since 1840 for advanced economies

Source: *Oeppen, J. and Vaupel, J.W. 2002. Science.*



This change has come about in an astonishingly linear fashion, with a per decade increase of 2<sup>1/2</sup> years.

**80**  
years

*Life expectancy at birth in the US, Canada, Iceland, Japan, Australia, New Zealand and in the most advanced EU countries.*

**3**  
months  
per year

*Extension in life expectancy for most advanced economies.*

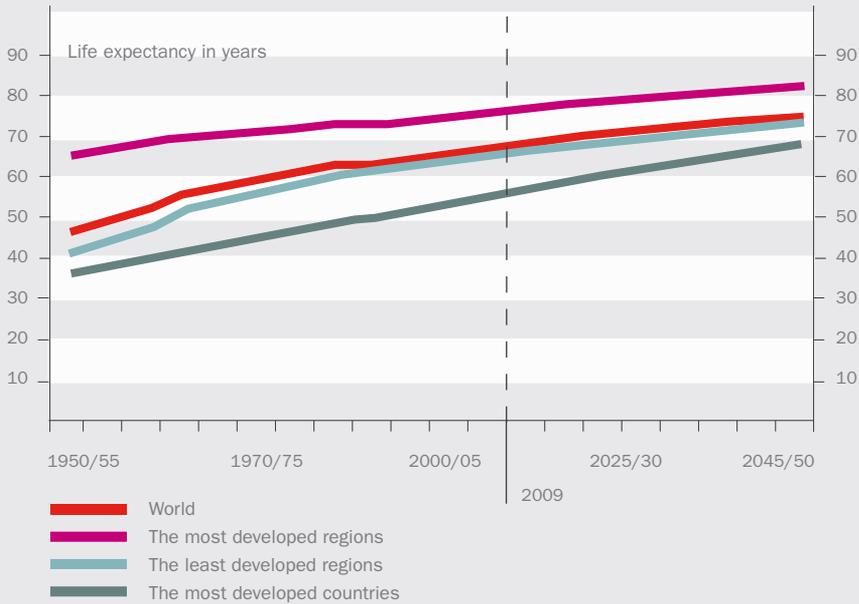
**86**  
years

*Life expectancy for women in Japan, the country where people currently live the longest.*

## LONG LIFE IS A WORLD-WIDE PHENOMENON

### Change in life expectancy at birth world-wide and by region, between 1950 and 2050

Source: *World Population Ageing 2009*, United Nations.



In 2040, three people out of four aged 65 and over will live in a developing country, i.e. 1 billion people.

## TODAY, THE DECLINE IN MORTALITY FOR THE ELDERLY IS THE MAIN FACTOR DRIVING LONG LIFE

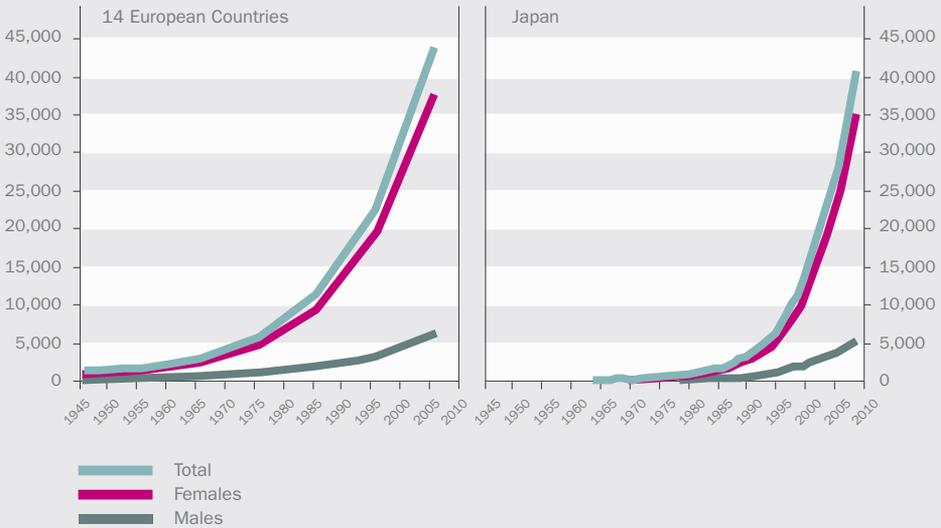
*“The explosion in very long life has already begun.”*

Pr. James W. Vaupel

THE MOST SPECTACULAR CONSEQUENCE IS THE EMERGENCE OF CENTENARIANS

Emergence of centenarians

Source: Robine, J.-M. Global Forum for Longevity.



*“Jeanne Calment, France’s longest-lived person, died at the age of 122. We cannot see much beyond 122.”* Pr. James W. Vaupel

*“Every year, we observe someone who dies at 114, 115 or 116. After that, we enter the domain of the outlier, and we know three people in that category: Jeanne Calment, dead at the age of 122, Sarah Knauss, dead at 119 and Mrs. Meilleur, a Canadian lady, who died at the age of 117.”* Pr. Jean-Marie Robine

THE OLDER ONE IS, THE MORE PRONOUNCED IS THE GROWTH RATE

*“Since World War II, the populations of all the upper age groups have considerably increased in countries with low mortality. And over the last few years, there has been no sign of that trend slowing.”*

Pr. Jean-Marie Robine

Increase in the number of 85+ year olds in Japan, since 1947

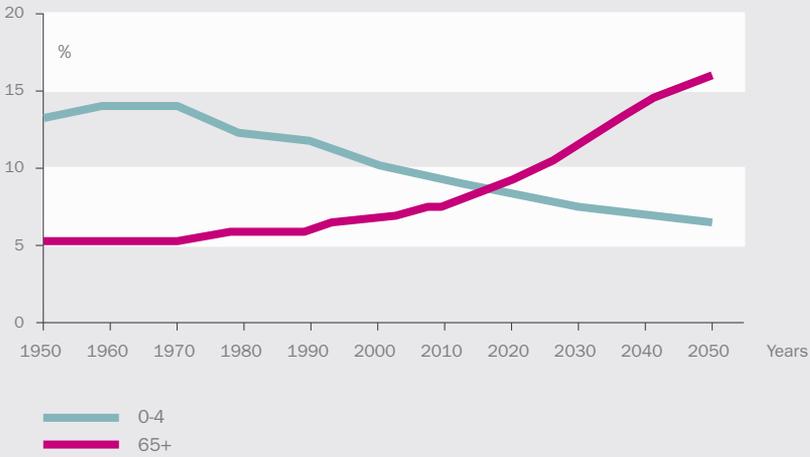
Source: Robine, J.-M. Global Forum for Longevity.



BECAUSE OF THE DROP IN BIRTH RATES, THE MAIN CONSEQUENCE OF LONG LIFE HAS BEEN AN AGEING POPULATION.

### Small children and the elderly as a percentage of the world population from 1950 to 2050

Source: "An Aging World: 2008/International Population Reports", June 2009. U.S. Census Bureau.



For the first time in the history of humanity, the number of people over 65 is soon to be greater than the number of children under 5.

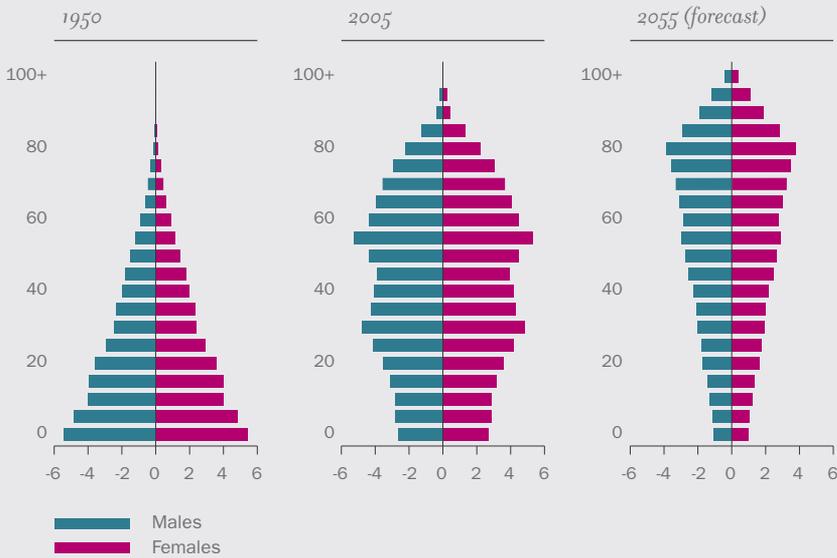
*“We have to prepare for a new reality. For every senior, there will be fewer and fewer working-age adults, as we go forward. This will have major socioeconomic consequences, ranging from impacts on pension policy to governmental incomes.”*

Dr. Daniel Vasella

THE AGE PYRAMID IS BEING ROCKED AND WITH IT, THE RATIO OF WORKING TO NON-WORKING CITIZENS

### Change in the distribution of the Japanese population, by age cohort, between 1950 and 2055

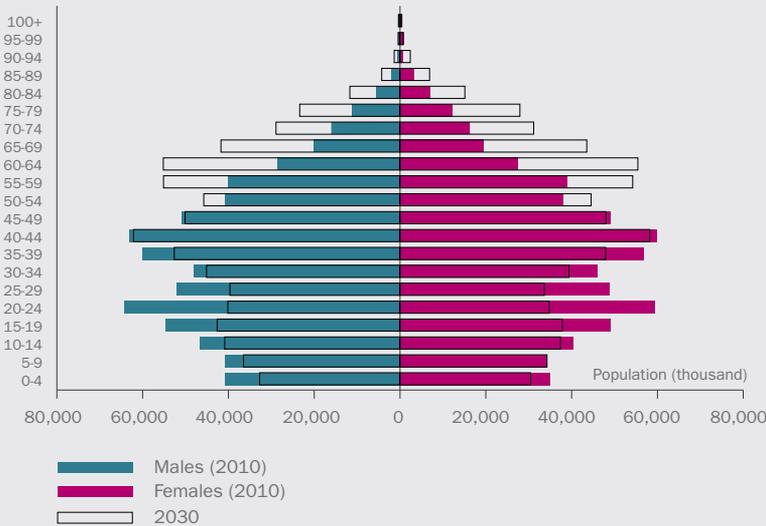
Source: National Institute of Population and Social Security Research.



THE TRANSITION WILL BE DRAMATICALLY FAST IN CERTAIN DEVELOPING COUNTRIES

Projected population structure:  
China, 2010 vs. 2030

Source: International Data Base, January 2011. U.S. Census Bureau.



**China is going to age four times faster than France;** it has taken more than a century for the proportion of people over 65 in France to go from 7% to 14% of the total population. That same transition will only take 26 years in China and 21 years in Brazil.

*“One observes that the ‘youngest’ countries are also the ones that age the fastest. More than a simple curiosity in demography, this is a real challenge for these countries, which are likely to grow old before they grow wealthy.”*

Robert B. Zoellick

# IT BEGINS TODAY

Life expectancy has already gone past 80 years in the most developed countries. Although longevity and life expectancy in good health can be influenced from the earliest ages by genetic and socioeconomic factors, it seems that it is also possible to influence it positively at any time in life.

*“We are probably one of the most resilient species, but more importantly, thanks to our intellect, we know how to change our environment so that it prolongs our longevity.”*

Pr. Jean-Marie Robine

## AGEING CAN BECOME A PREOCCUPATION, STARTING AT BIRTH

*“Contrary to what most people believe, there is no genetic programming for ageing. The ageing process is intrinsically much more malleable than we used to think.”* Pr. Thomas Kirkwood

## ACT ON RISK FACTORS IN ORDER TO PREVENT AGE-RELATED DISEASE

*“One sees that out of the major risk factors, which are best known, two are particularly preoccupying: obesity and inactivity. However once again, prevention has a role to play, since certain measures taken in France to combat childhood obesity in schools have had a salutary effect and one now sees children’s weight problems falling.”*

Dr. Françoise Forette

## Main risk factors and their incidence on reduction in lifespans

Source: WHO, 2002.

Risk Factors	Total DALYs (%) *
Tobacco	12.2
Blood pressure	10.9
Alcohol	9.2
Cholesterol	7.6
Overweight	7.4
Low fruit and vegetable intake	3.9
Physical inactivity	3.3
Illicit drugs	1.8
Unsafe sex	0.8
Iron deficiency	0.7

\* DALY (Disability-Adjusted Life Years) is a quantitative indicator, expressed in years, which measures the total sum of years lost due to a given illness, resulting either in premature mortality or disability.

The HYVET study has recently demonstrated that if high blood pressure is treated in people over 80, it can still reduce the mortality rate by 40% and the occurrence of stroke by 30%.

## FOR THE OLDEST, SLOW THE PROGRESS OF DEBILITATING ILLNESS.

*“Although disease prevention is a worthy goal, we have to be able to manage the oldest among seniors who have multiple diseases and conditions.”* Pr. Carol Jagger

**> 50%**

**Proportion of people over 85 who have one form or another of musculoskeletal disease, such as arthritis.**

Problems with vision are the second largest risk, attributable to the population.

# THE ABC'S OF "HEALTHY AGEING"

*"There is good evidence that diet, exercise and social interaction are important factors for healthy ageing although, in some cases, we do not fully understand the underlying mechanisms."* Pr. Carol Jagger

A FEW FACTORS IDENTIFIED,  
BUT STILL MUCH UNCERTAINTY...

*"Finally, there is no doubt that socioeconomic factors, such as education, wealth and social benefits, not only play a decisive role in the disablement process, but are also factors which can inhibit change in lifestyles or strategies to compensate for failing function."* Pr. Carol Jagger

*"Hence, we can understand the ageing process as being driven by an accumulation of damage which gives rise to cellular defects that in time give rise to age-related frailty, disability and disease. If we make good choices, and if living conditions improve to give less exposure to chronic damage, we can age more slowly."* Pr. Thomas Kirkwood

*"The impoverishment of mental stimuli is dramatic. It is essential that in urban planning we keep seniors integrated and do not create silver ghettos."*  
Dr. Daniel Vasella

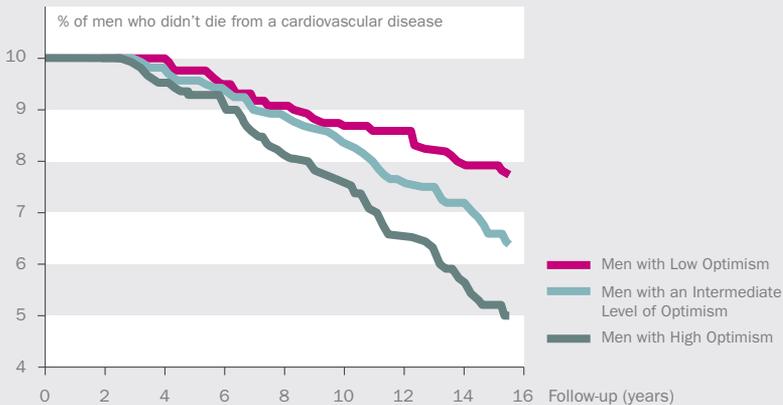
**2.7**

**Between 35 and 80, inactive people had a mortality rate 2.7 times greater than the rest of the population over the period 1991-99.**

Source: French statistics institute INSEE.

## An optimistic outlook is good for health

Source: Giltay, J.C. and co-researchers, February 27, 2006. "Zutphen Elderly Study", Archives of Internal Medicine 166.



Giltay's 15-year survey of men aged 64 to 84, free of history and risk factors for cardiovascular diseases, reveals that the risk of cardiovascular disease-related death is less for optimists than for pessimists.

*“For a start, we know that a very large number of studies have shown that education correlates positively with mental health at an advanced age. Education has no influence on lesions, caused by Alzheimer’s disease in the brain. However, it does slow down the appearance of clinical symptoms for the disease<sup>2</sup>, which is particularly vital. However and perhaps even more interestingly, recent studies have shown a very significant effect. When one postpones retirement, each added year of work delays the onset of Alzheimer’s by 0.13 years<sup>3</sup>. That is a fundamental fact which needs further confirmation, because it was a finding in a small study, surveying just 400 people.”*

Dr. Françoise Forette

1. Bennet 2003, Bruander 2008, Katzman 1993... 2. Letenneur 1999, Snowdown 1996, Stern 1994.  
 3. Lupton, M.K. et al. 2010. *International Journal of Geriatric Psychiatry* 25 (1): 30-6.

# SOME ARE MORE EQUAL THAN OTHERS

Our genetic makeup is reputed “only” to be responsible for 25% of individual differences in long life. Socioeconomic environment and the way we live, therefore, have a considerable impact on our life expectancies. In order to overcome those differences, access to adequate healthcare and disease prevention still offers significant potential for improvement in longevity, both on an individual and a nation-wide scale.

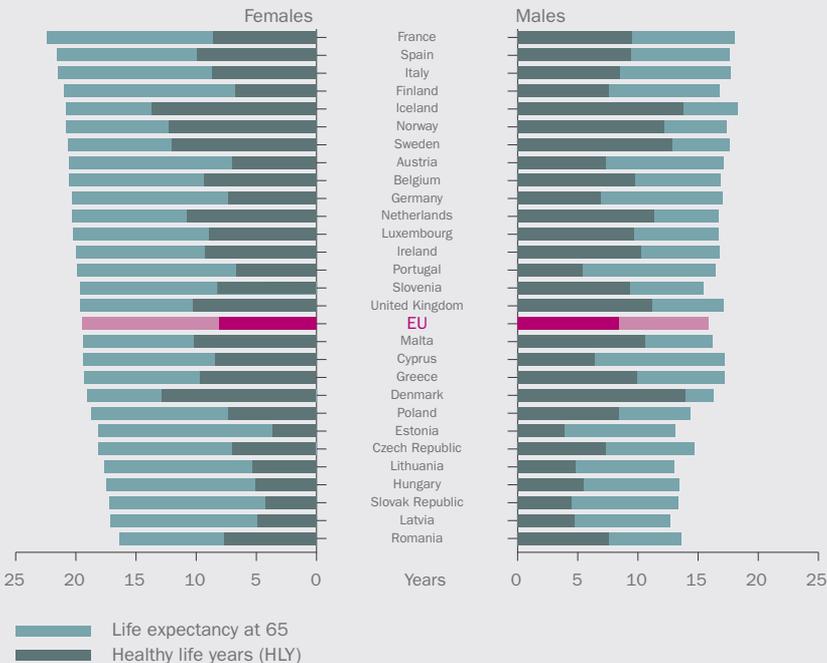
*“Which leads to the fact that we, as countries, could extend life in good health overall if we started to resolve some of the huge inequalities between our countries.”* Pr. Carol Jagger

## One reality, many faces

### INEQUALITY AMONG NATIONS

Life expectancy (entire bar) and healthy life years (HLY dark blue part of each bar) at 65, by gender, by European country, 2005-07

Source: EHEMU Database (European Health Expectancy Monitoring Unit).



*“Countries with the longest life expectancy at 65 are not necessarily those which have the largest number of healthy years. However, what is very noticeable is that most Eastern European countries have the shortest lives and the fewest healthy years.”* Pr. Carol Jagger

Even in countries with unexpectedly long life expectancy, differences remain.

**5**  
years

*Difference in life expectancy at 65 between Japanese and Danish women.*

*“Little is known about the role of the environment and that of culture (including the place and role of the elderly in society and in the family), the sense and the value placed on ageing, the types of care offered and the level of development. There is also the notion of political and economic freedom with free access to healthcare services and education, gender parity, solidarity, social justice and social engagement. All of these factors seem important in explaining levels and dispersion in longevity, but one does not yet know to what point differences between these factors can explain the difference noted in terms of longevity in countries with low mortality.”* Pr. Jean-Marie Robine

In certain countries, like Russia, average life expectancy is even dropping, because of an increase in mortality.

In Russia, the life expectancy of men plummeted 4 years between 1985 and 2004.

## SO-CALLED "AT RISK" POPULATIONS

France as an example of differences in life expectancy within a country

**7**  
years

*At 35 years old<sup>4</sup>, compared between upper-class and working-class socio-professional categories.*

**5**  
years

*At birth between people who live in Ile-de-France and those who reside in the Nord-Pas-de-Calais region.<sup>4</sup>*

**2.5**  
times

*Men without university diplomas have a mortality rate 2.5 times greater<sup>5</sup> than those who have achieved higher levels of education.*

4. Insee Première no. 1025, June 2005. Birth records and estimates for local populations, Insee 2005.

5. Report of the French high commission for public health (French: HCSP) on social inequality and access to healthcare: an end to fatalism – December 2009.

*"We know that those in the lowest socioeconomic groups have 10 or even more years less life expectancy than those in the higher socioeconomic groups. So there is still huge room for improvement, even with what we now know."* Pr. Thomas Kirkwood

## WHAT IS AT STAKE IN THE PERFORMANCE OF HEALTHCARE SYSTEMS

*"However, unless one aligns incentives for healthcare providers and funding agencies with the objective to achieve better outcomes and prevention, all efforts will be in vain."* Dr. Daniel Vasella

# QUALITY OF LIFE

As we blithely pursue longer and longer lifespans, age in good health becomes one of the main concerns, engendered by long life. Although the prevalence of age-related disease and the risk of dependency increase, starting at 80, the frontiers of ageing have nonetheless continuously expanded over the last 50 years.

*“We have shown in the Newcastle 85+ Study<sup>6</sup> that 85 year olds on average have four or five diseases, these being diagnosed by a doctor rather than simply self-reported. However, many of these 85 year olds still live independently and lead socially-active and engaged lives, so in many senses we would say that they were ageing successfully, even though they were not free of disease.”* Pr. Carol Jagger

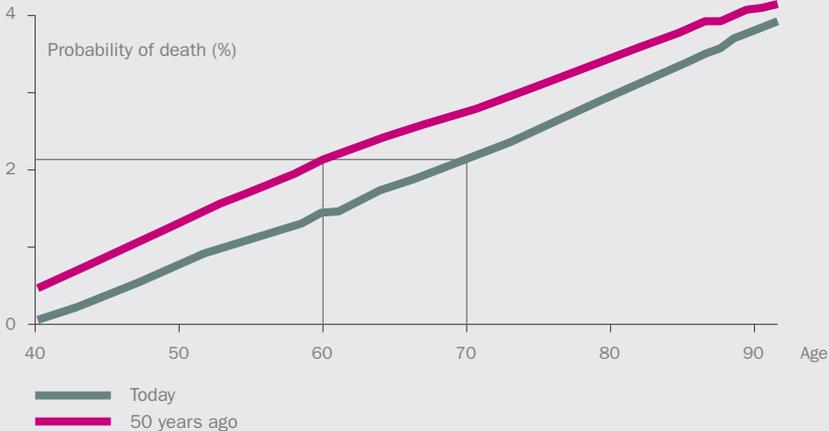
6. The Newcastle 85+ Study is a 5-year prospective study in more than 1,000 individuals, born in 1921, of the biological, clinical and psychosocial factors, associated with healthy ageing.

## GOOD NEWS: AGE CAN MAKE YOU FEEL YOUNGER

### Vitality rising, the example of the US.

Vitality as an indicator of health is the “capacity to resist destruction” (a definition offered by Benjamin Gompertz, in 1823).

*Source: Vaupel, J.W. Global Forum for Longevity.*



*“Today in the US, men 70 are as healthy as men 60 were 50 years ago. The chance of death for US men now 70 is just over 2%, whereas it was just over 2% for men 60, just 50 years ago.”* Pr. James W. Vaupel

> One also lives free of illness and disability longer.

*“Since 1950, senescence has been postponed by about 10 years in advanced economies.”* Pr. James W. Vaupel

## THE ONLY DRAWBACK: LIFESPAN WITHOUT DISABILITY IS INCREASING LESS QUICKLY THAN LIFE EXPECTANCY

**2.8**  
years

*Increase in life expectancy  
between 2010 and 2030.*

**1.6**  
years

*Number of years of life gained without disability  
over this same period.*

## TECHNOLOGY IS SET TO PLAY AN EXPANDING ROLE IN THE IMPROVEMENT OF DAILY LIFE

Internet as a new social media

**31%**

*People 65 and over who have surfed the Web during  
the last month, compared with only 4% in 2001.<sup>7</sup>*

**40%**

*People over 50 who use the internet to stay  
in contact with their families.<sup>8</sup>*

7. Study by Médiamétrie, 2010. 8. Study by Istrategylabs, December 2010. [www.istrategylabs.com](http://www.istrategylabs.com).

*“The quickening in the speed of adoption for innovation by the over 60 is much sharper when compared with younger age groups.”*

Yseulys Costes

Home automation and a future where the elderly can continue to live at home

*“Relatively simple technology becoming widely available will enable the elderly to maintain their independence longer and, above all, foster ties that are both reassuring and intellectually stimulating for all concerned.”* Pascal Brosset

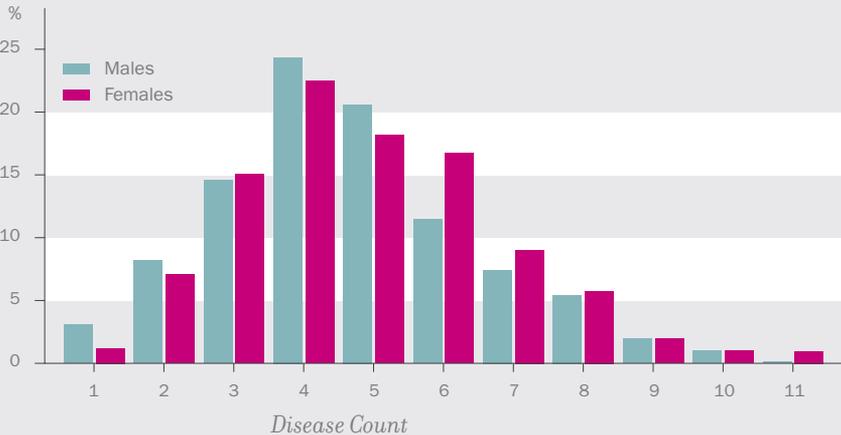
# DISEASE AND DISABILITY

Age is the first cause of illness in modern medicine. Despite pushing back the age when dependency sets in, which is to say a loss of autonomy, associated with certain disease-related disabilities, ageing in our society has made prevention and treatment of age-related diseases a major challenge of the 21<sup>st</sup> century.

BETWEEN FOUR AND SIX PATHOLOGIES ON AVERAGE, STARTING AT 80

## Number of health problems diagnosed for a panel of people 85 and older (Newcastle 85+ Study<sup>9</sup>)

Source: Collerton, J. et al. 2009. British Medical Journal.



<sup>9</sup> The Newcastle 85+ Study is a 5-year prospective study in more than 1,000 individuals, born in 1921, of the biological, clinical and psychosocial factors, associated with healthy ageing.

NEVERTHELESS, DISABILITY REMAINS RELATIVELY  
CONFINED UNTIL AGE 90.

*“Therefore, to be old in today’s society is not necessarily to be in a state of severely compromised health or misery. We found that a quarter of men surveyed had absolutely no problem with any of the activities of daily living and a sixth of the women had no problem either.”* Pr. Thomas Kirkwood

*“We have to understand why the aged cell or organ is vulnerable to disease and to do what is needed to understand the deep scientific mechanisms of ageing.”*

Pr. Thomas Kirkwood

French dependency rate<sup>10</sup>

**20%**

**Less than 20% of the population up until 90 years old; beyond 90, 70% of men maintain their independence, compared with only a little more than half of women.**

10. Insee. HID study (Handicap Incapacités Dépendances), GIR 1-4.

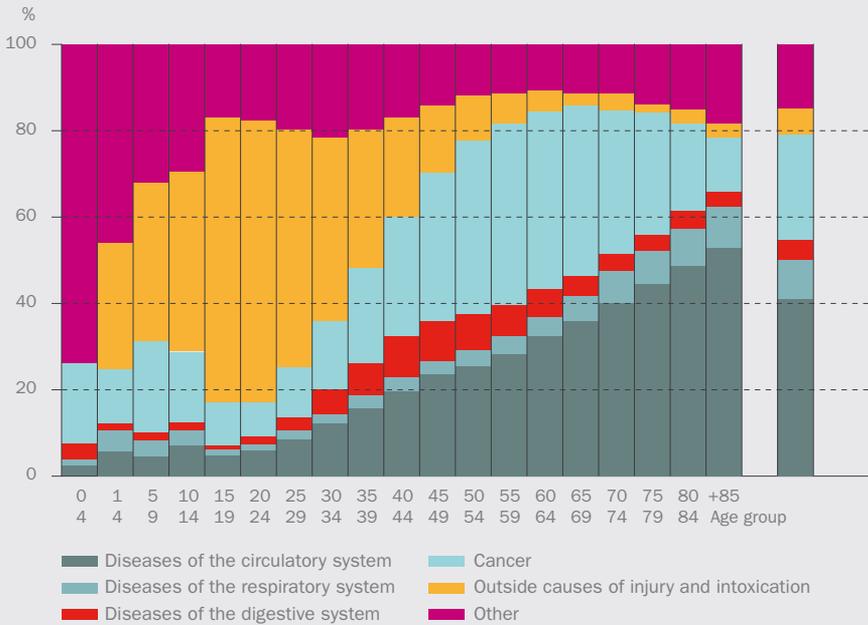
AND THE PERCEPTION, WHICH SENIORS HAVE OF THEIR OWN HEALTH, REMAINS VERY SUBJECTIVE

*“Not surprisingly, there is a lot of illness among people who are 85” or older. However, 78% (four out of five), when asked to evaluate their health, said that it was good (34%), very good (32%) or excellent (12%). That is really positive.”* Pr. Thomas Kirkwood

11. Source: Newcastle 85+ Study.

Main causes of mortality in the EU, by age, in 2001

Source: "An Aging World: 2008/International Population Reports", June 2009. U.S. Census Bureau.



# TIME TO BE ACTIVE

The lengthening of lifetime during retirement (and the decrease in the ratio of active to inactive citizens in most developed countries) poses two fundamental problems for society: (1) how to optimize a longer lifespan and how to avoid that the added time should only go to more work? and (2) how to ensure sustainable financing for one's time remaining at the end of active life?

*“For example, there was a sense in Europe and the US that retirement was necessary to give younger workers a chance. An increasing number of OECD studies have shown that it is not a zero sum. If you create opportunities for older workers to add value and productivity, it creates opportunities for younger workers.”*

Robert B. Zoellick

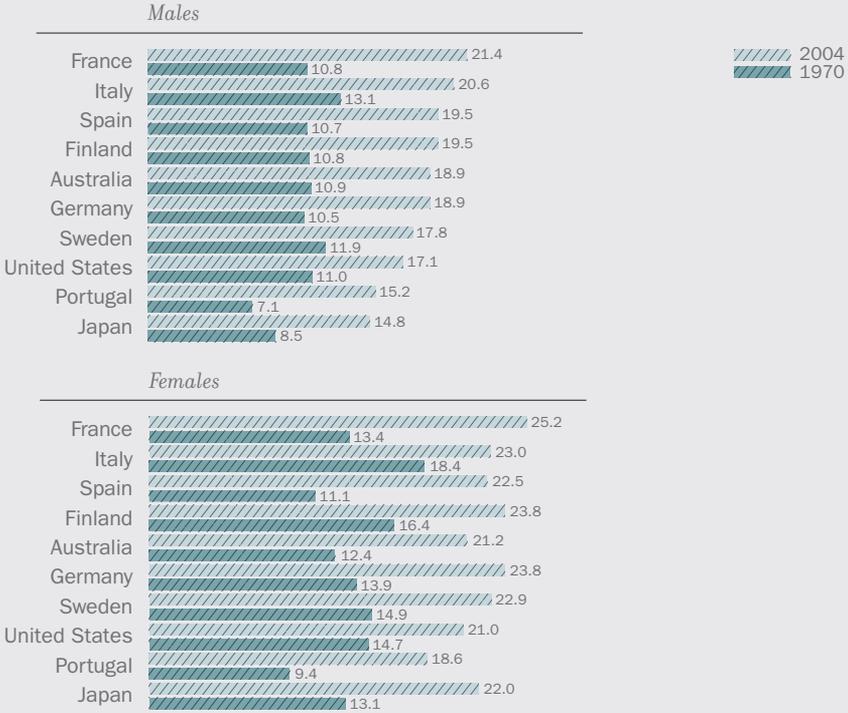
## THE LENGTHENING OF LIFETIME IN RETIREMENT CONTINUES TO INCREASE

*“However, many older people will also live on average a decade longer than their parents and two decades longer than their grandparents. That affects everybody, not just children.”*

Pr. James W. Vaupel

## Change in life expectancy after retirement, between 1970 and 2004

Source: "An Aging World: 2008/International Population Reports", June 2009. U.S. Census Bureau.



## POSTPONE RETIREMENT UNTIL AN OLDER AGE

### Method

*"I am a strong believer in the flexibility of human society, seen from an economic angle."* Eric Chaney

*"Employers are therefore going to have to adjust things to what older workers want—and they want things like flexibility in working hours and changes in working conditions."* Edward Whitehouse

*"However, you have to change some of the possibilities. Some countries, which allow more part-time work or expansion in the labour force, thanks to women and older people, can make a huge difference in terms of winning productivity gains. One needs to recognise that older workers will not be able to do the same hard physical labour and may need places of business that are closer to where they live."*

Robert B. Zoellick

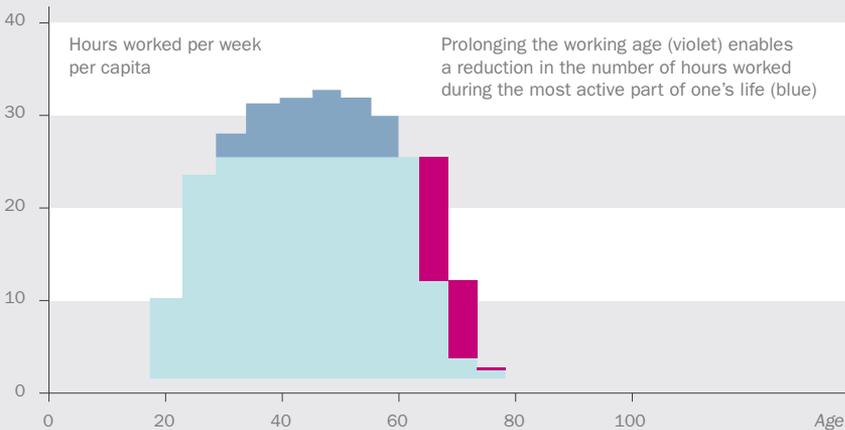
The value-added of seniors in the working world

*“It seems to me that businesses will have to reinvent what can be asked of and what you can get from more senior workers in terms of value-added. I have an image in my mind here, which is the coach. This is something that I have observed in my business life, which is that people who have a lot of experience in an industry and in a company can increase the joint value-added of themselves and younger workers by passing on experience, which is not written in books.”* Eric Chaney

DISTRIBUTE WORKING TIME BETTER ACROSS ONE’S ENTIRE LIFETIME

Forecast of the distribution of weekly working hours per capita in Germany, by age group

Source: Vaupel, J.W. Global Forum for Longevity.



*“Reforms like that would really help younger people who currently do not have enough time for their families, continuing education or leisure. It would also encourage older people to pitch in, since older people usually do not want to spend 40 hours per week working, but might be happy to spend 20 hours per week working.”*

Pr. James W. Vaupel

*“The first thing is that there is a kind of societal choice that needs to be made between the length of time that somebody works or at least produces value-added in the market economy and the length of time that is given over to leisure.”*

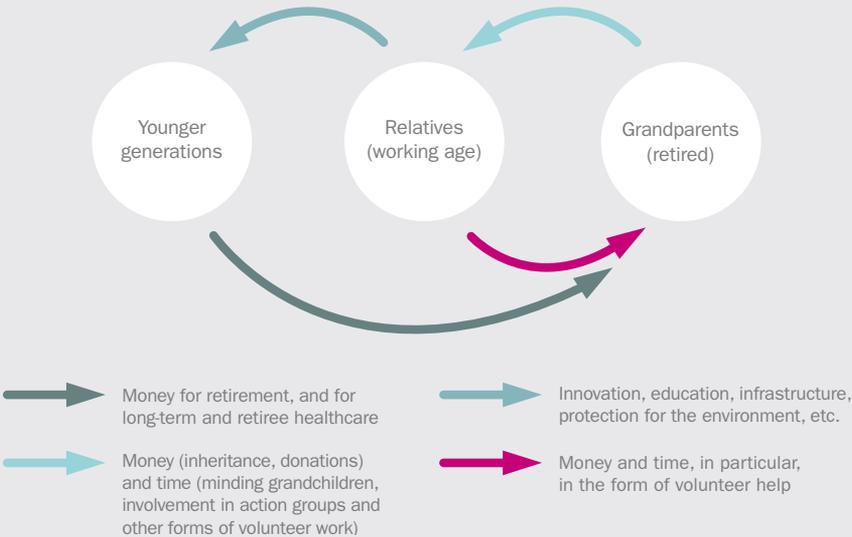
Eric Chaney

# THE INTERPLAY OF GENERATIONS

Today, families are the primary source of volunteer assistance for the elderly or the dependant. Public financing (retirement pensions, subsidised medicine and healthcare) also broadly relies on intergenerational solidarity, i.e. formal or informal exchanges between generations. As the need for financing of the very elderly increases and families have to deal with one or even two additional generations, the question of how to maintain intergenerational solidarity becomes paramount.

*“Intergenerational solidarity is about sharing which is mutually beneficial to all generations, and is as favourable to younger generations as it is to older ones. If that solidarity breaks down, everyone loses.”* Edward Whitehouse

## INTERGENERATIONAL SOLIDARITY: A COMPLEX NETWORK OF EXCHANGE BETWEEN GENERATIONS



## A BETTER WAY IS TO SPREAD ONE'S CAREER OVER AN ENTIRE LIFETIME

**More than 30% of older people (50 and older) give time**—typically in the form of child care—and the same proportion give money.

**Less than one out of four benefits from time given** by others, and less than 7% receive money. Time transfers follow a different pattern, coming mainly from children. A third of time given is from nonrelatives.

Similarly, **people 50 and older give the largest share of their time to non-relatives**, closely followed by the time they give to their parents.

A key driver in the amount of time older people give is whether they have grandchildren: nearly 50% of those with one or more grandchildren spent some time caring for them.

*Source: OECD analysis of SHARE data (2004, 2006-07)  
(Survey of Health, Ageing and Retirement in Europe).*

## INTERGENERATIONAL SOLIDARITY: A CRUCIAL ROLE TO PLAY IN FINANCING RETIREMENT

**60%**

**Share of public finances in benefits for the elderly in OECD countries.**

*“What we are seeing in most countries is that there have been major cuts in benefits for future retirees. In the 15 countries where we have analysed these reforms in detail, someone starting work today will get about 25% less in benefits than someone who is retiring today for the same career pattern.”* Edward Whitehouse

**70%**  
to  
**90%**

**Between 70% and 90% of people providing care for older people are family members.**

**2/3**

**About two-thirds of informal caregivers are women.**

*Source: OECD countries.*

*“There are difficult issues in long-term care that relate to intergenerational equality. What is the expectation that children will care for their elderly parents, if necessary?”*

Raphael Wittenberg

## THE STATE OF RELATIONS BETWEEN THE GENERATIONS IS QUITE GOOD

**Eurobarometer<sup>12</sup> asked people from the 27 EU member states the question, “Do you think that older people are a burden on society?”**

- Only 14% of people agreed with the proposition that older people are a burden, with 85% disagreeing, many of them very strongly.
- People in their 40s and 50s are those who disagree most that older people are a burden.
- Older people themselves are the most likely to say that older people are a burden on society.

12. “Survey on Intergenerational Solidarity” in *Flash Eurobarometer* no. 269. April 2009.

*“If we look at labour market conditions, again we find countries that are much more likely to disagree with this statement where there are more 60-64 year olds in the workforce.”*

Edward Whitehouse

# INNOVATION

The chances of having eternal life (still) remain a subject for fiction such are the biological mysteries of ageing great. However in some not-too-distant future, technology and best medical practices will undoubtedly contribute to significant improvements in the quality of life and health for the elderly.

## HOME AUTOMATION: TO HELP KEEP THE ELDERLY AT HOME AS LONG AS POSSIBLE

Driven by falling costs in becoming a homeowner and by a regulatory framework in favour of improving home access, the number of home automation installations is set to grow over the next 5 years.

*“Converging technologies enable applications, such as the measurement of a subject’s activity; a capacity not only to watch over people, but also to detect in an intelligent fashion any abnormal behaviour, such as a fall or a long period of inactivity.”* Pascal Brosset

## MEDICAL RESEARCH: CONSTANT PROGRESS IN UNDERSTANDING DISEASE AND EXTREME AGE

*“We need to understand a great deal more about how people experience life at older ages. In Newcastle, we have conducted a very large project, called the Newcastle 85+ Study<sup>13</sup>. We approached everyone in the city who was alive in 1921 and made a comprehensive assessment of the kind of shape which they were in. We are using the findings to understand a complex array of factors that contribute to health in old age.”*

Pr. Thomas Kirkwood

13. The Newcastle 85+ Study is a 5-year prospective study on more than 1,000 individuals, born in 1921, of the biological, clinical and psychosocial factors, associated with healthy ageing.

## PREVENTION: RAISE AWARENESS DAILY TO HELP OVERCOME INEQUALITY

*“We have at the ILC-France<sup>14</sup> a research project with the aim of trying to determine if a prevention programme, implemented by a company in the workplace can, first of all, improve the health culture of co-workers, and second, actually change their behaviours. Even among people who, in principle, have a good level of education, one sees the result, starting at 6 months.”*

Dr. Françoise Forette

14. International Longevity Center-France.

## HEALTHCARE AVAILABILITY: RATIONALISE TREATMENT FOR MORE EFFECTIVENESS

*“If an older person has four or five diagnosed conditions, some of those may be treated by his or her general practitioner, but others may require referral to specialist outpatient clinics. This may well entail multiple visits to hospital in order to see separate specialists, which may not only be tiring for the older person, but makes it difficult to implement a holistic approach. In Newcastle this is being addressed by special clinics, called Cresta clinics, where older patients with multiple conditions that commonly occur together can see all the specialists in one visit.”* Pr. Carol Jagger

# AND TOMORROW?

## LENGTHENING LIFESPANS

*“For the foreseeable future, there is no deceleration in the trends nor any empirical evidence or theoretical reason to expect them not to keep on going up.”* Pr. James W. Vaupel

*“There are many biologists who say that biomedical breakthroughs could lead to an understanding of the ageing process itself. Maybe then, life expectancy could begin to rise by 4 or even 5 months per year instead of 3.”*

Pr. James W. Vaupel

*“We hope that it will be possible to extend lifespans further by continuing the trends that have acted until now. Therefore, we have seen improved nutrition, lifestyle and environment. (...) However, we should remember that there is also important room for progress in addressing a real problem in today’s society—inequality.”*

Pr. Thomas Kirkwood

*“Of the approximately 22,000 genes in the human genome, the question is whether a special subset of genes determines our maximum longevity.”* Pr. L. Stephen Coles

## ECONOMICS

*“Ex ante is different from ex post. With ex ante, a lot of people worry about ageing societies, thinking that they will have a lot of negative consequences for productivity and innovation and that they will be a burden on public finances and that they will create a conflict between generations. That is the view ex ante. With ex post, societies change. Human beings adapt to new conditions and they think differently about what the challenge was before.”* Eric Chaney

*“What some of the data offers people is a sense that they could now start to make policy choices which could determine whether those demographic changes are a burden or an opportunity.”*

Robert B. Zoellick

## DISEASE

*“Ultimately, we want to be able to target age-related diseases by understanding the mechanisms that make us more likely to develop conditions like Alzheimer’s or osteoporosis. What is exciting about working upstream on the mechanisms that cause a particular age-related disease is that we find that common mechanisms are shared between different diseases, raising the really exciting possibility that in future we may be able to extend healthy living to a significant degree.”*

Pr. Thomas Kirkwood

## THE AGEING PROCESS

*“One remarkable thing, which has been discovered, is that some species age very rapidly and some age more slowly, whereas some do not age at all, but repair damage. There are some species that show negative senescence, where things get better and mortality goes down. Understanding general principles about why some species age and some do not could shed fundamental light on ageing.”*

Pr. James W. Vaupel



## LONG-TERM TREATMENTS

*“The role of the researcher is to provide relevant, robust evidence that will help decision-makers with those difficult choices.”*

Raphael Wittenberg

## WORK

*“The 21<sup>st</sup> century will probably be a time of redistribution of labour. However, with more people in the labour force, they will work fewer hours per week. Longer, healthier lives and a redistribution of work will greatly enhance human happiness.”* Pr. James W. Vaupel

*“When people talk about education after school years in many developed countries, they tend to focus on ages 30-40. It makes sense to talk about an ongoing process for people in their 50s, so that they can benefit from additional training and education as well.”* Robert B. Zoellick

# CONFERENCE PROCEEDINGS FROM INITIAL MEETINGS

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## PREFACE

# OPENING UP PERSPECTIVES ON LONGEVITY

Over the last 150 years, the world population has gained over 30 years in life expectancy, essentially in good health. In the developed countries, the process of lengthening lifespans is now perceived as normal. Today, children are born and grow up almost certain that they will live to be 100. For everyone, this extraordinary leap into long life is sure to redefine our relationship with the passage of time. On becoming adults, longevity translates into a broadening of the frontiers of ageing. New expectations arise at all ages. For younger generations, this unprecedented chance to live longer offers the perspective of a less “linear” life. New directions become possible.

Nonetheless, because of the many and complex social, economic and family-related stakes that come into play, the lengthening of lifespans and the demography of ageing, which are their handmaidens, are now among the great challenges of the 21<sup>st</sup> century. That is why the AXA Group has initiated a Global Forum for Longevity: in order to understand long life, its mechanisms, the stakes and the more positive vision which we need in facing this upheaval in demography in order to begin to build together the solutions of tomorrow.

AXA Chairman and Chief Executive Officer Henri de Castries has said, *"Our conviction as an insurer and observer of demographic and social change throughout the world is that longevity should not be seen as a fatality, but rather as an opportunity. In order to seize our chance, we have to assess, both quickly and together, the challenges that it poses to society. Encourage the sharing of knowledge acquired and think collectively about realistic solutions—that is why AXA has opened a Global Forum for Longevity."*

The Global Forum for Longevity is designed as a place for debate and exchange between researchers, experts, public and private decision-makers. As such, it fosters better understanding of the phenomenon and aims to encourage sharing of knowledge and common efforts. Through an interdisciplinary approach, which crosses generations and international boundaries, the ambition is to master the challenges of longevity and identify its opportunities.

The Global Forum for Longevity also has the ambition to share its newfound understanding with society at large, in all walks of life, and to contribute to a discussion, which concerns us all. It envisages giving new voice to thoughts about the future, gathering together current scientific and empirical knowledge, listening to the points of view of different players concerned by longevity and observing new social trends which long life engenders.

These first meetings of the Global Forum for Longevity are part and parcel of efforts by AXA in support of research and initiatives in favour of a better understanding and prevention of the risks that confront society, particularly through the work of the AXA Research Fund.



Henri de Castries,  
*AXA Chairman and CEO*

## INTRODUCTION

# LONGEVITY AS A WORLD-WIDE, SOCIAL, COMPLEX AND STIMULATING PHENOMENON

by Henri de Castris

Talking about longevity in a place with so much history and spiritual context as the *Collège des Bernardins* is particularly inspiring. Why has this subject become so important for us? Because long life is an extraordinarily powerful vector for change in our civilised world and, paradoxically, it is also a little discussed topic, little known, probably widely misunderstood, and which merits our attention.

The role of an insurer is to have a long-term vision. It is to contribute to the development of society by trying to help our fellow citizens in taking risks—in a nutshell, to foresee the future. The problems posed by long life are at the heart of our business every day. They are at the heart of our thinking. They are at the heart of what we consider to be our corporate responsibility, because we believe that we have to share with all of society the knowledge that we have acquired in our day-to-day affairs, in order to go forward together, to facilitate change and to keep our eyes on the future.

*“Long life is an extraordinarily powerful vector for change in our civilised world [...] which merits our attention.”*

Long life is still too often considered in the ageing societies of the developed world, if not as a threat, at least with some circumspection and a certain dose of fear. That is because in a society, which tends to deny the reality of death and ageing, the topic can somehow seem slightly unsavoury. It may also appear as a liability. Today, everyone questions if we can pay the price of its consequences. Thanks to this forum’s participants—and our speakers who I want to warmly thank for having accepted to be with us for this event, in particular, Doctor Vasella, Robert B. Zoellick, Professor Vaupel, Professor Robine and Professor Kirkwood, who will be properly introduced in a moment—today, we want to try and make you all more familiar with the problems, to think together in order to demonstrate that longevity can be an amazing opportunity.

> I am not a specialist in demography. However, a few simple facts are extremely enlightening. Our great-great-grandparents, at the beginning of the last century, had an average life expectancy of 45 years. If they had been told that the century would enable them to gain 30 years of life, I do not think that they would have seen that as a threat. I think that they would have believed it was their lucky day. If they had been told that the main source of new wealth, during the 21<sup>st</sup> century, would be a very powerful combination of increased longevity and innovation, I also do not think that they would have seen a threat. If they had been told that starting in 2005, in Europe, the number of people over 65 would be greater than the number of youngsters under 15, I believe that instead they would have seen the news as a new source of hope. Why do we see a threat when we should be seeing an opportunity?

*“The structural tissue of society has changed.  
We can no longer think in terms of three generations.  
We have to consider four or even five generations.”*

Even if natural or geopolitical events, such as the recent catastrophe in Japan and instability in the Middle East, are daily sources of worry in a more and more global world, the 21<sup>st</sup> century is still a time when life will continue to get longer at a steady pace. Medical advances spur the dance while innovation has never been greater. And if one is convinced that the combination of lengthening lifespans and ongoing innovation fuels growth and progress, and offers a way out from poverty for millions of people, there are perhaps more than a few reasons to be a bit more optimistic than some of our fellow citizens, when reflecting on the start of this century.

Longevity has to be seen in light of its medical, demographic, social and economic components. I believe that this gradual lengthening in lifespans for our fellow human beings is going to generate profound adjustments.

The structural tissue of society in the 19<sup>th</sup> and 20<sup>th</sup> centuries was made up of three generations at most. When children had just grown out of childhood, their grandparents would most likely have already died. Today, we live in a society where one inherits from one's parents at an age which is between 60 and 75 years old. Things have changed. We can no longer think in terms of three generations. We have to consider four or even five generations. At the heart of the nuclear family, the very foundation of our social structures, nothing is any longer the same. Intergenerational solidarity, based on a generation at work while youth prepared to take up the burden on the one hand and the older generation laid down its tools on the other hand, can never again be the same, since now there is one or even two additional generations. The generation reaching 50 cannot support the weight of two older generations, and of one or two younger ones.

Corporations have to change the way they look at the world. It is hard to imagine how people are going to work between the ages of 25 (once they have completed their education) and 55, and then live another 30, 35, 40 or more years, sidelined from the economics of productivity, cut off from a part of their social lives, and despised for their burden on society.

Education itself is going to have to change. Who could really believe that what one learns between 5 and 20, or even 25, is sufficient to enable one to function for a lifetime, without ever having to update, to come abreast of current thinking, regularly to revise one's knowledge base, with innovation continuing at its present pace—it would simply be naive.

And sovereign states are going to have to change their institutions. We are entering a time of great restructuring. I think that today's conference is going to enable us to grasp some of the implications. I think that those changes are going to affect societies everywhere in the world, and not simply those in the "old" developed world. We will have numerous occasions to discuss this point throughout the day; however, I would now like to talk about the very striking example of China.

Today, China is the main locomotive in the world economy. It is overtaking little by little the European locomotive, which is running out of steam, and the American locomotive, which now periodically needs to be jump-started. Yet, China too has to face considerable demographic problems, since it is ageing, but four times faster than, for example, France. What exactly does that mean? In France, it has taken—and would the specialists please correct me if I am mistaken—115 years for the population over 65 to go from 7% of total population to 14%. It is only going to take 25 years in China. Its one-child policy is going to have very serious repercussions, because the average age in China is likely to be—around 2040—identical to that of European countries, such as France, meaning greater than 45. As one can see, there will finally be a rather small number of working individuals who provide support for their two preceding generations. And that problem is not only in countries with low birth rates. Birth rates, moreover, remain significantly different from one country to another. France indeed is lucky to still have a birth rate sufficient to replace its current generations.

All of these problems spark strong passions, and in some cases, can even cause conflict. For my part, I am stoically serene. On the contrary, I want to see a formidable opportunity. And I am sure that today, given the quality of the speakers who are going to share with us their knowledge, the fruit of their research and even at times their puzzlement, we are going to have together a chance to forge ahead and add a modest stone to an edifice that I think will profoundly mark the years to come.





# A FUTURE, WHERE EVERYONE LIVES TO BE 100?

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*Overview of increased  
life expectancy*

## INTRODUCTION

# OVERVIEW OF INCREASED LIFE EXPECTANCY

In 150 years, the world population has gained over 30 years of life expectancy, essentially in good health. Why do we live longer? Can the current trend continue? And if so, up until what age? Thanks to a combined demographic, social and biomedical approach, this first plenary conference aims to explore the panorama of current knowledge on the mechanisms and factors behind longevity.

In developed countries, life expectancy continues to increase linearly, on average at a rate of 3 months per year. A leading authority on bio-demography and longevity, James Vaupel analyses (cf. paper on page 44) the 20<sup>th</sup> century, when there was no effect—either due to economic crisis, war or epidemic—which could durably reverse the rising trend in life expectancy, and therefore, one can reasonably bet that the current process, which drives longevity, will continue.

These last 30 years, the fall in the mortality rate for the extremely elderly has been the main driver behind spectacular gains in long life. This took the entire field of demography by surprise. Thomas Kirkwood, who is a biologist and director of one of the most important centres in Europe for research devoted to the study of the ageing process, explains (cf. paper on page 52) that “the body is programmed for survival, not death” and that there are good reasons to hope to be able still to push back the biological limits of long life.

Today, the main difficulty for research into long life is in the complexity of ageing mechanisms which depend on numerous parameters, such as one’s genetic makeup and social background as well as the environment. Through work in demography and epidemiology which he conducts at the French national institute of health and medical research (French: *Inserm*), Jean-Marie Robine (cf. paper on page 60) seeks to understand common denominators between longevity and individual differentiation, which more or less dictate an individual’s life expectancy.



Pr. James W. Vaupel

*Demographer, founder and director of the Max Planck Institute for Demographic Research in Rostock, Germany*

***James Vaupel is a leading authority in bio-demography and also works in the recent field of evolutionary bio-demography. In 1994, he published a paper on a discovery of capital importance in connection with the biology of ageing: Vaupel was one of the first to observe that mortality was declining among the extremely elderly.***

# LONGEVITY TRENDS IN DEMOGRAPHY

By Pr. James W. Vaupel

*“Very long lives are the likely destiny  
of children living today.”*

The doubling of life expectancy, from under 40 everywhere in the world before 1800 to more than 80 in many countries today, is the most significant accomplishment of modern civilisation. Swedish women had the world’s longest life expectancy in 1840, living 45 years on average. Since 1840, other countries have moved into the top slot. Japan has been number one since the 1980s and today Japanese female life expectancy is more than 86 years. That trend has been remarkably linear, increasing by 2½ years per decade, or 3 months per year. This is the most remarkable mass human endeavour on a regular basis ever observed. Jacques Vallin and France Mesle at French national institute for demographic studies INED in Paris have also analysed the data, starting earlier, and they find a somewhat more complicated pattern in the early years. However, since the middle of the 20<sup>th</sup> century until today, they find the same pattern—a remarkably linear rise in life expectancy.

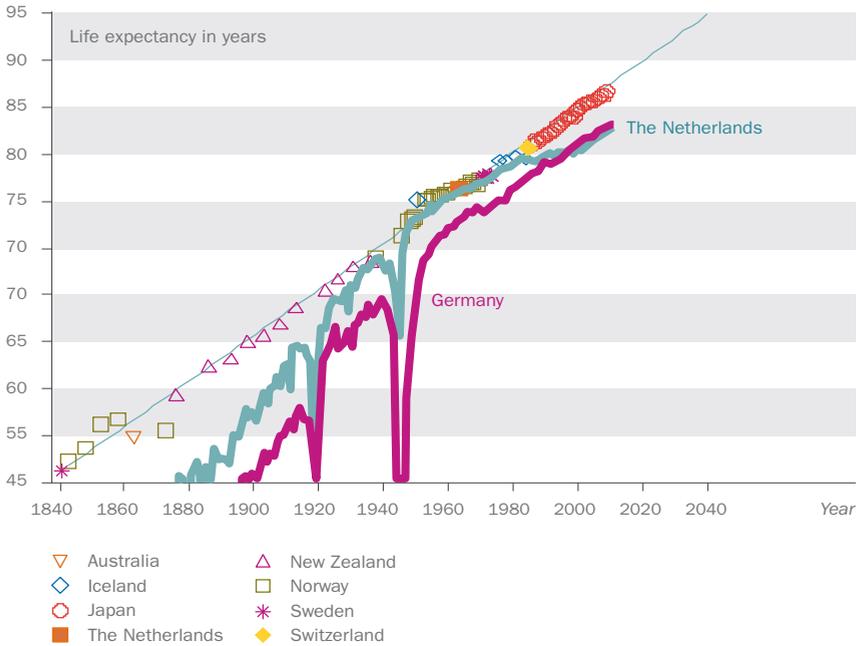
## LIFE EXPECTANCY IS INCREASING BY 3 MONTHS PER YEAR IN MOST ADVANCED ECONOMIES

Any particular country, of course, shows a more complicated pattern (cf. Figure 1). The 20<sup>th</sup> century was a tough one for Germany, especially the first half with World War I, the Depression and World War II. Life expectancy in 1900, even for women, was only 45. Yet Germany caught up, despite those terrible events, and life expectancy has risen steadily since 1950. Today, it is going up by 3 months per year, the same as in Japan, albeit with a life expectancy of about 3 years less. Another example is the Netherlands. There were disasters such as the Spanish Flu and World War II, but nonetheless the Netherlands caught up with the world’s leading countries and was even the world leader itself for 1 year. And then, largely because of an epidemic of cigarette smoking among women, there was a levelling off. However, female life expectancy in the Netherlands is now also rising by 3 months per year.



**Figure 1: The increase in life expectancy since 1840**

Source: Oeppen, J. and Vaupel, J.W. 2002. Science.



The important message is that life expectancy is currently going up by about 3 months per year in most of the advanced economies. That is true in the US, Australia, New Zealand, Canada, and most countries in Europe. Other countries with lower life expectancies are catching up. Another important message is that disasters, like economic depression, war, and epidemics, leave no lasting effect. Life expectancy continues to rise.

### THE EXPLOSION IN VERY LONG LIFE HAS ALREADY BEGUN

Extrapolating those continuing trends forward, most children born in France, Germany and the US since 2000 will celebrate their 100<sup>th</sup> birthdays. Very long lives are not the distant privilege of remote future generations. Very long lives are the likely destiny of children living today. The result of the increase in life expectancy will be children living to 100. However, many older people will also live on average a decade longer than their parents and two decades longer than their grandparents. That affects everybody, not just children.

In recent years, progress in bringing down death rates has mostly been in older age groups. In fact over the last 20-30 years, most of the increase in life expectancy has been due to progress in bringing death rates down among those aged 80 and over, which is when most people die nowadays. The result is an explosion in the number of very old people. Until 1950, there were very few centenarians in Sweden. Then a dramatic increase came. The same goes for Japanese women. Until 1950, there was virtually no increase, and then a vertical rise. Therefore, the explosion in very long life has already begun. Moreover if the trend continues, we will see a situation where most children born in advanced countries today survive to be 100 and many will live to 105. That is probably what the future holds in store.

## THE HEALTHY SPAN OF LIFE IS INCREASING AT ABOUT THE SAME PACE

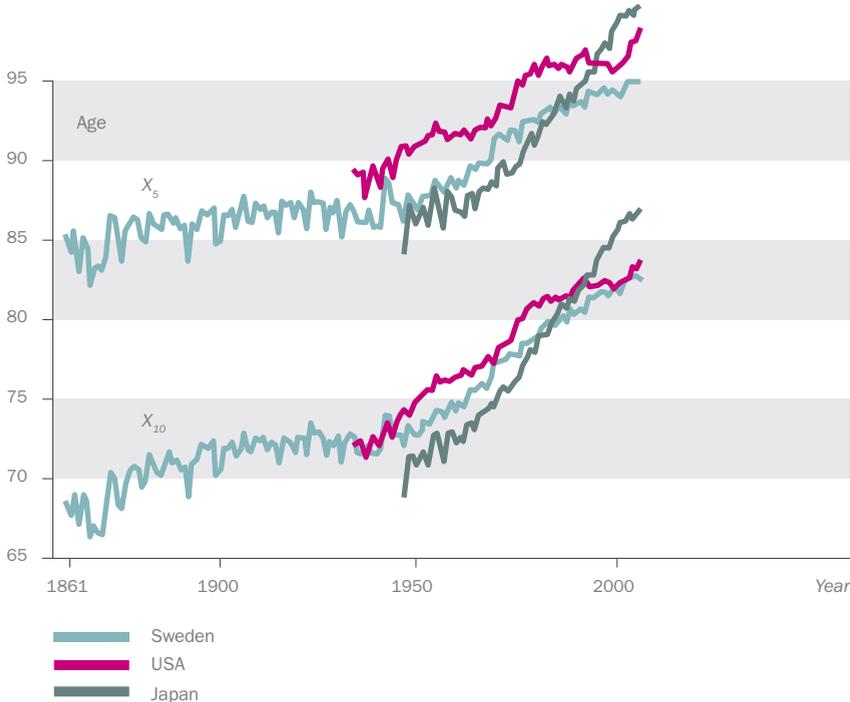
One key concern that people have about longer and longer lives is “what about health?” What will health be like for those very old people? The good news is that the span of healthy life appears to be increasing at roughly the same pace as total lifespan. Although health is difficult to measure, a number of indicators support that hypothesis.

One fact is that bad health often afflicts people at the end of their lives. The last 5-10 years of life are often years of disability and disease. However, the average onset of disability and disease is being pushed up to higher age brackets (cf. Figure 2). Taking X5 as the age where you have 5 years of life left on average and X10 as 10 years left of life expectancy on average, both values have moved up by a decade in Sweden since 1950. The same thing is true for the US and even more so for Japan.

&gt;

## Figure 2: Since 1950, senescence has been postponed by about 10 years in advanced economies

Source: Vaupel, J.W., March 2009. "Bio-demography of Ageing", Nature.



Another way to look at this is to consider whether 70-year-olds today are as healthy as 60-year-olds were 50 years ago. One way to measure health is to study vitality. In 1823, Benjamin Gompertz defined vitality as “the ability to withstand destruction,” which is to say the ability to survive another year. Conversely, it would be “the ability not to die in the coming year.” Looking at the chances for death among US men today, they go up roughly linearly on a log scale, because mortality increases exponentially. Looking back 50 years ago, we see a roughly parallel shift. The chance of death for 70-year-old US men today is just over 2%, whereas it was just over 2% for 60-year-old men 50 years ago. According to that definition of vitality, in the US, 70-year-old men today are as healthy as 60-year-old men were 50 years ago. And 70-year-old men and women in France today are as healthy as 59-year-old men and women were 50 years ago. That fact is relevant for today’s discussions of retirement age.

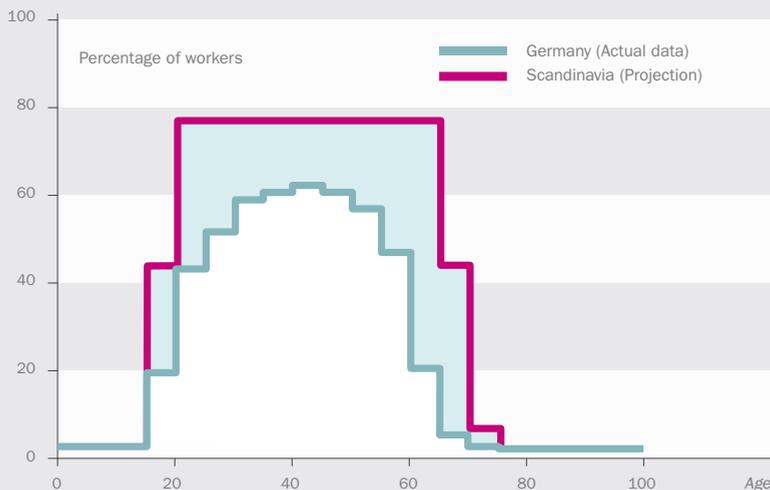
## A REASONABLE WAY TO ACHIEVE REDISTRIBUTION OF LABOUR

Because they are living longer, people will have to work longer. Broadly speaking, for every 2-year increase in life expectancy, people will have to work part-time (i.e. 20-hour weeks) for an extra year. That can be done with flexible work-weeks and retirement ages. The average work-week over a working lifespan could be cut substantially if more people worked. That would give young people more time for continuing education, for cultural pursuits, for leisure, and crucially for child-raising, instead of (as it is now) having work concentrated in the child-bearing years. In addition, reducing the work-week would encourage older people to participate in the labour market.

Let me suggest one radical, but reasonable, way to achieve that. Look at current data for Germany and the direction the Scandinavian countries are moving (cf. Figure 3). The Scandinavian countries are moving toward very high levels of participation in the labour force for people 20 to 65 years old, with some participation even after 65. Suppose that nations like Germany and France as well as the Scandinavian countries could actually sustain that kind of work ethic, what could they achieve?

**Figure 3: Workforce participation in Germany by age and a projection for Scandinavian countries**

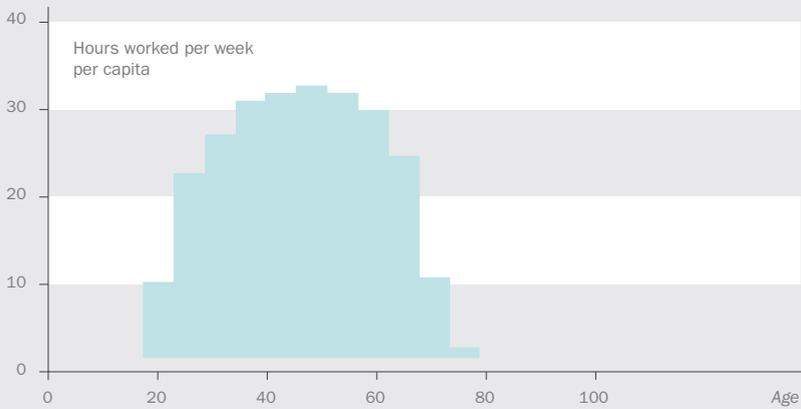
Source: calculations by Vaupel, J.W.



Now look at average weekly hours worked per capita in Germany (cf. Figure 4). It is a little over 30 hours per week for people aged 30 to 55-60 (not 40 hours per week, because a lot of people are unemployed).

### Figure 4: Weekly hours worked per capita in Germany

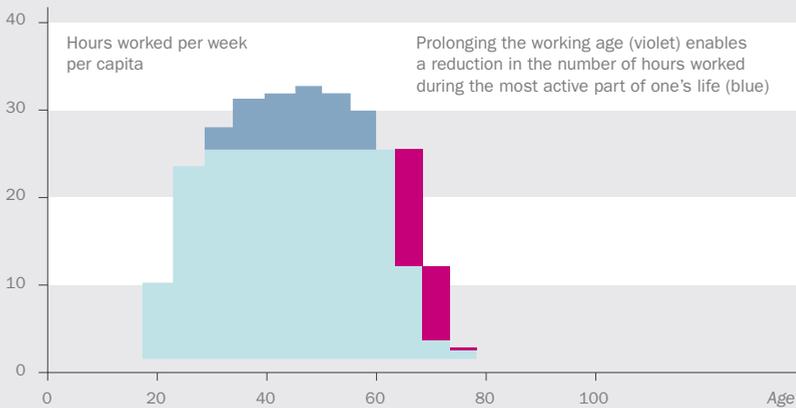
Source: Vaupel, J.W. and Loichinger, E. 2006. "Redistributing Work in Ageing Europe", Science.



Increasing (cf. Figure 5) the percentage of people who work (in blue) would cut the top off that curve (in dark blue). People could then work 25 hours per week on average. Some people, but not many, would work 40 hours, while most would work 20-30 hours per week. And again, that would encourage older people to remain longer in the labour force.

**Figure 5: Hours worked per week per capita by age in Germany—if work were redistributed**

Source: calculations by Vaupel, J.W.



Reforms like that would really help younger people who currently do not have enough time for their families, continuing education or leisure. It would also encourage older people to pitch in, since older people usually do not want to spend 40 hours per week working, but might be happy to spend 20 hours per week working.

In summary, the 21<sup>st</sup> century will probably be a time of increasing healthy longevity. And there will have to be a redistribution of labour. The 20<sup>th</sup> century was a time of redistribution of income. The 21<sup>st</sup> century will be an era of redistribution of work. However, with more people in the labour force, they will work fewer hours per week. Longer, healthier lives and a redistribution of work will greatly enhance human happiness.



### Pr. Thomas Kirkwood

*Professor of medicine and biologist, Director of the Institute for Ageing and Health (IAH), Newcastle University (United Kingdom)*

***Thomas Kirkwood's work is primarily focused on the evolution and molecular genetics of ageing and age-related diseases, and the establishment of a bio-mathematical model of cellular senescence. In particular, he developed the theory of disposable soma which says that animals evolved to sacrifice the potential for indefinite longevity in favour of enhancing their reproductive capacity.***

# UNDERSTANDING LONGEVITY AND HOW TO IMPROVE IT

By Pr. Thomas Kirkwood

*“The body is programmed for survival, not death. It is just not programmed to survive indefinitely.”*

*“The ageing process is intrinsically much more malleable than we used to think.”*

There is no question that we are all struggling to come to terms with something which was not foreseen by our politicians, our economists or even our health professionals. The remarkable surprise which has become apparent during the last two to three decades is that there is no obvious limit to increasing human longevity. Despite the fact that average longevity had increased steadily for 200 years, leading demographic forecasters as recently as 20-30 years ago still predicted that such increase would soon come to an end. For example, the UN were forecasting in 1980 that the increase in longevity would rapidly hit a ceiling and then stop. However, to the UN's (and nearly everyone's) surprise, life expectancy has continued to increase at exactly the same rate. We are therefore no longer sure for how long lifespans might continue to increase and to what level.

## WHY THE CONTINUING INCREASE IN LONGEVITY HAS TAKEN THE WORLD BY SURPRISE

We can ask, “Why did the UN predict that life expectancy would reach a ceiling?” The reason is that the increase which had occurred until the last quarter of the 20<sup>th</sup> century was due to one process only, namely reducing deaths in the early and middle years of life, chiefly by controlling infection. The assumption was that ageing was a fixed process. Once infection control was achieved, which in developed countries was largely the case by the 1960s-70s, it was assumed there would be no further increase in life expectancy. Instead we would simply see more people living long enough to exhibit the spectrum of age-related frailty, disability and disease. However, the last 20-30 years have seen the clear emergence of a new driver in increasing longevity: declining death rates among people who are already very old. This surprising development overturns previous ideas that ageing is a fixed process and fortunately the emerging scientific understanding of ageing can help us to understand what is occurring.

**1. Watson, J.D. and Crick, F.H.C. 1953.**

"A Structure for Deoxyribose Nucleic Acid"  
in *Nature* 171: 737-738.  
In April 1953, James Watson and Francis Crick's  
classic paper first described the double helical  
structure of DNA. With some understatement they  
noted that the structure "suggests a possible  
copying mechanism for the genetic material".

> The first and most important thing that emerges from the science of longevity is that, contrary to what most people believe, there is no genetic programming for ageing. The body is simply not programmed to age and die. The reason for that is found in nature. In animals just as in ancient human populations, death mostly occurs from extrinsic hazards rather than from intrinsic decline. In earlier times, it was very much less common for people to live long enough to become old. Similarly, it is very rare to see truly old animals in the wild, because the great majority die when they are still young. Hence, there was no opportunity or reason to evolve a "programme" for ageing. Ageing is something that we see almost exclusively in protected environments. In those circumstances the body was programmed for survival, but because of the pressure of natural selection, there was never enough priority on long-term survival to evolve a body that would last forever. All that we needed was a body which would survive for as long as we had a reasonable chance to remain alive. According to that concept, our bodies have evolved sufficient maintenance and repair capabilities to keep in good condition through the kind of period that we could expect to be alive in a natural environment. For humans a few thousand years ago, that might have been 25-30 years—beyond that, it was unnecessary.

The clear implication is that the ageing process is caused not by a "programme" but by the gradual lifetime accumulation of damage. That tells us something very important about the ageing process: it is intrinsically much more malleable than we used to think.

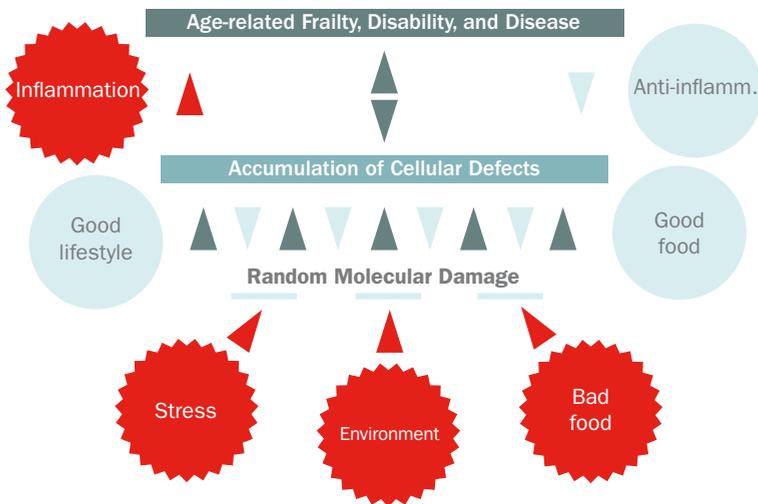
## WHAT IS DRIVING THE AGEING PROCESS? AND WHERE WILL IT TAKE US IN THE FUTURE?

We are learning a lot about the mechanisms responsible for ageing. We have to understand those mechanisms in the context of the journey that our bodies make through life. We begin our lives as one cell, the fertilised egg, which must grow and develop as a foetus, then as a baby, then grow into adulthood, and then live for many decades. During that time, our cells must divide and divide; a fundamental process that requires cells to copy their DNA. What happens when you copy something many times? I will illustrate this by making an analogy with the image of the DNA helix from the original 1953 paper by Crick and Watson<sup>1</sup>. To conduct my "experiment," I passed five very boring minutes at the photocopier, putting the image on the plate of the copier and hitting the copy button, then repeating this cycle for 50 generations, each time copying from the previous copy. What do you end up with? You end up with a helix, which is just a shadow of the original form.

The sad truth is that this is happening in the cells of your body. Every time cells divide, they introduce new mutations, so that by the time you are an adult your DNA is damaged. We can visualise that damage and understand how it accumulates (cf. Figure 1). Hence, we can understand the ageing process as being driven by each year’s accumulation of damage which gives rise to cellular defects that in time give rise to age-related frailty, disability and disease. The important thing about our understanding is that it also allows us to embed the biology of ageing in the context of the factors that influence our lives. Therefore, ageing is driven by damage. However, there are lifestyle factors as well, which can cause damage to accumulate faster or slower. These include what we eat; poor nutrition can accelerate damage while good nutrition can boost repair. Similarly, factors like stress and exercise exert effects for worse or for better. If we make bad choices, we can age faster than average. But if we make good choices, and if living conditions improve to give less exposure to chronic damage, we can age more slowly. There is good evidence that we are reaching older age, on average, in better shape. That is part of what we believe to be driving the current increase in human longevity.

Figure 1: The mechanisms of ageing

Source: Kirkwood Cell 2005.



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## CAN WE EXTEND THE AGEING PROCESS FURTHER?

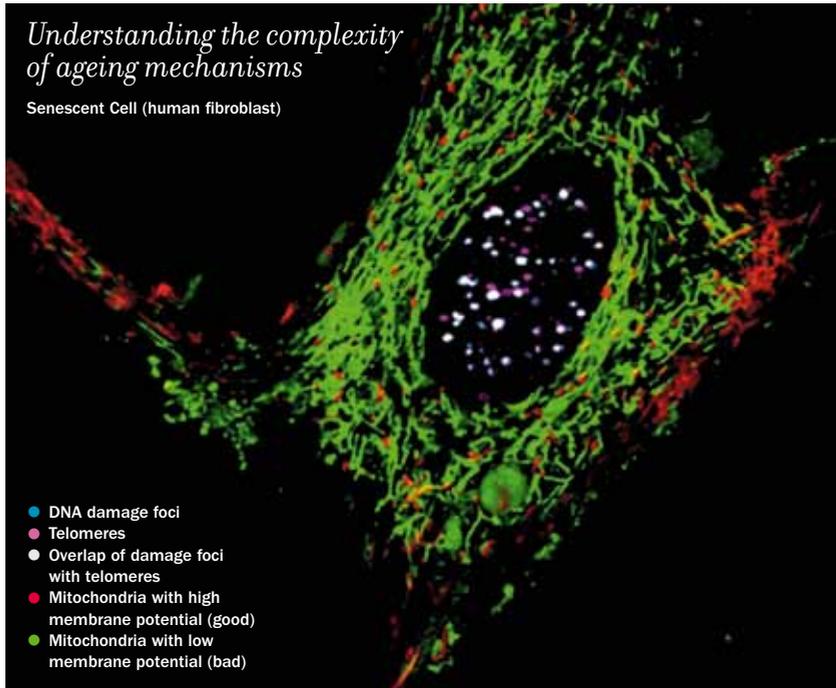
In order to do this, we need to do some pretty demanding scientific research. We hope that it will be possible to extend lifespans further by continuing the trends that have acted until now. Therefore, we have seen improved nutrition, lifestyle and environment. In the future, it may be possible to extend those processes further by producing even better nutrition, by using new drugs and by employing stem cell therapies. However, we should remember that there is also important room for progress in addressing a real problem in today's society—inequality. We know that those in the lowest socioeconomic groups have 10 or even more years less life expectancy than those in the higher socioeconomic groups. So there is still huge room for improvement, even with what we now know.

## WHAT WILL BE NECESSARY?

Looking to the future, new research will reveal new possibilities. I would like to say something about this very briefly. We understand the essence of the scientific processes that drive ageing in broad terms. We now need to go deeper. We have to understand why the aged cell or organ is vulnerable to disease and to do that we need to understand the deep scientific mechanisms of ageing. It is exciting that we can now visualise cells in great detail with the powers of modern science (cf. Figure 2). Dysfunctional mitochondria, the little organelles that produce energy in the cell, are an important form of damage that we can see becomes more widespread with ageing. When we see how many of them are defective in aged tissues, meaning that our cellular capacity to produce energy is compromised, it is easy to understand why we cannot run as fast for the bus when we are old, if we can run at all, and why perhaps our thinking might be a little slower. We can actually visualise the accumulation of damage in the nucleus of the cell and the DNA, and we can use the power of new “systems biology” methods to analyse in ever increasing detail the complex molecular and cellular processes that underlie the functional ageing of our bodies. We hope to be able to make significant further progress in that area in the coming years.

## Figure 2: A senescent cell

Source: Centre for Integrated Systems Biology of Ageing and Nutrition and AXA Research Fund's Chair.



Ultimately, we want to be able to target age-related diseases by understanding the mechanisms that make us more likely to develop conditions like Alzheimer's or osteoporosis. To do this we need to shift the focus from looking at the end results of what has already gone wrong to looking at the upstream causes that begin the deterioration. What is exciting about working upstream on the mechanisms that cause a particular age-related disease is that we find that common mechanisms are shared with different diseases, raising the really exciting possibility that in future we may be able to extend healthy living to a significant degree.

**2. The Newcastle 85+ Study** is a 5-year prospective study in more than 1,000 individuals, born in 1921, of the biological, clinical and psychosocial factors, associated with healthy ageing.



## WHAT ARE THE CONSEQUENCES FOR HEALTH IN OLD AGE?

We need to understand a great deal more about how people experience life at older ages. In Newcastle, we are conducting a very large project, called the Newcastle 85+ Study<sup>2</sup>. We approached everyone in the city who was alive in 1921 and made a comprehensive assessment of the kind of shape which they were in. We are using the findings to understand a complex array of factors that contribute to health in old age.

I want to share two findings with you. One is that not surprisingly there is a lot of illness among people who are 85 or older. The average number of diseases carried by people in that age group is four or five. No one among the 1,000 people in the study was without health problems. However, 78% (four out of five), when asked to evaluate their health, said that it was good (34%), very good (32%) or excellent (12%). That is really positive. Looking at the levels of disability, we scored 17 different functions and asked whether people could do them or not. We found that a quarter of the men had absolutely no problem with any of the activities of daily living and a sixth of the women had no problems. Therefore, to be old in today's society is not necessarily to be in a state of severely compromised health or misery. Surprisingly many of our participants at age 89 or older remain highly independent enjoying a good quality of life. Traditionally, our medical systems have seen mainly those old people who are sick and disabled. It is important that society recognises the broader spectrum of health in old age, as the Newcastle 85+ Study has discovered.

## WHAT ARE THE BARRIERS TO FURTHER PROGRESS?

There are serious barriers that we need to overcome. The first of these is fatalism. The second is the negative stereotyping of old people. The next is tunnel vision—people tend not to see beyond the constraints of what they are dealing with now. The next is the bias towards youth prevalent in today's society. And then we have the problem that government departments sometimes have to invest in education in order to generate a benefit for health, but politicians find it very difficult to handle that kind of cross-departmental accounting. We need to acquire hard evidence as there is too little of it. And we need to get beyond the problem of thinking only in the short term.

I would like to show you what I would regard as the traditional view of ageing: (1) it is biologically determined, (2) we are programmed to age and die, (3) ageing is all bad news, (4) it is gradual, irreversible deterioration, (5) it only concerns those who are already very old, and (6) it is the ticking time bomb of demographic change, the much talked-about burden of all those old people.

It is time to re-examine that view and replace it with a new view of age. The body is programmed for survival, not death. And it is intrinsically malleable. Youth and age are a continuum. Today's young person is tomorrow's old person. And today's old person was once a mischievous child. We saw that beautifully in the life of Jeanne Calment. Her jokes in later life showed what a mischievous little girl she must have been, and how that spark of a strong character remained bright throughout her very long life. We need, above all, to recognise that increasing longevity is a huge success.



Pr. Jean-Marie Robine

*Demographer, epidemiologist and research director at the French national institute of health and medical research (INSERM) in Paris and Montpellier, France*

***The objective of Jean-Marie Robine's demographic and epidemiological research into longevity is to understand the different relationships between health and longevity. In particular, Robine is looking to measure the impact of continuous increase in life expectancy on the state of health for the elderly.***

1. Fries, J. F. 1980. "Aging, natural death, and the compression of morbidity" in *The New England Journal of Medicine* 303 (3): 130-135.

2. In 1693, the first table of adult durations of lives (for the city of Breslau, 1687-91), published and annotated by Edmund Halley, marked the invention of the mortality table. The curve is almost flat from 40 to 75 years old.

# ADULT LONGEVITY: A REVOLUTION

By Pr. Jean-Marie Robine

*“The most common duration for a lifetime is clearly the result of continuous interaction between the human genome and our environment.”*

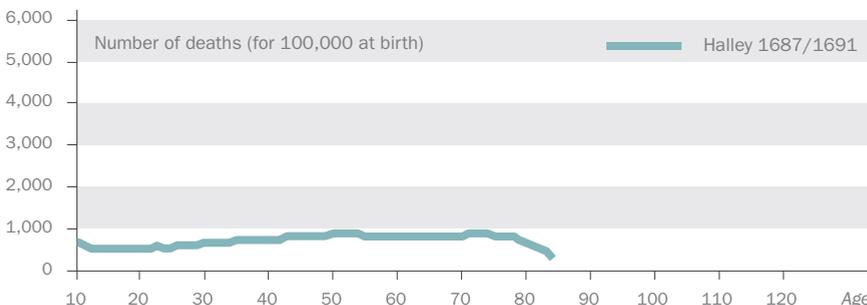
The fall in mortality among adults began, starting in the 1930s, in the most developed countries; however, it did not command real attention until the 1970s. With that fall, the distribution in ages at death began to shift towards older age groups, resulting in increases in the populations of people over 90 and even of centenarians. Consequently, ages at death became compressed around the modal value, illustrating the scenario for the compression of morbidity<sup>1</sup> which was postulated by James Fries in 1980. Nonetheless, the most recent results, in particular for Japan which is headed for the “scenario for a shift in mortality,” compel us to take another look at the scenario for the compression of morbidity.

## THE GRADUAL APPEARANCE OF A MODAL VALUE FOR AGE OF DEATH

The first life table available for duration of lives among adults was compiled in the 17<sup>th</sup> century (cf. Figure 1). It did not reveal any particular age for death. The distribution of adult ages at the moment of death, published by Halley in 1693<sup>2</sup>, is totally flat.

**Figure 1: First mortality table for adults for the city of Breslau, published by Halley in 1693**

Source: Halley, E. 1693. "Some further consideration on the Breslau bills of mortality", *Philosophical Transactions of the Royal Society of London*, vol. XVII, 198: 654-656.

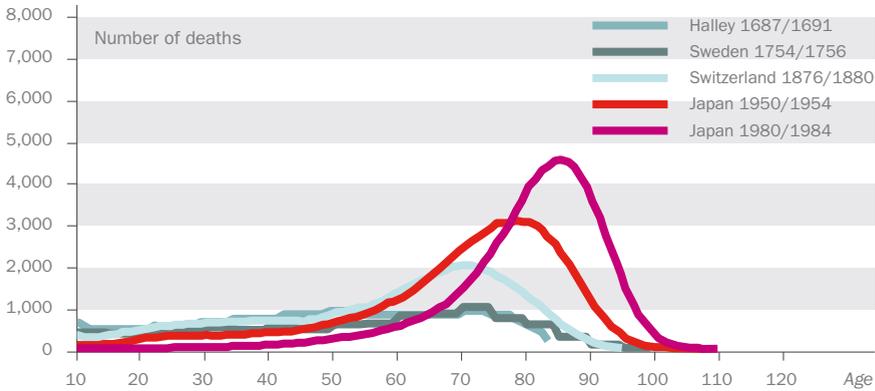


3. The work of Kannisto (2001) shows that the modal age of death among adults represents the most frequent value for longevity (i.e. ordinary longevity) under today's conditions of morbidity and accepting that this value can increase under the effect of a fall in adult mortality.

> And then, little by little, a modal age of death began to appear around 70-75 years old. As adult ages grow, we see an increasingly larger number of deaths concentrated around the modal age. We are not talking here about a decline in infant mortality, which is the reason for the spectacular surge in life expectancy among newborns (only 60% of babies reached adulthood in 1751, the year that the first published data became available) with, in fact, over 99.5% of them reaching adulthood, today.

**Figure 2: Distribution in duration of adult lives. Empirical data from between 1693 and 1884**

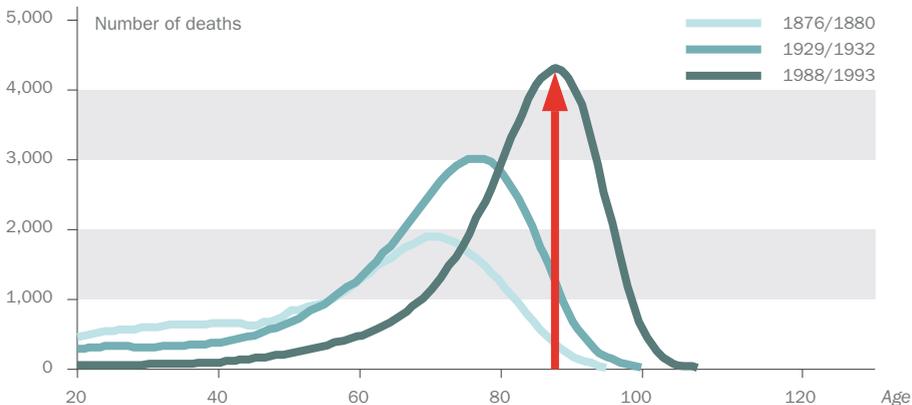
Source: Robine, J.-M., Cheung, S.L.K. 2008. "Nouvelles observations sur la longévité humaine", Revue Économique, 59 (5): 941-954.



The most relevant way of indicating adult longevity is with the modal age of death, i.e., the most common duration of life<sup>3</sup> (cf. Figure 3).

**Figure 3: Increase in the modal age of death for Switzerland (1876-80, 1929-32, 1988-93)**

Source: Robine, J.-M., Inserm.

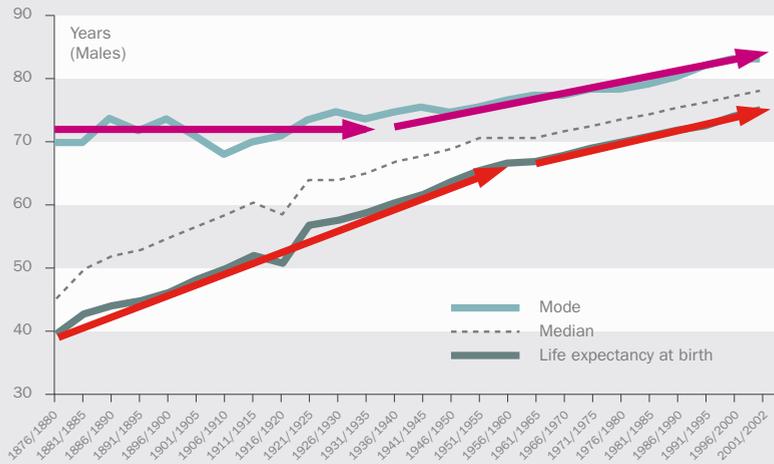


4. The scenario for the compression of morbidity is based on the process of rectangularization of the survival curve and on the compression of morbidity (Fries, F, 1980), i.e., the higher the modal duration of life, the more concentrated becomes the distribution of durations for individual

lifetimes. In this highly-concentrated distribution of adult lifetimes, suggested by Fries, the modal lifetime is 85 years (about 10% of the population should die at the mode), and nearly no one should die before 70 or after 100.

### Comparative variations in the modal age of death and in life expectancy at birth, the example of Switzerland since 1876

Source: Cheung, S., Robine, J.-M., Paccaud, F., Marazzi, A. 2009. "Dissecting the compression of mortality in Switzerland", 1876-2005, Demographic Research, 21 (19): 569-598.



While calculation of life expectancy at birth shows a strong increase during the demographic transition (about 5 months per year), followed by a less marked net increase since World War II (an average of 3 months per year), observation of the modal age of death tells a very different story. After a long period of stagnation in the modal age of death, at a time when life expectancy was sharply increasing, the modal age of death showed a steady increase of just 3 months per year, almost in parallel with the increase in life expectancy. This change in the modal age of death is seen in nearly all countries with low mortality rates. However, we have to point out a certain divergence at the time when there appeared the first increase, during the demographic transition.

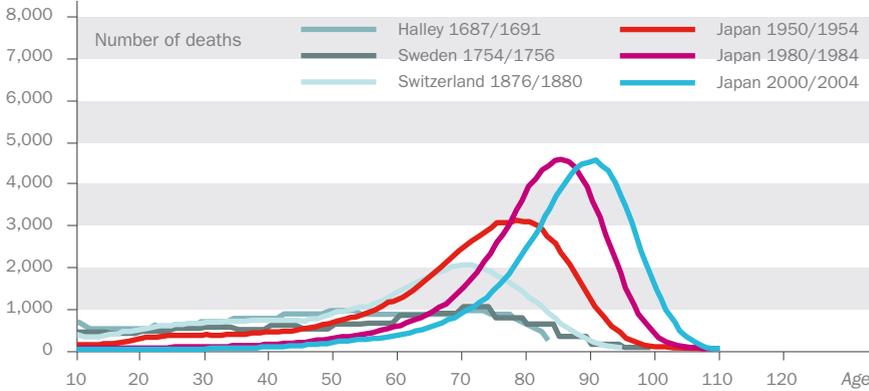
### TWO SCENARIOS TODAY: (1) COMPRESSION AND (2) DELAY IN MORBIDITY

The question which must be asked is how to know if the lengthening in adult life is accompanied by a compression<sup>4</sup> or by a delay in morbidity. It seems that in Japan (cf. Figure 4, following page) it would be the scenario of delayed morbidity which prevails, while most Western European countries (cf. Figure 5, following page), such as France, seem to support the hypothesis of a compression in morbidity.

> **Figure 4: The scenario for delayed morbidity in Japan**

Source: Robine, J.-M., Cheung, S.L.K. 2008. "Nouvelles observations sur la longévité humaine", *Revue Économique*, 59 (5): 941-954.

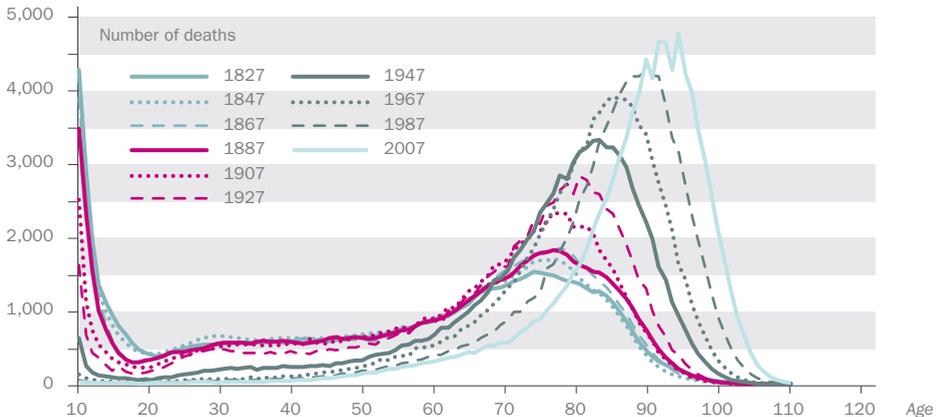
After having followed the general scheme for compression of morbidity, Japan has been heading for 10 or 20 years now towards a "scenario for delayed morbidity." The series 2000-04 of the modal age of death is characterised by a shift towards older ages in the distribution of durations for adult lifetimes, while maintaining exactly the same form and the same characteristics as the preceding series (1980-84).



**Figure 5: The scenario for compression of morbidity in the example of the modal age of death for French women since 1827**

Source: Robine, J.-M. 2010. "La situation démographique de la France : état des lieux et perspectives", *Retraites, démographie, santé : Vieillir en France aujourd'hui et demain*, pp. 23-48 (Vuibert).

Contrarily in France, as in most developed countries, adult mortality continues to centre at the level of the modal age of death in step with the rise in lifetimes.



The most spectacular consequence of lengthening adult lifetimes is the emergence of centenarians. Their number is doubling every 10 years in countries where longevity is in part offset by a compression of morbidity, like in Europe. Their number is quadrupling every 10 years in Japan, where the distribution in durations for adult lifetimes has shifted towards older ages without compression of morbidity, i.e., with a maximum age for death which increases by the same number of years as the modal age of death.

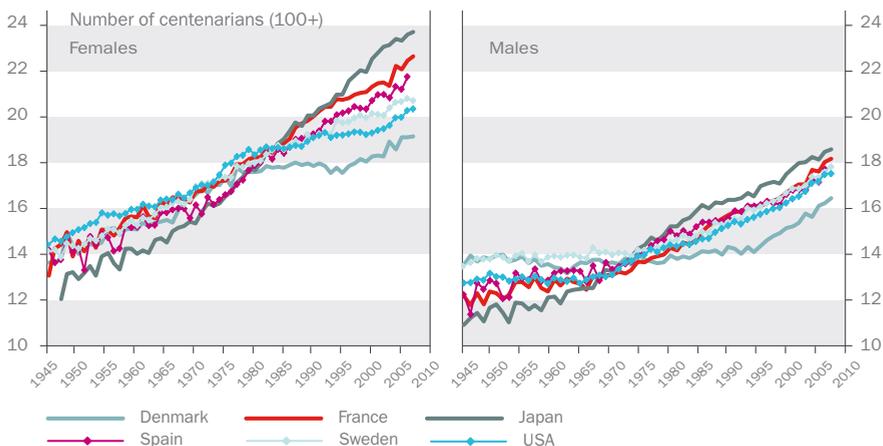
The number of centenarians is an easy indicator. In fact, the populations of all the upper age groups have considerably increased in countries with low mortality since World War II. Nonetheless, the older an age group, the faster is its growth rate. And over the last few years, there has been no sign of that trend slowing.

**SINCE THE MID-70'S, DIVERGENCES IN LONGEVITY HAVE PERSISTED BETWEEN COUNTRIES WITH LOW MORTALITY**

It is essential to be aware of the fact that there exist divergences and variability. The strong convergence observed in the OECD countries—countries with low mortality—after World War II (cf. Figure 6) had led to a life expectancy of 65 years, nearly identical with that of Japan, North America or of the Scandinavian countries and the rest of Western Europe. However, that all changed in the 1970s, ushering in a period of strong divergence which has lasted for two decades. Even if this period of divergence is now over, the differences remain the same. There are over 5 years of difference between the life expectancy of women over 65 in Denmark and in Japan. The Western European countries are spread between those two extremes.

**Figure 6: Divergences in life expectancy at 65 in certain OECD countries**

Source: Human Mortality Database. See also: Robine, J.-M., Saito, Y., Jagger, C. 2009. "The relationship between longevity and healthy life expectancy", *Quality in Ageing*, 10 (2): 5-14.

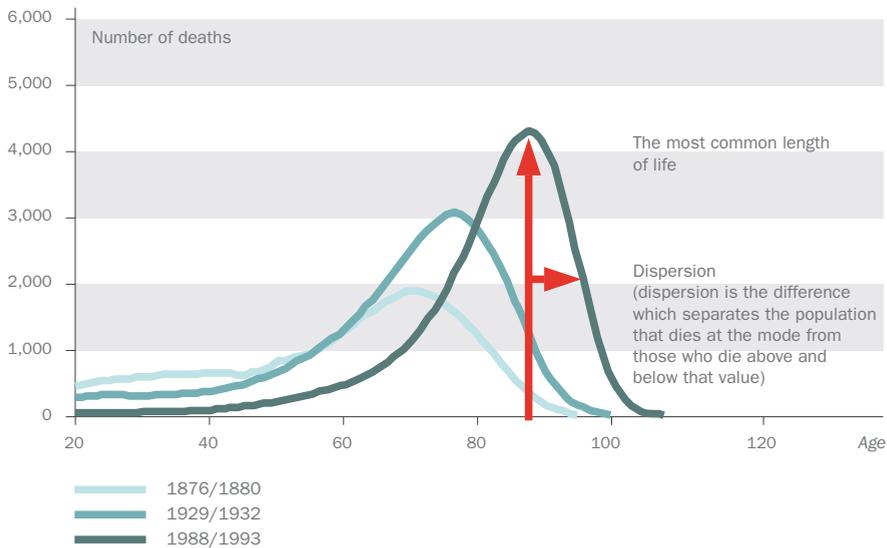


> These differences in life expectancy lead to significant differences in the quickening growth in numbers of the oldest individuals. For example, it is ten times easier for a woman to become a centenarian in France than in Bulgaria. Every value possible exists between those two European extremes.

When one examines the determinants in adult longevity, it is important to distinguish the level (i.e., the determinants of the most common value for longevity) of dispersion (i.e., what are the determinants for homogeneity or, contrarily, the dispersion of individual life durations).

Figure 7: Determinants in adult longevity

Source: Robine, J.-M., Inserm.



## DIVERGENCES AID UNDERSTANDING FACTORS IN INDIVIDUAL LONGEVITY

The most common duration for a lifetime is clearly the result of continuous interaction between the human genome and our environment. It is not simply a question, to paraphrase Professor Kirkwood, of a biological trait specific to our species. We are probably one of the most resilient species, but more importantly, thanks to our intellect, we know how to change our environment so that it prolongs our longevity. When we began to assemble data on morbidity by age brackets at the end of the 17<sup>th</sup> century, there was no specific moment when people died. The modal age of death emerged gradually to lie between the ages of 70 and 75 years old, and then to increase to the values that we see today, which are 90, 91, even 93 for the most-developed countries. No one can say with certainty when the modal age of death will stop increasing, or what level it will reach.

However, we do know something about the determinants in variability of longevity. To start with, it is important to note that we have strongly homogenous results in terms of longevity, compared with other species. Durations of lives are much more varied in other living species, and human civilisation is without doubt the main reason for this homogeneity. The biggest challenge consists in defining the relative contribution of the principal determinants which have been suggested. Genetic factors probably explain 25% of the variability in human longevity. Little is known about the role of the environment and that of culture (including the place and role of the elderly in society and in the family), the sense and the value placed on ageing, the types of care offered and the level of development. There is also the notion of political and economic freedom with free access to healthcare services and education, gender parity, solidarity, social justice and social engagement. All of these factors seem important to explaining levels and dispersion in longevity, but one does not yet know to what point differences between these factors can explain the difference noted in terms of longevity in countries with low mortality.



DISCUSSION BETWEEN JAMES W. VAUPEL, THOMAS KIRKWOOD,  
JEAN-MARIE ROBINE AND THE AUDIENCE

# LONGEVITY IN QUESTION

**Bruno Giussani (forum moderator):** Professor Vaupel, the rising trend in life expectancy, which you have shown, seems linear and open-ended. Is there the least reason to believe that the situation could change over the short, or even the midterm?

**James W. Vaupel:** In the foreseeable future, no slowing in the trend is projected and there is no empirical proof or theoretical reason to support a halt in the rise. Perhaps there exists a limit to lifespan—150, 200 or an age that we cannot even imagine. Jeanne Calment (the Frenchwoman who for the moment is humanity's longest living individual) died at the age of 122. Therefore, we have no visibility beyond 122 years. Perhaps something happens at that age, but as far as we know, there is not any insurmountable barrier. Having said that, it is perfectly clear that no one is going to start living forever anytime soon. Life expectancy increases 3 months per year, which is it. Negative events could happen, such as an economic depression, war, epidemic and so on. However, let us not forget that during the 20<sup>th</sup> century, there were economic depressions, wars and epidemics and that life expectancy still continued to increase...which is why I am reasonably optimistic. Some biologists think that I am too conservative in my modelling of the past. They think that biomedical advances could enable a deep understanding of the ageing process. Maybe then, life expectancy could begin to increase by 4 or even 5 months per year, instead of just 3.

**B.G.:** Professor Robine, you directed the group who studied the particular case of Jeanne Calment in 1997. What are your conclusions today from that study?

**Jean-Marie Robine:** Jeanne Calment is without a doubt a special case. With Professor Vaupel, we are compiling an international database on longevity, in which we have grouped all the data on centenarians. The distribution of adult lifespans, which I am talking about, peters out around 115 years. Each year, we hear about a death at 114, 115 or 116. Beyond that, we are in the realm of the outliers, and we know of three people in that category: Calment, dead at 122, Sarah Knauss who died at 119 and the Canadian, Mrs. Meilleur, dead at 117 years old. So, 122 is nevertheless 7 years beyond 115, and thus we can say that Jeanne Calment was exceptional in more ways than one. Yet, when we look into her long life, what is exceptional was that a good number of her direct ancestors, looking back five or six generations, had lived until exceptionally advanced ages

> for their time as well. We looked at a control family, going back five generations and we note that it was rare to find more than one person who lived to 90 or beyond, while in the Calment family, there were sixteen of her direct ancestors who lived more than 80 years.

**B.G.: You have studied other species; what can one learn from other species that could be important in terms of longevity?**

**Thomas Kirkwood:** A lot of work is being done on nematode worms and fruit flies; however, to be frank, I prefer the work with mammals, because they are more like us. For example, when we observe cells in small mammals, such as mice, dogs

*“We repair our DNA better than a mouse, a cat or a sheep, which explains in part human long life.”*

or similar animals, we see that they have repair mechanisms which work less well than in human cells. We repair our DNA better than a mouse, a cat or a sheep. That explains in part human long life, and confirms the theory according to which maintenance is the key to a long and healthy life. There are other less obvious examples, such as the honeybee, offering a considerable contrast between lifetime for the queen bee, which lives 10 years, and worker bees, which live only a few months. In sum, zoology offers many opportunities to understand ageing.

**James W. Vaupel:** One remarkable discovery, which has been made, is that certain species age very quickly and others more slowly, while still others do not age at all, but totally repair damage. There exist species which even evidence negative senescence, meaning their condition actually improves and their mortality diminishes over time. Generally understanding why certain species age and others do not could shed light for us on the essential nature of ageing.

**Polish member of the European Youth Parliament: Professor Kirkwood, your metaphor of the photocopier to illustrate cell reproduction was amusing and fascinating. However, do we have the potential to equip ourselves in the future with a better photocopier?**

**Thomas Kirkwood:** Theoretically, it is without doubt possible; although I would not risk saying that it could happen tomorrow. There are people in gerontology of dubious expertise who claim to have the possibility of building human bodies with lifespans of 1,000 years. I believe that it will require an enormous effort

to understand fully what is possible. We understood several decades ago what the basic problem was in cancer. Since then, there has been considerable progress; however, we have still not solved the problem. Therefore, on the one hand I am truly optimistic, because theoretically there are many possibilities for improving the body's systems for cell maintenance. Yet on the other hand, we still have an enormous amount of work and investment ahead of us. I am stupefied to see what little resources are given to the study of ageing... especially since age is the number one cause of most disease in modern medicine, whether cancer, heart disease or others. Just consider how many people in European medical research institutes are studying ageing—it is just a handful. That is why I believe that in 30 or 40 years, when we look back at the beginning of the 21<sup>st</sup> century, a lot of people are going to ask how we could have been so slow to understand what needed to be done.

**From the floor: You have placed the emphasis on individual life expectancy rather than on age cohorts and their ageing. However from an economic point of view, it is not so much the individual as the cohorts which are important...**

**James W. Vaupel:** The question of cohorts is interesting. We have shown statistics on the lengthening of life expectancy, based on a specific period. Today, life expectancy is over 80 years in many countries and is going gradually to reach 100 years or more during the upcoming century (at a rhythm of 2.5 years per decade). So what happens if we now shift the focus to cohorts? If we take as a subject a newborn child and follow her on the basis of a study of cohorts, we will have to wait 80 years before she reaches the age of 80. Meanwhile, considerable progress will have been made in the field of healthcare. The child who has benefited from it will reach 80 in better health and will have more of a chance of living an additional 20 years in good health. Consequently, the trend encourages even more optimism on the basis of cohorts, because cohorts benefit from future progress as well. Life expectancy on the basis of a given period increases 6 hours per day, and it increases 8 hours per day on the basis of cohorts.



**Dr. Daniel Vasella**

*Novartis AG Chairman of the Board of Directors, Doctor of Medicine, and holder of Honorary Doctorates from the University of Basel and Harvard Business School*

# LIFE IS THE PAST, A DREAM – THE FUTURE IS A WISH

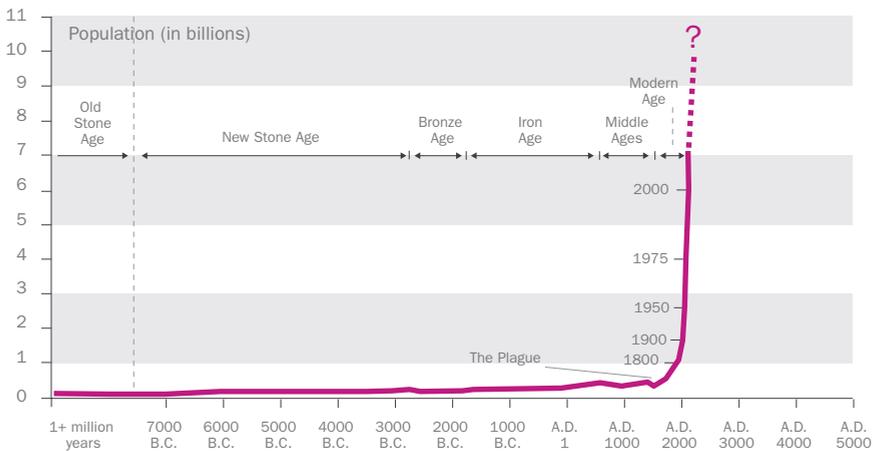
By Dr. Daniel Vasella

*“It is fascinating to observe that dramatic changes in age distribution have occurred in one generation.”*

## AN UNPRECEDENTED EXPLOSION IN POPULATION, A DIRECT RESULT OF THE INCREASE IN LIFE EXPECTANCY

Figure 1: Exponential growth in human population

Source: Population Reference Bureau and World Population Projections, United Nations.



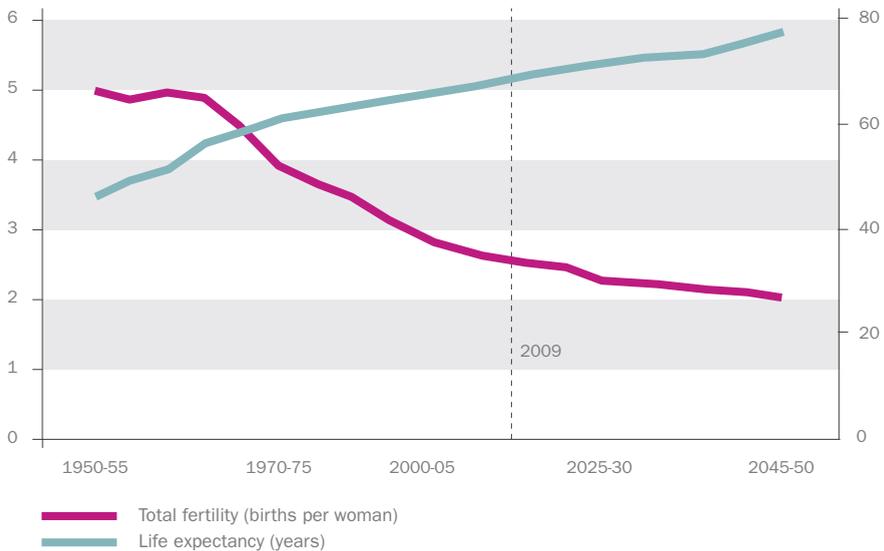
The last two centuries were marked by yearly exponential growth in human population (cf. Figure 1). This unprecedented explosion in population was a direct result of the increase in life expectancy, which in fact doubled during this period. The early advances in life expectancy came primarily from reduction in infant mortality, made possible by a combination of factors including safe drinking water, hygiene, nutrition, sterilization techniques, vaccines and antibiotics. Mortality from infectious diseases saw a steep decline during this period. The recent gains in life expectancy were primarily through delay of older age mortality, where advances in cardiovascular medicine, among other factors, play a major role.<sup>1</sup>



Gains in life expectancy are not uniform across nations. Sub-Saharan Africa and erstwhile republics of the ex-Soviet Union are laggards in this regard. This showcases the role economic development, education and political stability play in translating technological advances into human benefits.

Figure 2: Fertility rates and life expectancy rates (global)

Source: The World Population Ageing 2009, United Nations.



Gains in life expectancy mean an increase in the probability of a child reaching adulthood. From a parental perspective, this naturally reduces the need for more children. Change of income flow between parents and children (e.g., legislation against child labour, increase in education costs) can also provide additional incentives to have fewer children. The desire to have fewer children was realized with the availability and acceptability of contraceptives. We therefore see a significant decrease in fertility rates (cf. Figure 2).

Figure 3: Japan's population by age group (in millions)

Source: National Institute of Population and Social Security Research.

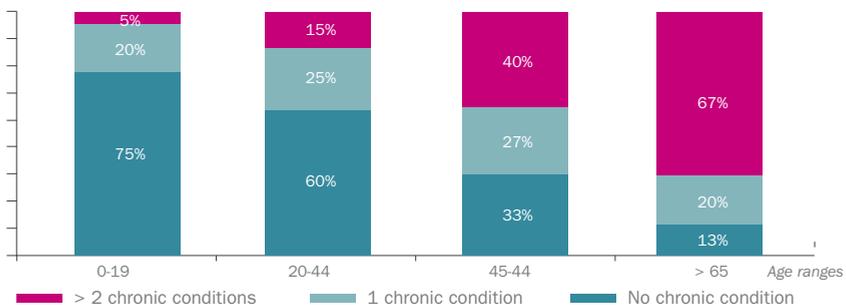


The combination of increasing life expectancy and decreasing fertility rates is leading to rapid ageing in many societies (cf. Figure 3). It is fascinating to observe that dramatic changes in age distribution have occurred in one generation. I am reminded of this fact whenever I go to Africa and see so many children and so few old people. That had been the standard in Europe during the 1960s. The deviation since then has been towards having fewer children and much healthier older people.

### AGEING IN GOOD HEALTH

Figure 4: Chronic conditions by age group

Source: US Medical Expenditure Panel Survey, 2001.



2. Manton, K.G. et al. 2006. Proceedings of National Academy of Sciences.

3. Druker, P. et al. 2006. *New England Journal of Medicine*.

> What are the consequences of an ageing society from a healthcare perspective? As there is a direct correlation between age and number of chronic diseases (cf. Figure 4), the disease burden of ageing societies will increase. Neuropsychiatric, cardiovascular, musculoskeletal and ophthalmic disorders are likely to be the leading contributors to disease burden. Projections of known demographic changes indicate that there will be a substantial increase in the prevalence of these diseases. We will have to bear the cost of treating these chronic conditions, while the costs associated with end-of-life care will continue to be the most expensive. Sometimes people ask why we still spend so much money for end-of-life care and the problem is that nobody knows when their last days are going to be. It appears that current challenges from healthcare costs are just the tip of an iceberg.

The number of chronic conditions is also found to correlate with disability in patients, which can compromise their ability to work and earn an income. However, there is good news. We see in Switzerland, the US and certain other countries that disability rates among seniors have declined significantly over time<sup>2</sup>. It is critical that progress continue in order to maintain productive societies. We must find innovative ways to strengthen disease prevention and reduce disability in order to open a path to healthy ageing.

*“The secret to prolonging one’s life is to not shorten it.”*

## POSSIBLE WAYS FORWARD

Let me give you an example of innovation in medicine. In 1999, patients diagnosed with chronic myeloid leukaemia (CML) had a daunting choice between two treatment options: (1) a high-risk bone marrow transplant or (2) daily injections of interferon, the side effects of which have been compared to having a bad case of flu every day of your life. Only 30% of patients survived more than 5 years. Now the situation has dramatically improved, thanks to an innovative targeted therapy, called Glivec®, which was developed in the laboratories of Novartis. Patients can now take this pill daily and have a good chance of driving the cancer into remission—normalizing their blood count with few, if any, side effects. The 5-year survival rate is in over 95% of cases<sup>3</sup> and many patients return to a normal working life.

4. National Cancer Institute, 2003. Surveillance, Epidemiology and End Results Program from 1975 to 2000.

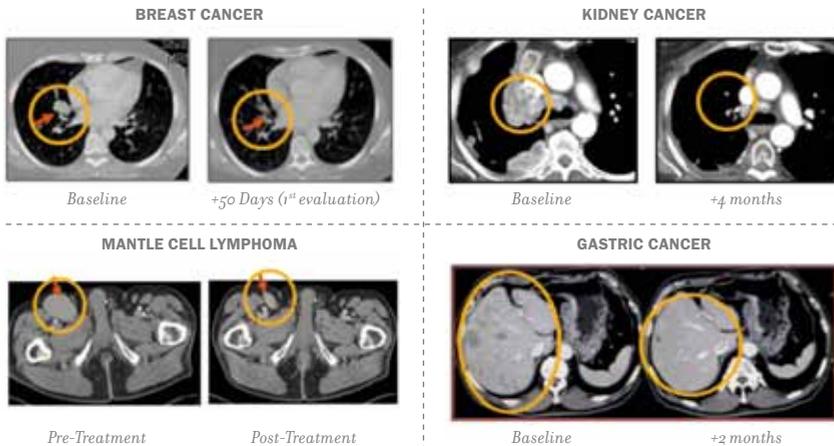
5. Smith, M. et al. 2004. *Journal of Pediatric Oncology Nursing*.  
6. American Cancer Society, 2004. *Cancer Facts & Figures*.

We have made progress in other types of cancers too. About 65% of adult cancer patients and 80% of children with cancer live longer than 5 years.<sup>4,5</sup> Mortality in children has basically been halved in the last 25 years with the aid of better diagnostics and therapies<sup>6</sup>. We are transforming cancer from an acute, deadly disease into a chronic disease.

Such pharmaceutical advances are made possible by a combination of factors. New tools, such as integrated protein biology and model organisms to study genetics, have significantly improved our understanding of disease mechanisms. Robotics, including high-throughput biology, allows us to run experiments round the clock. Advances in bioinformatics have made a profound impact. Imagine that communications occur within and between cells, like a language. What we are trying to do is understand the words and their meaning. If we can hit one target at one nodal point, we change the meaning of the signal by adding a “do not” or a reinforcing “yes.” We are discovering various new pathways with nodal points where we can intervene. The more specific to the disease, the better they are.

**Figure 5: Afinitor® is an important cancer treatment with potential in different tumour types**

Source: Novartis/Afinitor®.



7. Harrison, D.E. et al. 2009. *Nature*.

8. Cao, K. et al. 2011.  
*Science Translational Medicine*.

> The enzyme, mTOR, represents one such nodal point in cell signalling. The enzyme increases cell proliferation, angiogenesis (i.e. the formation of new blood vessels) and nutrient uptake. We discovered a drug (Afinitor®) that inhibits this enzyme and thereby blocks those mechanisms all at the same time. As a consequence, there is less cell proliferation, less angiogenesis and less nutrient uptake. That clearly suggests their use in cancer treatment. However, those drugs were first developed as an immunosuppressant for transplants. We have now shown that this drug is also effective in a variety of cancers (cf. Figure 5) and has already been approved to treat multiple types of cancer.

We found another effect of this drug—it impacts autophagy, which is the process where organelles within a cell are destroyed and recycled by enzymes of the same cell. Autophagy plays a key role in cellular housekeeping by removing damaged organelles. During ageing, the efficiency of autophagic degradation declines and intracellular waste products accumulate.

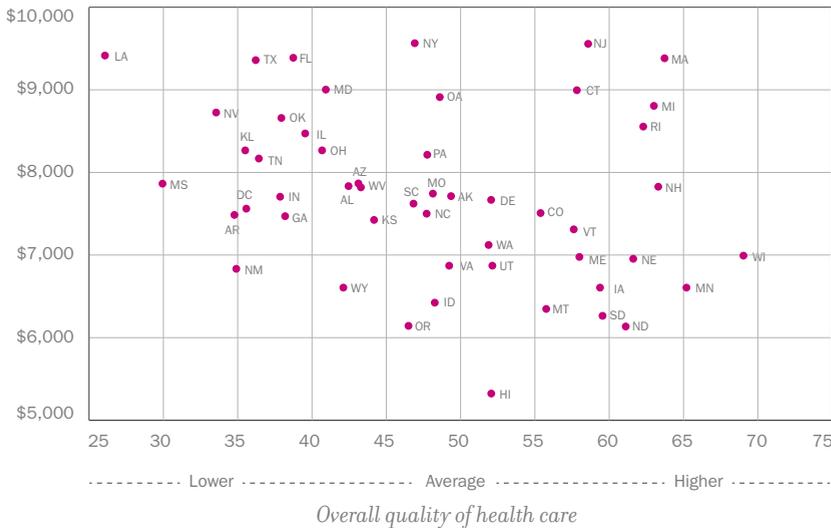
## *“Pharmacological modulation of ageing is possible.”*

Having said that, will inhibitors of mTOR have any effect on ageing? A study published 2 years ago, showed that administration of Rapamycin (another known inhibitor of mTOR) increases lifespan in mice<sup>7</sup>. Interestingly, the effect was observed also in those mice which were treated only during their adult lives. The second study looked at patients with progeria, a lethal genetic disorder, characterized by premature ageing<sup>8</sup>. Progerin is a protein whose abundance increases as cells age and its accumulation is observed in progeria. When cells of these patients were treated with Rapamycin, progerin levels were significantly reduced, both through reduced production and through increased clearance via autophagy. Taken together, it appears that pharmacological modulation of ageing is possible. This will be an interesting area to watch.

## THE CHALLENGE OF PERFORMANCE FOR HEALTHCARE SYSTEMS

Figure 6: Medicare spending per beneficiary (2006)

Source: Dartmouth Atlas of Health Care and Federal Agency for Healthcare Research and Quality.



How will healthcare systems cope with significant increases in demand at a time when healthcare (HC) spending is straining national budgets? Medicare data from the US shows that spending more does not necessarily deliver a better outcome. If there is a correlation at all, then it is negative (cf. Figure 6). This shows that it is not the absolute amount of money, but how one spends it that matters. HC reforms in high income countries have mainly focused on across-the-board reductions in cost and not on improving quality or value for money. These populist, short-term, piecemeal measures, taken without addressing the complex, root causes of inefficiency, have not changed either the realities or the challenges of healthcare on the ground, where problems continue unabated.

At Novartis, we commissioned research to look into how one can compare different HC systems objectively and adopt best practices from the best performing systems. We coined the new metric of HC productivity (“value for money”—measured as reduction of disease burden per HC spend) and used it to compare the performance of various HC systems at a disease level. No single healthcare system was found to be the best in treating all diseases. However, depending on the disease, we found myriad differences in productivity between HC systems. For example, if you have COPD, then you are much better off in France than you are in the US.

> In contrast, the US is the place to be if you are at risk of developing breast cancer. The US has a much more effective screening programme for breast cancer, much earlier, and more aggressive therapy than in many other countries, such as the UK or Switzerland. You can even see differences within countries. For example, in the cantons of Switzerland where mammograms are being routinely performed, many more patients are being diagnosed in an early phase of the disease, leading to better outcomes than in cantons where mammograms are done on a random basis.

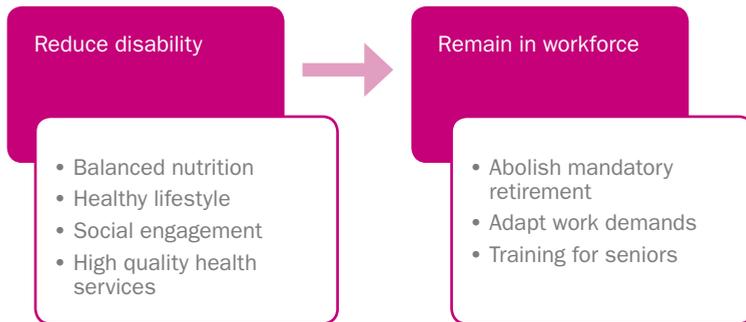
Therefore, depending on what policy is introduced and what standard protocols are applied, the outcomes in different countries are very different. We think it is necessary to have clear protocols and standards with measurement of outcomes. It is vital to have integrated care, particularly for chronic illnesses. You cannot view a patient like a bicycle, where you can fix individual parts as they fail. The right answer is an understanding of patients in their bio-psycho-social whole and addressing their needs correspondingly.

We also see that productivity gets a huge boost when sufficient measures are taken to prevent disease. Prevention should be the cornerstone of any healthcare policy, but it seldom is. Looking at the prevalence of obesity and especially childhood obesity in the US, I am not sure that gains in life expectancy will be sustained. Many chronic diseases, ranging from diabetes to degeneration of joints to hypertension, can be prevented to a good degree by healthy lifestyle choices. And vaccines to prevent infectious diseases, for example, can be more effectively deployed.

However, taking both those who provide healthcare and those who pay for it, one has to align incentives with the achievement of better outcomes and the objective of prevention; otherwise all efforts will be in vain. Take the example of defensive medicine. It is widely accepted that this creates huge, unnecessary healthcare costs. But it is extremely difficult to change the system, as many players are recipients of money spent for defensive medicine, ranging across insurance companies, lawyers, diagnostic companies and hospitals.

## PREPARING FOR THE FUTURE

Figure 7: Multiple steps can be taken to maintain function capacity

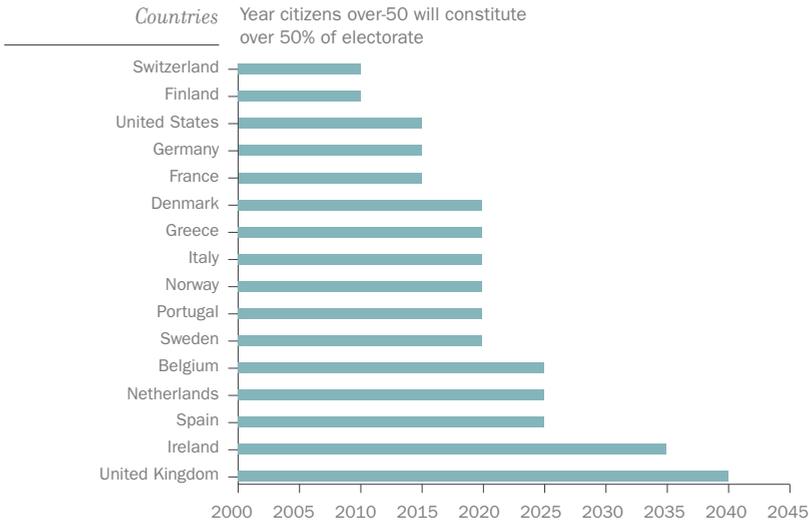


We have to prepare for a new reality. For every senior, there will be fewer and fewer working-age adults as we go forward. This will have major socioeconomic consequences ranging from pension policy to governmental incomes.

We could partly negate some of these challenges, by reducing disability among seniors and by taking steps to allow them to work. But a manual worker is likely to have more age-related constraints than an office worker. We need to adapt the system to the demands of work and abolish mandatory retirement. Many companies including Novartis allow retirees to re-enter the workforce. Since they can have flexible hours and work less, they like working, while their employer does not lose their expertise from one day to the next. One should also think about ergonomic design in the workplace to suit the needs of senior workers. A major automobile maker in Germany has shown that an ergonomic design for its production plant boosted the productivity of its older-aged workforce to levels seen with younger-aged workforces<sup>9</sup>. The question of retraining is a very important one. Self-renewal is something that we will all have to face as we get older and older.

Figure 8: Shifts in electoral power

Source: Hayashi, C. et al. 2009. World Economic Forum publication.



*“It is essential that in urban planning we keep seniors integrated and do not create silver ghettos.”*

We also are starting to see the shift in electoral power. In some countries, voters over 50 years of age constitute the majority of the electorate (cf. Figure 8). Many more countries are expected to follow suit in the coming decades. This will have an impact on policymaking as seniors exert political pressure for their welfare. High income countries with ageing populations will increasingly rely on immigration to meet labour shortages. This could be a source of political tensions.

Urban planning also needs to change. Thinking back to my days at a long-term care unit as a physician, I prayed that I would not end up with one bed, a bedside table and a closet, because that is all that is left. The impoverishment of mental stimuli is dramatic. It is essential that in urban planning we keep seniors integrated and do not create silver ghettos.

While speaking in Paris about longevity, the story of Jeanne Calment comes to mind. In 1965, her lawyer made an unusual deal with her. In exchange for ownership of her apartment, he agreed to pay her a monthly pension for the rest of her life. Because Mrs. Calment was 90 years old at the time, it seemed likely that the lawyer would only have to make a few payments before her demise. However as it turned out, it was a much better bargain for Mrs. Calment. During the next 32 years of her extraordinary life, she was paid three times the worth of the apartment. She outlived her husband, who died in 1942. She outlived her daughter, who died in 1936. She outlived her only grandson, who died in 1963. And yes, she outlived her lawyer who died—at age 77—soon after Mrs. Calment's 120<sup>th</sup> birthday. The exponential growth in the number of centenarians worldwide suggests that the fascinating story of Mrs. Calment may be the omen of things to come.



# LIVING TO BE 110...

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*Super centenarians,  
alive and well!*



## INTRODUCTION

# **SUPER CENTENARIANS, ALIVE AND WELL!**

For each of us, ageing in good health is one of the main challenges, posed by longevity. As a corollary to this crucial question, we may also ask: how to get the most from the increase in lifetime? This conference aims to take stock of medical knowledge on the determining factors behind ageing in good health.

The latest projections tend to show that life expectancy in good health is increasing more slowly than longevity, which is leading to the social conundrum of how to age without incurring disability.

Carol Jagger (cf. paper on page 88) is an epidemiologist, studying the interaction of biological, clinical and psychological factors behind ageing in good health, working with people 85 and over. She finds that there is still considerable room for

improvement in disease prevention and treatment, and explains why it is urgent to give priority to decreasing the incidence of disability in the extremely elderly.

To date, one counts 90 proven cases of people 110 and older around the world. A medical doctor, Stephen Coles (cf. paper on page 96) has specialised in the study of super centenarians in order to understand what it is that makes them so unique: e.g., why do they live so long and how do they manage to avoid most illnesses? And how do they usually die? The goal is to solve these mysteries someday in order to help ordinary people live longer.



**Pr. Carol Jagger**

*Professor of epidemiology of ageing, Institute for Ageing and Health (IAH), Newcastle University, UK*

***Carol Jagger's research into ageing covers demographic and epidemiological aspects with a particular focus on physical and mental functioning. Within the Institute for Ageing and Health, she holds the AXA-Newcastle University Chair on "Longevity and Healthy Active Life" which is aimed at increasing understanding of determinants of ageing in order to improve medical prevention and healthcare policies.***

1. MAP2030 (Modelling Ageing Populations to 2030). For further details of the simulation model SIMPOP see Jagger, C., Matthews, R., Lindsay, J., Robinson, T., Croft, R., Brayne, C. 2009.

"The effect of dementia trends and treatments on longevity and disability: a simulation model based on the MRC Cognitive Function and Ageing Study (MRC CFAS)", *Age and Ageing* 38: 319-325.

# HOW CAN WE EXTEND LIFE IN GOOD HEALTH?

By Pr. Carol Jagger

*"Extending life in good health is not enough. We have to extend it by more than the increase in life expectancy if we are to reduce unhealthy years."*

Before discussing how we can extend life in good health, it is important to consider whether extending life in good health is the right target to aim towards. Earlier speakers in this Forum used mortality as a surrogate for health, however, the following example will use disability. The illustration will use projections of life expectancy and disability-free life expectancy at age 65 from a simulation model, SIMPOP, developed as part of the MAP2030<sup>1</sup> project, which models pensions and long-term care requirements for the UK older population out to 2030.

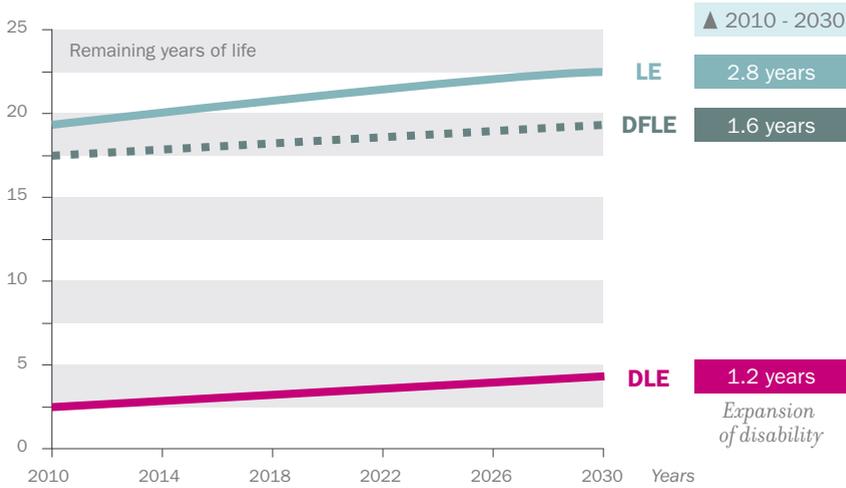
## THE MAIN OBJECTIVE HAS TO BE TO REDUCE THE NUMBER OF YEARS WITH DISABILITY

Looking at projections of women's life expectancy at 65 over the next 20 years (cf. Figure 1), there are clear increases in both life expectancy (LE) and disability-free life expectancy (DFLE), meaning we are extending life in good health. However, life expectancy will increase by about 3 years, but disability-free life expectancy by only about half of that (1.6 years). Therefore, years with disability also increase, resulting in an expansion of disability. This clearly demonstrates that a focus on extending life in good health is not enough, but that life in good health must be extended by more than the increase in life expectancy if unhealthy years are to be reduced.



Figure 1: Projections of life expectancy (LE), disability-free life expectancy (DFLE) and life years with disability (DLE) for women at age 65 for the period (2010-30)

Source: Longevity and Healthy Active life – SIMPOP – MAP 2030 (Modelling Ageing Populations).



### WE HAVE TO REDEFINE THE VERY NOTION OF “GOOD HEALTH”

How do we define what is good health in later life? The main models for successful ageing, which were developed a couple of decades ago, include being free of disease and disability. Although there may be short-term increases in functioning and health, over the long term, health and functioning tend not to improve with age. How realistic is a model of successful ageing that demands an older person be free of disease and disability, particularly for those aged 85 and over, the oldest old, who are the fastest growing segment of the population? We have shown in the Newcastle 85+ Study (cf. page 58) that 85 year olds on average have four or five diseases, these being diagnosed by a doctor rather than simply self-reported. However, many of these 85 year olds were still living independently and living socially-active and engaged lives, so in many senses we would say that they were ageing successfully, even though they were not free of disease. In addition, such models of successful or healthy ageing have too often been created by researchers with no input from older people themselves, and we need to know how older people define success in ageing.

## ONE MAJOR CHALLENGE IS TO DELAY THE ONSET OF DISABILITY

### An inexorable march towards disability

Because functioning is considered an important aspect of healthy ageing, we will now briefly touch upon the main drivers of disability using as a framework the disablement process described by Verbrugge and Jette<sup>2</sup>. Most models of the disablement process begin with disease or pathology, though bio-gerontologists may consider there are molecular or cellular changes that precede disease. The process then moves through impairment and functional limitation, such as visual, hearing, and cognitive impairment at the body level, which then results in restrictions in daily activities for instance dressing and eating. Restrictions in these essential personal care activities rapidly result in a need for long-term care.

*“Such models of successful or healthy ageing have too often been created by researchers with no input from older people themselves, and we need to know how older people define success in ageing.”*

### Main factors

External factors impact the disablement process, as do risk factors and predisposing, socio-demographic and lifestyle factors. These might include an individual’s personal factors, such as changes in lifestyle (e.g., taking up exercise), or one’s abilities to cope with, adapt to or accommodate change, with the result that one might take longer to do something or not do it as often.

We will look at each of these factors, but first let’s return briefly to disease and consider how disabling particular diseases are and whether in a climate of ageing populations we are investing research money in the right diseases.

> TODAY, RESEARCH FUNDING AIMS AT THE MAIN CAUSES OF MORTALITY (CANCER AND CARDIOVASCULAR DISEASE) RATHER THAN DISABLING ILLNESS (ARTHRITIS AND DEMENTIA)

Figure 2: Comparison of disabling impact in terms of Disability Adjusted Life Years (DALYs) and the proportion of money spent on research for selected health conditions

Source: Health Research Analysis, UKCRC (United Kingdom Clinical Research Centre), 2006.  
 Estimated DALYs for United Kingdom 2002 (WHO Global Burden of Disease Project)  
 Note: Data excludes R&D support for NHS providers, funded by the UK Health Departments, core support costs and research taking place outside the UK.

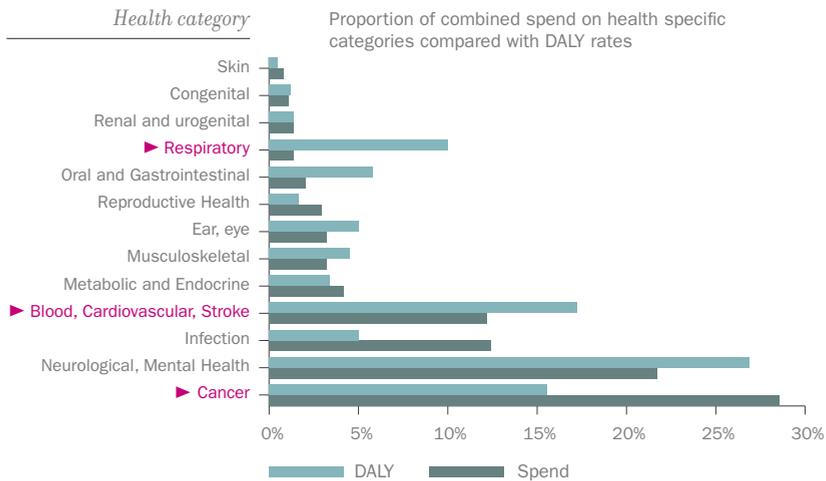
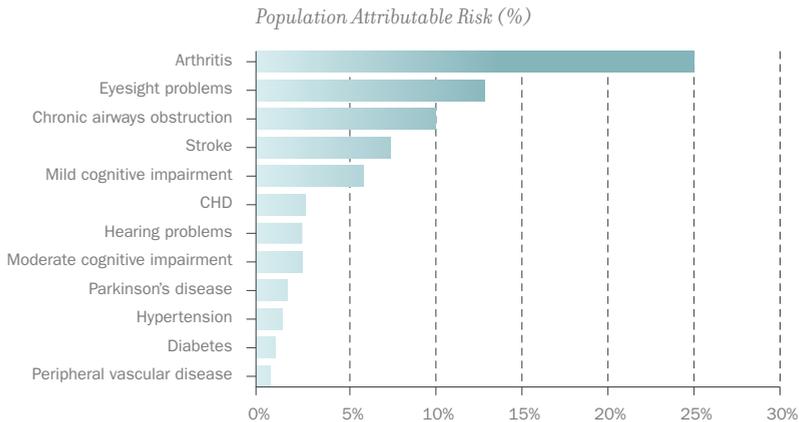


Figure 2 highlights the relatively small spend on research into some conditions, like respiratory disease, despite their large impact in terms of disability and mortality. For example, compare stroke and cancer. Both have rather similar disability-adjusted life years (DALYs), but the research spend on stroke is much lower than on cancer. That picture might well differ between countries, which could account for the differences we see in life expectancy and disability-free life expectancy. It would be interesting to see how much research spending for different diseases contributes to the differences that we see between countries.

The DALYs shown in Figure 2 were for all ages, but is the disabling impact of diseases the same at older ages?

**Figure 3: Population-attributable risk of disability for specific diseases for the 65+ population**

Source: MRC CEAS (Medical Research Council Cognitive Function and Ageing Study).



The population-attributable risk of disability, or in other words, the disability attributed to different diseases for the population aged 65 and over, takes into account not just the disabling effect of a disease, but also its prevalence. This is the reason why musculoskeletal diseases, like arthritis, have a very high attributable risk (25%), because of their very high prevalence (e.g., over 50% of 85-year-olds have some form of musculoskeletal disease). Eyesight problems have the next largest impact in terms of population-attributable risk, but from Figure 2 both have relatively small research spends. It may be therefore that this balance should be addressed if we want to resolve some of the issues about disabling disease.

## > THE STAKES IN PROVIDING MEDICAL CARE WHICH DELAYS THE ONSET OF DISABILITY

As indicated earlier, there are factors that impact the progression of a disease to disability, including technology, outside support structures, environment, building access and, of course, medical care. Let us focus on the latter as this is a particular concern with the growing numbers of the oldest old. Although disease prevention is a worthy goal, we have to be able to manage the oldest people who have multiple diseases and conditions. If an older person has four or five diagnosed conditions, some of those may be treated by the general practitioner, but others may require referral to specialist outpatient clinics. This may well entail multiple visits to hospital in order to see separate specialists, which may not only be tiring for the older person but makes it difficult for a holistic approach. In Newcastle this is being addressed by special clinics, called Cresta clinics, where older patients with multiple conditions that commonly occur together can see all the specialists in one visit. The specialists review each case together, and discuss the best course of treatment. This may hopefully move targets towards slowing the onset of disability (or of its progression) as well as disease prevention which tends to be the focus now.

Now, let us move on to the effect on disability progression of predisposing factors and intra-individual factors, such as making lifestyle changes. There is good evidence that diet, exercise and social interaction are important factors for healthy ageing though, in some cases, we do not fully understand the underlying mechanisms. Moreover, most interventions are not trialled on the oldest old and may not be suitable, although in many cases we have little idea of whether lifestyle changes are best taken up in mid-life or can be taken up with the same effect in later life.

Finally there is no doubt that socioeconomic factors, such as education, wealth and social advantage, are not only main players in the disablement process, but also these factors can inhibit a change in lifestyle or a strategy to compensate for failing function.

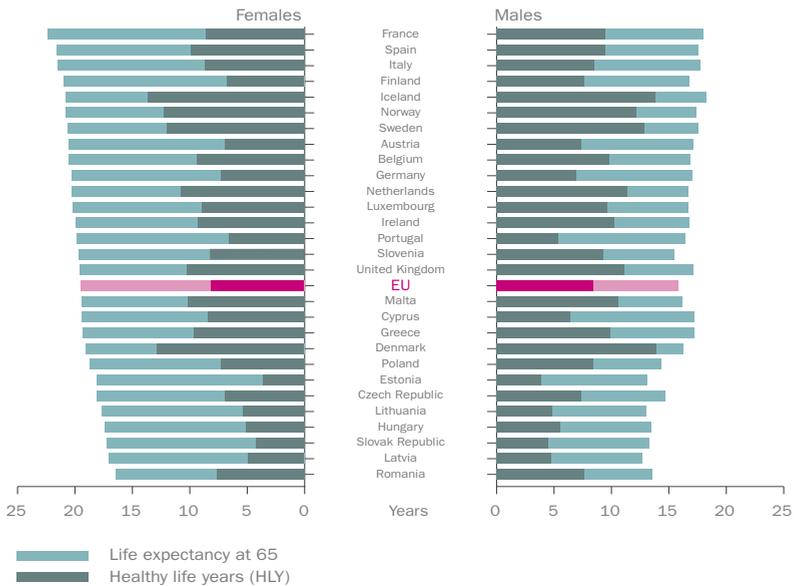
## REDUCE INEQUALITY BY FOCUSING EFFORTS ON UNDERPRIVILEGED POPULATIONS

This leads to the fact that we, as countries, could extend life in good health overall if we started to resolve some of the huge inequalities between our countries.

Regarding the relationship between the EU structural indicator, Healthy Life Years (HLYs) and life expectancy at age 65 (cf. Figure 4), two points are noteworthy. First, the relationship between the longest life and the most HLYs is not perfect. Countries with the longest life expectancy at 65 are not necessarily those which have the most HLYs.

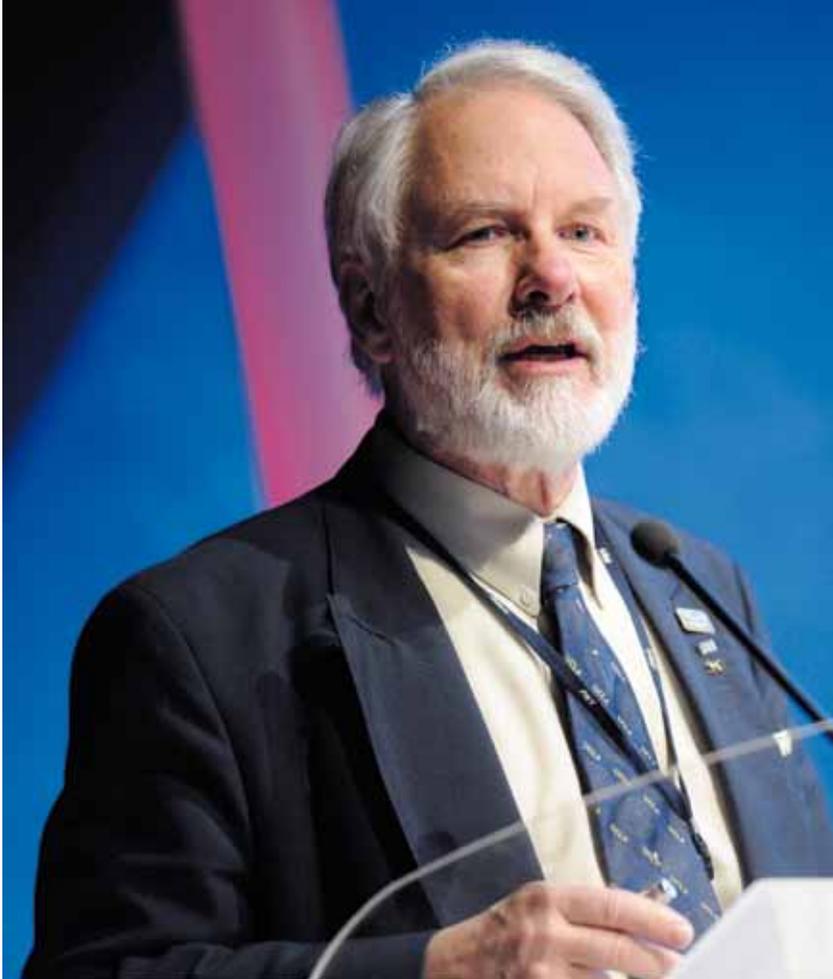
### Figure 4: Healthy Life Years (HLY) at age 65 for men and women by European country

The number of years in good health (or Healthy Life Years—HLYs) is calculated according to the indicator, defined by the EU. Source: OECD Health at a Glance 2009.



However, what is very noticeable is that most Eastern European countries have the shortest lives and the fewest healthy years. Not only are these inequalities evident between countries, but gaps of the same magnitude can be seen in Newcastle and within other countries.

Policies aiming at extending healthy life should recognise the need to do this in relation to increases in life expectancy. Ideally, targets should aim to reduce unhealthy years, although this may have a more negative connotation. However, just increasing healthy life years is not enough. Most of the risk factors for diseases also play a part in accelerating the progression of disability. Although this might be a good starting point, there needs to be a better understanding of the mechanisms operating between diet, exercise, social integration, disability and longevity. We need to know whether changes are still beneficial in late old age and how to design interventions, appropriate for all age groups. Inequalities also need addressing, which may mean targeting specific hard-to-reach groups. An emerging challenge with the growing numbers of the oldest old will be to deliver healthcare in new ways to this age group with its high level of multiple diseases, in order to ensure that they too maintain high levels of wellbeing and quality of life.



Pr. L. Stephen Coles, M.D., Ph.D.

*Doctor of Medicine and Mathematics, and Director of the Super Centenarian Research Foundation (USA)*

**Pr. L. Stephen Coles is a specialist in tracking human super centenarians (defined as persons aged 110 or older). It has been established that their extreme longevity is inherited from their parents and shared to some extent by their siblings. He is now seeking to identify their longevity-determining genes by performing a complete DNA sequence in the laboratory. In 2006, he co-founded the Supercentenarian Research Foundation (SRF) with the aim of sequencing human DNA. He is currently a lecturer at the Molecular Biology Institute within the University of California, Los Angeles (UCLA).**

1. Coles, L.S., Fahy, G.M., Harris, S.B. and West, M.D., Editors, 2010. *The Future of Aging, Pathways to Human Life Extension* (Springer, New York).
2. Misteli, T. and Spector, D.L., Editors, 2011. *The Nucleus: Cold Spring Harbor Perspectives in Biology* (New York).

# IS THERE AN UPPER LIMIT TO HUMAN LONGEVITY?

By Pr. L. Stephen Coles

*“Of the 22,000 genes in the human genome, the question is whether a special group determines longevity?”*

As we are certain to witness soon enough, the general public is vastly ignorant regarding the issue of longevity and what will happen to the fixed age of retirement in the coming decades. In fact, this ignorance is so widespread that everybody living today who imagines that they will retire at age 65 (or even sooner) is sure to be disappointed. I do not believe that age 65 is a realistic age. We are looking at the data, and it is very clear that 65 will not be sustainable as average life expectancy continues to rise and a smaller cohort will be asked to finance the retirement of a much larger one. To begin, I wish to discuss the research that I conducted with laboratory mice at UCLA more than two decades ago. Someone pointed out to me that humans are not just “big mice,” or conversely mice are not just “little humans,” even though we share the majority of our genes. For example, our lifespans are very different. So, we really need to study people, not mice, to understand human ageing. Thus, about 15 years ago, I began looking at the most extreme example of human longevity that we know about—the oldest old—those who are called super centenarians (persons 110 years or older). I like to begin a discussion with my undergraduate students at UCLA by comparing professional gerontologists with the blind men in an ancient Indian proverb—“The six blind men touching different parts of an elephant.” The first touches the tail and thinks an elephant must look like a snake. Another touches the tusk and thinks an elephant is hard like a rock, and so on. Today’s researchers in ageing are essentially saying the same kind of thing—that ageing is defined by the molecular biology of mitochondria or whatever. But others say it’s in the telomeres, and so on and so on. Obviously, the mechanisms of ageing are not very well understood at present, although we have made enormous advances with each passing year.

## BIOLOGY’S IGNORANCE OF THE AGEING PROCESS REMAINS IMMENSE

So, we are still in the “alchemy stage” of chemistry—like scientists in ancient Europe 300-400 years ago—long before Mendeleev and the discovery of The Periodic Table or the Elements, when chemistry evolved into a true science. I and three of my colleagues co-edited a book, called *The Future of Ageing* (860 pages), published back in November 2010<sup>1</sup>, and sadly it’s already obsolete. I read a 517-page textbook on the plane from Los Angeles to Paris called *The Nucleus*.<sup>2</sup> I learned enormous numbers of

3. **Rectangularization** is the squaring of a longevity curve so that, in the limit, all individuals from a particular cohort continue to live without any of them dying until they all die abruptly on the same day.

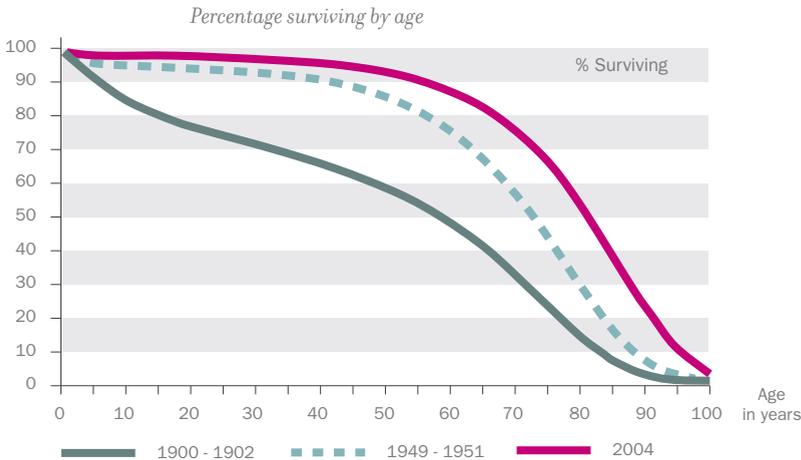
> new facts from the editors of this book, a team at Cold Spring Harbor in New York, where Pr. James Watson, the Nobel Prize winner, has worked for many years. I cannot believe the progress that has been made in the biology of ageing, but our ignorance is still enormous.

### A SCENARIO FOR THE RECTANGULARIZATION OF LONGEVITY

Going back to ancient history, 2.5 million years ago, there was a very stable number of our primate ancestors, a situation which lasted only until very recently. There were several occasions during which Homo sapiens nearly became extinct as a species. That changed with the discovery of agriculture. From this period up until now, we have witnessed a progressive increase in life expectancy, as Pr. James Vaupel explained. Nevertheless, looking at the longevity curves from the 1900s until the present time in the US (cf. Figure 1), we can see a right shift in what we called the rectangularization<sup>3</sup> of longevity. Nevertheless, there has not been a shift in terms of the maximum lifespan for our species. That means something is going on as you hit 110, 112 or 114, which is a little different.

Figure 1: Rectangularization of US longevity over one century (1900 - 1950 - 2004)

Source: data from NVSS (National Vital Statistics System) Report, CDC (Centers for Disease Control and Prevention), 2007.



The projected number of centenarians is rising exponentially, but the numbers of super centenarians does not appear to be rising in the same way. Indeed, today, the total number of super centenarians worldwide is only 89. That number increased by 1 to 90 just before my coming here, because we identified a new Italian case. Thus, the actual number should be 90. However, what is even more remarkable is that the number of super centenarian women is more than 10 times the number of men. That is still a mystery. We do not have a clear explanation for why that is. There was a hypothesis that it had to do with estrogens, since that is the distinguishing hormone of women, but I suspect that since all of them had been post-menopausal for so many decades, this may not be the case. It may have something to do with the fact that the “female advantage” is related to their two X chromosomes, but even that explanation may not be adequate. We have many more PhD-theses to go before deciphering this mystery.

### 122 YEARS: THE RECORD FOR LONGEVITY IS STILL HELD BY A FRENCHWOMAN, JEANNE CALMENT (DIED 1997)

Nevertheless, the mortality rate on hitting 110 is about 50%. It is like flipping a coin as to whether you will even live 1 more year. Therefore, those people are a precious resource, and we need to act quickly to understand what their secret is or they'll be gone forever. One way to do that is to study them directly, to go and interview them and, of course, the most famous example is the Guinness Book of Records record-holder, the Frenchwoman Jeanne-Louise Calment. She stopped smoking at 120, because she could no longer light her own cigarettes. Indeed, she was both a pretty heavy smoker and drinker. Despite those bad habits, she was an extreme outlier who lived to 122 years and 164 days.

Jack Lalanne died just about a month ago at age 96. We thought he would certainly become a centenarian, because he had the healthiest lifestyle possible. He not only exercised every day, even when in the hospital with pneumonia, but he has also taught people all his life about how to live so long. Next, David Murdoch, an American billionaire, has started to invite people to his anticipated 125<sup>th</sup> birthday party, because he believes he will break the Calment record. That limit has not been exceeded by anybody in England, Spain, Italy, or Sweden.

### THE DIFFICULTY IN MAKING PROJECTIONS OF IMPROVED MORTALITY IN EXTREME OLD AGE

Next, I had to look at some of the gerontological data from model organisms to understand mortality rates as a function of age. In the case of fruit flies (*Drosophila*), mortality rates appear to plateau with age. Could that be true for human beings as well? If you managed to live long enough, maybe the mortality rate would become at least stable, if not zero.

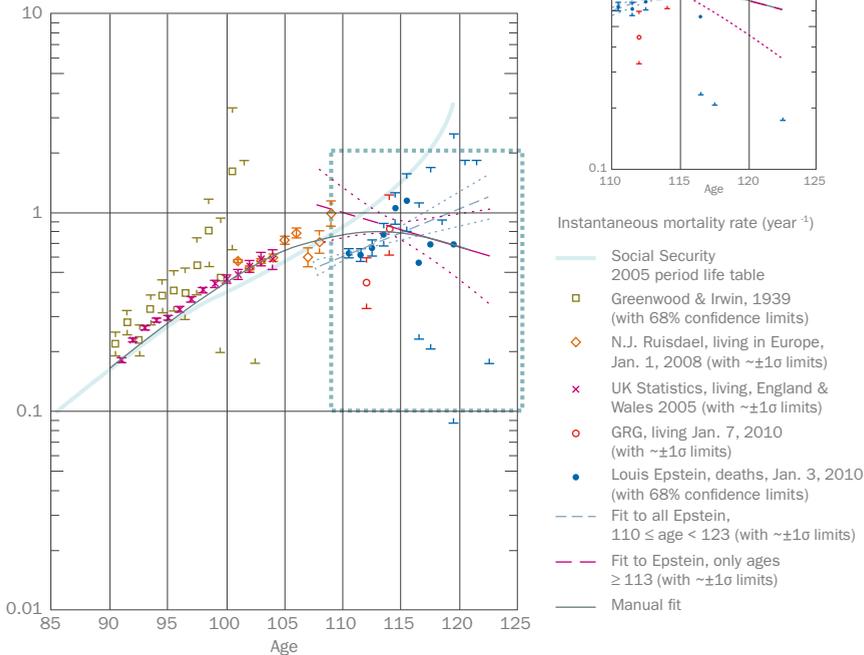
4. Mueller, L.D., Rauser, C.L. and Rose, M.R. June 2011. *Does Aging Stop?* (Oxford University Press, New York).

5. The instantaneous mortality rate in any year is a measure of the risk of an individual dying before the next year.

> Plotting human mortality at extreme ages reveals a blizzard of data (cf. Figure 2). So many things are going on simultaneously, and one cannot make immediate sense of them at these extreme ages. However, as of April last year, one thing to observe is that mortality rates went up from 50% to something in the order of 72%, before there was too much statistical noise to allow us to make sound judgements. Therefore, mortality rates still appear to be rising for humans and not plateauing as in the case of flies, where there may be a heterogeneous mix of different genotypes. One of our colleagues from UC Irvine has suggested that human mortality does plateau in a new book to be published by Oxford University Press<sup>4</sup>.

Figure 2: Estimates of the Instantaneous Mortality Rate<sup>5</sup> as a Function of Age between 85 and 125

Source: Gennery, D.B. Biostatistician at the Jet Propulsion Laboratory (January 19, 2010).



We have to distinguish between potential longevity, determined by our genes and by our lifestyles. There are many ways to die prematurely, such as “being hit by a truck,” but of the approximately 22,000 genes in the human genome, the question is whether a special subset of genes determines our maximum longevity. Over the last 15 years,

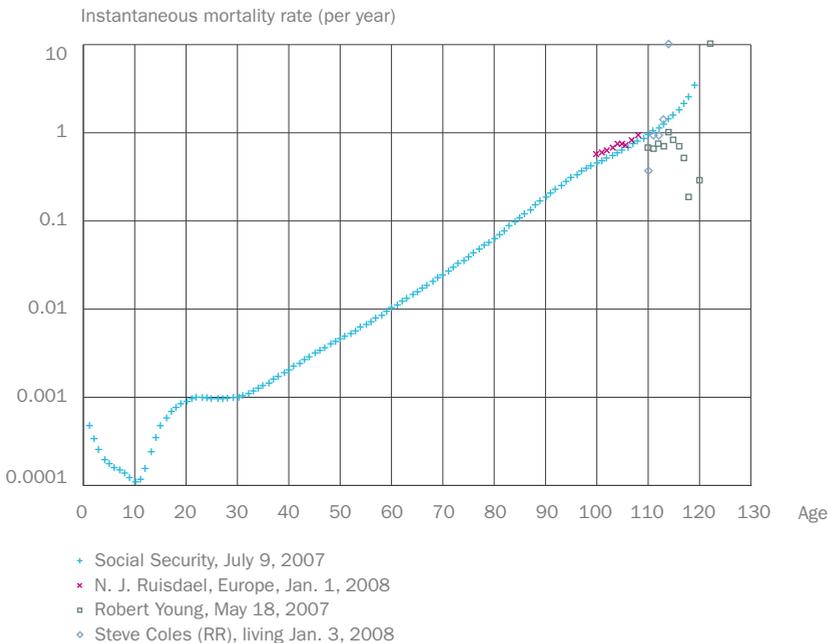
**6. The instantaneous mortality rate**  
in any year is a measure of the risk of an individual dying before the next year.

I discovered while interviewing between 30 and 40 of those individuals that they had virtually nothing in common: They had different occupations, different lifestyles, different religions, you name it, but the one thing I noticed in their family histories was that they all had long-lived relatives. Their parents and siblings were long-lived and probably their children will be long-lived as well.

The ratio of females to males is about 10:1 in the super centenarian category, and it gets even more extreme as one passes 115. Looking at the graphs for survival and longevity, one can attempt to project extrapolations of where the numbers may go; but to see them more clearly, it is better to look at mortality rates. We see them rise exponentially in absolute numbers. However, demographers and actuaries, in order to visualize them better, tend to use a semi-log plot (cf. Figure 3), where it appears to be a straight line with a well defined slope, but at the extreme, it is very difficult to see whether it will go straight up, will plateau, or possibly go down. The biostatisticians in our group believe that the numbers are too few to make an informed judgement at the fringe (what is called “statistically significant conclusions”).

**Figure 3: Instantaneous Mortality Rate<sup>6</sup>**

Source: Plot produced by Gennery, D.B. March 2011.



## > THE NUMBER OF SUPER CENTENARIANS SEEMS TO HAVE REACHED A PLATEAU

We have seen the numbers of super centenarians, including the Guinness Book of Records record-holder, increase throughout history. The oldest person known in 1857 was 111. The Book of Genesis in the Old Testament teaches that Methuselah—the oldest person cited in the Bible—was 969 years old when he died, but we were not around at that time to validate his claim. Jeanne Calment is still our modern-day record-holder, as of her death in 1997. I must say that nobody has come even close to her extreme age over the last 14 years. So we refer to 122 as the “Calment Limit” for human longevity.

Going to the year 2000, in fact, the graph for the absolute number of super centenarians appears to plateau. We have not seen the number of super centenarians exceeding 94 for 3 or 4 years. We are getting a little closer to 90 at this time, but it still looks as if there is a plateau in terms of the total number of super centenarians.

I performed a number of autopsies at UCLA and Stanford in order to better understand the true cause of death for these individuals. So far, we have done nine autopsies of super centenarians, though there are a couple of 101-year-old youngsters among them. The diagnoses as to the primary cause of death in the pathology reports were that they had in common a disease called TTR Amyloidosis. Transthyretin (or TTR) is a native protein in the body, synthesized in the liver, which transports thyroid hormone from the gland in your neck to all the cells in your body (approximately 50 trillion cells in an adult body). Thyroxine helps to calibrate your body temperature to 98.6 degrees Fahrenheit unless of course you have a fever. Recall that body temperature has a normal diurnal rhythm throughout the day from the time you wake up to the time you go to sleep. A couple of our subjects died of pneumonia, but seven or eight of the nine had TTR Amyloidosis as a common diagnosis.

We would like to know more about this disease process, which appears to increase exponentially with age in ordinary people, but usually as an incidental finding, not a common cause of death. Rarely, it can in some circumstances, be a premature cause of death, for instance, in the event of a sporadic mutation in the gene that synthesizes the protein. But there is no cure for this disease. Even if you manage to escape from all the traditional causes of death that are written on death certificates (heart disease, cancer, stroke, chronic obstructive pulmonary disease, Alzheimer’s Disease and so on) there is still another disease waiting to take you out of the population, so to speak. Therefore, the SRF has taken the study of Amyloidosis upon itself with the help of the SENS Foundation. Our aim is to find a cure in the form of a specific antibody against this mis-folded, sticky protein. If and when we do, it is very possible that super centenarians would be able to live even longer, healthier lives, given the opportunity.

Let me conclude with the sweeping summary that we have seen a systematic increase in average life expectancy over the history of the human race (over the last 200,000 years)—since hunter/gatherer times when life expectancy was only around 18 to present day, in the 80s. In the future, we hope for an increase that we might call a “Biological Longevity Escape Velocity.” In such a case, we would gain 1 year or more of additional life expectancy with each passing year. This notion was first introduced by Dr. Aubrey de Grey, one of our colleagues in Cambridge, England. Presently, we gain just 3 months per year every year. The time for the transition to “escape velocity” is sometimes referred to as “The Singularity” (by futurist Ray Kurzweil). Hopefully, we will be around in the year 2038 to witness the singularity in person. But we will need a “bridge plan” to get us there, as we may not be endowed with the lucky genes that our super centenarian subjects share. Therefore, we cannot afford to smoke or drink heavily as some of these folk have done over their lifetimes. The Bridge Plan involves doing exercise and certainly not smoking or indulging in heavy drinking. Rather, we must take our vitamin supplements, get plenty of rest at night, and keep ourselves intellectually stimulated by playing games or solving puzzles, or even by attending this conference.

*“Interviewing 30-40 of those super centenarians, I discovered that they had virtually nothing in common. They had different occupations, lifestyles, religions and so on. But the one thing I noticed in their family histories was that they all had long-lived relatives.”*



# MAINTAINING SOCIAL TIES

*And what if we all felt  
concerned about longevity?*

## INTRODUCTION

# AND WHAT IF WE ALL FELT CONCERNED ABOUT LONGEVITY?

For society in general, there is a responsibility both to navigate the transition to a new social order successfully and to ensure everyone has the right to age in dignity. Innovation is at the heart of a solution to these challenges, not only in terms of public policy but also for new technologies which will know how to adapt to all ages, enable everyone to maintain his or her social ties and foster intergenerational cohesion.

For each of us, ageing in good health is one of the main challenges, posed by longevity.

Françoise Forette (cf. paper on page 108) is a doctor of medicine, specialised in risk factors for dependency, associated with ageing. She lays out the crucial role of preventive medicine and regular activity throughout one's life, as a way to reduce socioeconomic inequality which persists for many diseases, associated with ageing.

Today, home automation is emerging as one possible response to society's challenges in helping seniors to continue living at home, thanks to its functionalities, which enhance comfort and risk prevention in the home, and in the near future, remote medical monitoring.

Pascal Brosset (cf. paper on page 116), director of innovation at Schneider Electric, explains why falling home-automation equipment costs, combined with future regulatory developments in favour of keeping the elderly at home, are set to contribute to easing access to these new technologies.

In France in 2010, 31% of the over 65 have surfed the internet, during the last month, compared with 4% in 2001.

Yseulys Costes (cf. paper on page 122) is a specialist in social networks and viral marketing. She analyses the spectacular acceleration in the adoption for new technologies by the over 60 and the emergence of the Web, as a new tool to help maintain social ties for the baby boomer generation.



### Dr. Françoise Forette

*M.D., university professor at Cochin teaching hospital (French: CHU) and at the University of Paris (Descartes)*

*President of the International Longevity Center in France*

***Dr. Forette is also president of the French society for geriatrics and gerontology (French: Société française de Gériatrie et Gérontologie). Her main fields of practice cover epidemiology, the prevention and treatment of Alzheimer's disease, high blood pressure in the elderly, and risk factors in dementia. She is also interested in healthcare systems and how they deal with the elderly, their place in society and the impact of being employed on longevity.***

*This paper is drawn from the transcript of a speech by Dr. Françoise Forette at the Global Forum for Longevity. Dr. Forette reserves the right to make any amendments which she feels necessary. You can consult her complete speech in a video at [www.longevity.axa.com](http://www.longevity.axa.com).*

# PROMOTING HEALTH AND ACTIVE LIFESTYLES TO REDUCE INEQUALITY

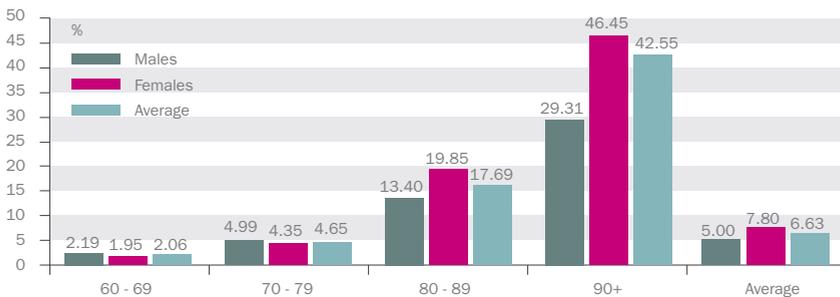
By Dr. Françoise Forette

*“What counts most in prevention is that it is never too early and never too late.”*

In France, the population of the over-80 is set to double between 2010 and 2050. The same can be said for the rest of Europe as well as for other developed countries. In certain countries, their number is even going to triple. Having said that, it is at 80 that one sees an increase in the prevalence of diseases which correlate with age and which in most cases lead to “dependency,” which is to say the loss of independence, because of disabilities resulting from certain of these illnesses. The problem which we face, due to the revolution in increasing longevity, is how to maintain these people in good health, active and fully part of society. Only then, will the absolutely fabulous increase in life expectancy remain an achievement. Consequently, two major goals arise: the promotion of good health, thanks to prevention, as other experts clearly agree, and the promotion of active lifestyles, which is probably just as important.

## French people and dependency, correlated with debilitating diseases

Source: Insee, HID Study (Handicap Incapacités Dépendances), GIR 1-4.



Overall, the ageing French population is in rather good health, if one just looks at figures which measure the dependency rate, which is to say the loss of independence, correlated with disabling illnesses. Some 93% of the population over 60 is “independent,” in “good health” and that despite the large number of diseases which often afflict them (five or six diseases, starting at 80). Obviously, dependency is going to rise with age, but it is only a problem for less than 20% of the population until the age of 90. Even beyond 90, 70% of men remain independent.



1. Insee Première no. 1025, June 2005.
2. Birth records and estimates for local populations, Insee 2005.

## > NUMEROUS INSTANCES OF INEQUALITY PERSIST BETWEEN AND WITHIN COUNTRIES

In France, like in most European countries, the advance to date in average life expectancy has been constant. It is also interesting to note that the difference between men and women has slightly diminished (cf. Figure 1). Projections show that in 2050, life expectancy for women should be around 90 years. However nothing is less sure, because the increase in average life expectancy correlates with the socioeconomic status of individuals and therefore, access to healthcare. Moreover in certain countries, like Russia for example, one notes that average life expectancy is declining (cf. Figure 2), impacted by an increase in mortality (cf. Figure 3).

Even within the borders of a single country, very strong instances of inequality persist. In France<sup>1</sup>, men 35 years old have an average life expectancy which varies by up to 7 years according to whether they are white-collar workers, which is to say part of the upper echelons of the socio-professional world (with 46 years of life expectancy), or blue-collar workers (with just 39 years of life expectancy), which is absolutely unacceptable. Among women of the same age, the difference is 3 years. The region in which one lives also has an influence on one's life expectancy. For instance, there is a difference of practically 5 years of life expectancy at birth between people who live in the Ile-de-France region and those who live in the Nord-Pas-de-Calais region<sup>2</sup>. Finally, one's level of academic achievement also plays a role. Still in France, one can compare mortality rates, depending on level of education (cf. Figure 4). One sees that men who have no diplomas evidence a mortality rate two and a half times greater than for those who have completed university studies. This flagrant cause of inequality is all the more terrifying when one knows that in France, 20% of children 10-12 years old do not know how to read correctly on entering middle school – a major risk factor in providing access to culture, employment and healthcare.

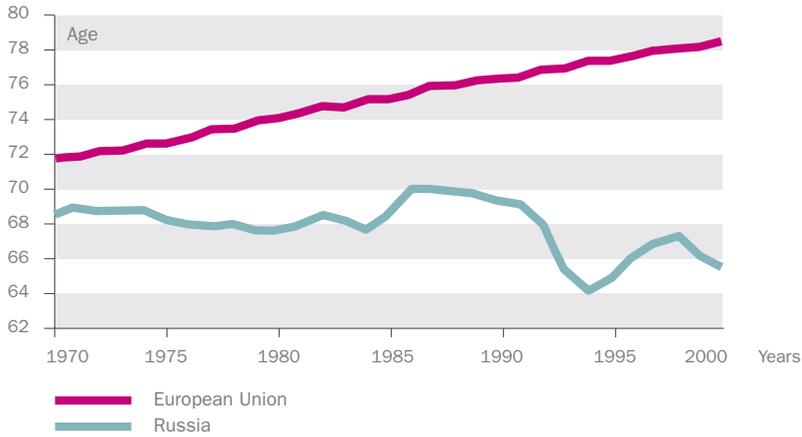
### Figure 1: In France, where life expectancy continues to increase, the difference between men and women still exists, even if it is tending to narrow.

Source: "World Population Prospects: The 2008 Revision", Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. <http://esa.un.org>

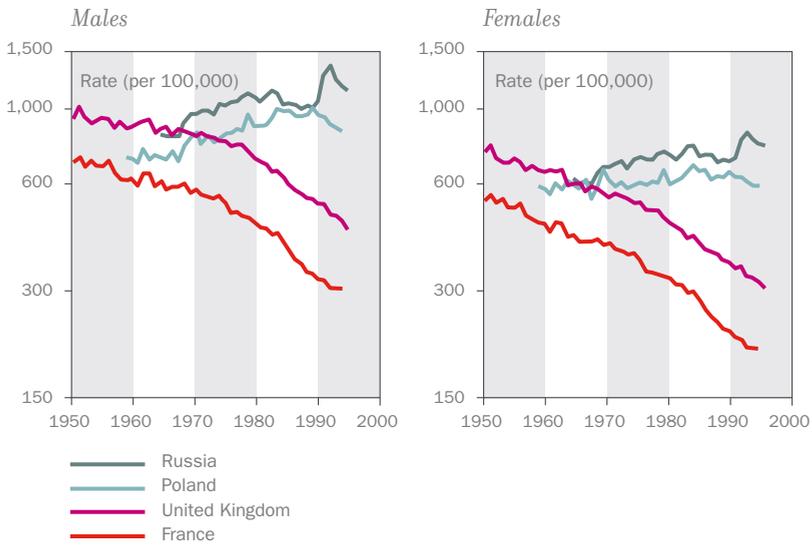


Figures 2 and 3: In Russia, average life expectancy is declining, because of an increase in mortality.

Source: Science, 2006. Vol. 311 (5758): 155.

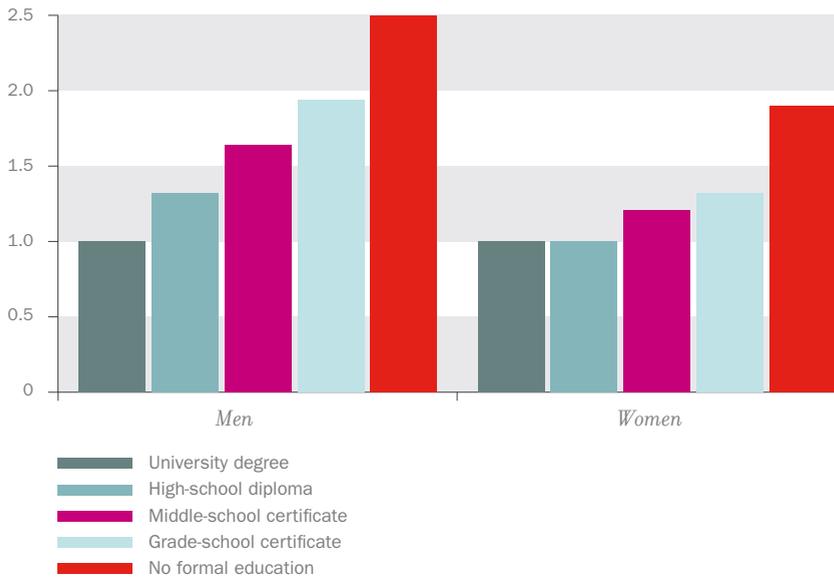


Source: Vallin, J., Mellé, F., Ined 2002.



> **Figure 4: Level of education impacts strongly on mortality rates (e.g., France).**

Source: Report of the French high commission for public health (French: HCSP) on social inequality and access to healthcare: an end to fatalism – December 2009.



*“In France, 20% of children 10-12 years old do not know how to read correctly on entering middle school – a major risk factor in providing access to culture, employment and healthcare.”*

## THREE TARGETS FOR PREVENTION TO CORRECT FOR INEQUALITY

In order to increase average life expectancy in good health for all categories of the population, one must correct for inequality, mainly through prevention. Prevention has to target three issues: (1) diseases, correlated with age; (2) what is commonly known as “frailty,” a recently described syndrome; and (3) inactive lifestyles.

### Age-related diseases

It is clear that most age-related diseases (note that I voluntarily exclude Alzheimer’s from the list) correlate with “modifiable” risk factors and thus can be targeted by prevention. What counts most is that it is never too early and never too late. Too early? It is before the age of 20 that a person builds his or her skeletal structure. Too late? If one treats high blood pressure in the over 80, a very interesting study (called HYVET) recently found that after 80 one can reduce mortality by 40% and the incidence of stroke by 30%. Moreover, today’s medical advances will surely boost the benefits of prevention even further.

Prevention in this case does not have to mean pharmaceutical treatments for high blood pressure. More essentially speaking, there is also lifestyle. However, it is important to know that adopting an appropriate lifestyle basically depends (and this is the heart of the matter) on level of education, which is why it is important to provide advice on prevention to segments of the population who are particularly at risk.

### Obesity

One sees that out of the major risk factors, which are best known, obesity and inactivity are particularly worrisome. About obesity, no country is spared the spectre of this phenomenon. One sees that the US is certainly the hardest-hit, but one also sees that France, which is about average, is subject as well to a steady annual increase in the level of obesity. However once again, prevention has a role to play, since certain measures taken in France to combat childhood obesity in schools have had a salutary effect and one now sees children’s weight problems decreasing.

So who are the key players in prevention? School of course. And it has been proven that measures taken at school are effective. The workplace is probably another (because who wants to go to a website about prevention during the weekend, even the magnificent website, curated by French national institute for prevention and health education INPES). It is clear that prevention requires taking the fight to where people spend the majority of their time.

Programmes for prevention have to be put in place by companies, on their premises and during working hours. That is the only way to be sure of reaching the categories of the population who (for the moment) are completely passed over by advice on prevention.

> We have at the International Longevity Center, in France, a research project with the aim of trying to determine if a preventive programme, implemented by a company in the workplace can, first of all, improve the health culture of co-workers, and second, actually change their behaviours.

We all see that corporate image could often be better and that if we want the majority of people to work longer (which is preferable for many reasons including medical ones), then people must be happy at work. So maybe (as we have proposed to public authorities) it is time to put labels on companies. One label might be the “good health” label of corporate responsibility for companies that put into place preventive programmes for their co-workers.

### Frailty

Frailty is a recently-described health syndrome, which affects nearly 10% of the very elderly population, but it is not yet clear whether frailty is in fact a constructed syndrome. It is a physiological state of acute vulnerability, exacerbated by stress, which makes an independent person become dependent, for instance, after a hip fracture. The criteria for onset are well understood. The problem is whether it is reversible. One can treat certain symptoms (sarcopenia, osteoporosis, etc.). That is to say to what point this segment of the population, often extremely elderly and frail, have to become a priority target for prevention.

*“Mental activity, leisure activity, and pretty much all sorts of activity reduce mortality, but perhaps more than the rest, professional activity.”*

### Inactive lifestyles

A typically French phenomenon is when one sees diverging trend lines for a regular and continuous increase in average life expectancy, accompanied by a dropping age for entering into retirement. Often the French tell me, “It’s great. Scientists have proven something that is absolutely fundamental: the less you work, the longer you live.” And I tell them, “No, look at it this way: those who are unemployed, but not retired, have a mortality rate nearly three times higher than working people.” However, when one is unemployed, it is often for reasons of ill health, but even when that bias is taken into account in the analysis, one still detects an increase in mortality for inactive people.

Every kind of activity may reduce mortality, while also improving cognitive health. Yet, it is extremely difficult to prevent a cognitive deficit. Mental activity, leisure activity, and pretty much all sorts of activity reduce mortality, but professional activity is probably best at it.

A very large number of studies have shown that education correlates positively with mental health at an advanced age<sup>3</sup>. Having said that, education has no influence on lesions, caused by Alzheimer's disease in the brain. However, it does slow down the appearance of clinical symptoms for the disease<sup>4</sup>. This is particularly vital and is the basis of the concept of cognitive reserves<sup>5</sup>.

Leisure activity is also promising and seems to diminish the prevalence and incidence of Alzheimer's disease<sup>6</sup>. Social activities<sup>7</sup>, by the same token, reduce mortality and reduce the risk of symptoms appearing for Alzheimer's. However and perhaps even more interesting, recent studies have shown a very significant effect which results from postponing retirement. When one continues to work, each added year delays the onset of Alzheimer's by 0.13 years<sup>8</sup>. That is a fundamental fact which needs further confirmation; the findings were from only surveying 400 people. However, those were also the findings of a meta-analysis, combining two larger studies: (1) the Health and Retirement Study, conducted in the US between 1998 and 2006, and (2) a study, called Survey of Health, Ageing and Retirement in Europe (a.k.a. SHARE). Researchers Eric Bonsang and Stéphane Adam<sup>9</sup> have shown a significant, comparable effect for retirement age on cognition.

What is important is that results are comparable between Europe and the US. Therefore, it is clear that the promotion of working seniors not only has an important effect in supporting social security systems, especially the French one which is a pay-as-you-go system, but also can push back the age of disability and so might even reduce the healthcare cost burden.

We need to set in motion a "virtuous spiral," where education—and that is where it all starts—can drive prevention. Prevention promotes health; health leads to longevity; longevity goes hand in hand with work; and work is the key to prosperity. Full circle, prosperity feeds into education. And I hope that all of us will be able to benefit.

3. Bennet 2003, Bruander 2008, Katzman 1993...

4. Letenneur 1999, Snowdown 1996, Stern 1994.

5. Nithianantharajah, J., *Prog Neurobiol.* 2009: the concept of a cognitive reserve has been offered to explain epidemiological data indicating that people having intensive physical and intellectual activities present less risk of developing cognitive disorders, such as Alzheimer's or other forms of dementia.

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8. Lupton, M.K. et al. 2010. *International Journal of Geriatric Psychiatry* 25 (1): 30-6.

9. Bonsang E., Adam, S., Perelman, S., Research Centre for Education and the Labour Market – Maastricht University – ROA-RM-2010/1, February 2010. "Does Retirement Affect Cognitive Functioning?"



## Pascal Brosset

*Director of Innovation at Schneider Electric<sup>1</sup> (France)*

**Engineer and graduate of the Swiss Federal Institute of Technology of Lausanne (Switzerland), Pascal Brosset joined Schneider Electric in May 2010 as its Director of Innovation.**

1. Schneider Electric, a world specialist in energy management, is present in more than 100 countries. It has leading positions in several sectors, particularly in infrastructure, industrial processes and building automation from which it also develops home automation solutions.

# HOME AUTOMATION: A KEY FACTOR IN HELPING SENIORS STAY AT HOME

By Pascal Brosset

*“Relatively simple technology becoming widely available will enable the elderly to maintain their independence longer.”*

At the risk of disappointing, allow me to begin my talk by putting technology into the right perspective. The day is not near when a robot will take over from us in caring for our parents, which is how it should be. Contrarily, relatively simple technology becoming widely available will enable the elderly to maintain their independence longer and, above all, foster ties that are both reassuring and intellectually stimulating for all concerned. The whole range of these technologies is grouped under the heading “home automation,” a fast-changing business.

## THE GROWING ROLE OF TECHNOLOGY

Let's take a closer look at robotics. If one takes as an example a “vacuuming robot,” already able to get around furniture, it will not be long before a machine can move about in complex spaces. Issues of homecare aside, we can certainly hope for much more from artificial intelligence. The recent victory of an IBM programme that plays the game of Jeopardy marks the passing of computers from structured problems, such as playing chess, to fields of application much closer to day-to-day living, such as the capacity to carry on a conversation. Combined with the capacity to track in real time the actions of an individual, those abilities offer very interesting possibilities for personal care-giving, which is a topic I want to come back to.

Home automation has more modest ambitions, like easing and extending the use of our living space through combining various technologies, and soon robotics. Today's tasks are pretty simple, such as opening and closing the sun-blinds or ventilation that keeps the air fresh. Despite that simplicity, it was just recently that one had to be Bill Gates in order to afford those products and solutions, for two reasons: (1) you had to be rich, because it was expensive and (2) one had to have extraordinary intelligence, because it was hard to use.

> **HOME AUTOMATION IS BECOMING WIDELY AVAILABLE**

The state of affairs is changing and a radical drop in the costs of functions, such as video, offers numerous possibilities. Only a few years ago, if one wanted to install a video camera to keep tabs on someone from a distance, it was either impossible, or extremely costly. It would have cost about 1,000 euros for the camera and, with a little luck, nearly as much again to have it installed by a specialist. There would also have been problems arising from the cost of communications. However, thanks to mobile phones with built-in digital cameras, whose manufacturing cost is now down to around 5 euros, those same cameras are starting to be used for other applications. Today, one can find micro-cameras in high-street shops which work off two AA batteries, stick to walls and connect automatically to Wi-Fi networks found in most homes. Examples of slashed prices are more and more common and mean that we are now able to do much more than in the past—which is exactly the current trend. Technology has not made any great leap forward, but it is now more widely available.

Another place where prices are tumbling in a spectacular way is “cloud computing” which means, thanks to the Web becoming ubiquitous, there is a chance to pair our video camera—or any other sensor—with an “intelligent” assessment of different situations, provided by computer programming, like the example I mentioned earlier. Today, such programming sophistication is beyond the reach of an isolated user, but if it were shared by thousands... it could become very affordable.

*“Technology convergence enables applications, such as the measurement of a subject’s activity, which gives a capacity to detect in an intelligent fashion any abnormal behaviour.”*

## EXAMPLES OF APPLICATIONS FOR STAY-AT-HOME SENIORS

Technology convergence enables applications, such as the measurement of a subject's activity, a capacity not only to watch over people, but also to detect in an intelligent fashion any abnormal behaviour, such as a fall or a long period of inactivity.

Another application is the use of automated scenarios for daily life, like for example turning on the lights along the hall to the bathroom when an elderly person gets up at night. That is fairly simple; and it is also a solution to a major cause of accidents for the elderly.

Add to those two applications the possibility—thanks to the combination of two mainstream appliances in modern homes, i.e. the television and internet access—the possibility of engaging at any moment in videoconferencing, with as a result, everyday safety for grandma between your visits.

For people with reduced physical aptitude, we are of course also working on automating a growing number of household appliances in order to reduce a person's physical workload. There also exist interesting projects for the hearing-impaired, including the display of information by using other means like light for instance.

One can easily imagine how these kinds of applications will enable keeping the elderly at home for longer, with all of the advantages evoked by our other speakers in terms of quality of life and life expectancy.

## ADDITIONAL USES

By combining, via the Web, intelligent sensors with computer programmes and services shared by large numbers of users, many cases for use—which are all likely to converge in integrated home automation solutions—are set to emerge beyond the simple control of roller blinds and lighting.

The market for security services is already well advanced, and demonstrates the vigour of the approach. Millions of individual homes, both in the US and in Europe, are now connected 24/7 to surveillance centres. With that communication infrastructure and those service platforms in place, it will be relatively easy for the same service providers to extend their services to monitoring people.

Another booming market is the one for energy efficiency, where the regulatory framework is becoming tighter and tighter when it comes to managing building

> energy consumption carefully, and soon individual homes. Once more, the combination of technologies is the same—low-cost easy-to-use sensors and software (probably a cloud computing solution...). Schneider Electric research teams have developed a standalone sensor, powered by a solar cell, capable of measuring temperature, brightness, humidity and soon CO<sub>2</sub>... Installed in each room, the sensor transmits information to a computer programme which gradually builds up a model of regular behaviour in the home, and then uses it to optimise energy consumption. Again, the programme—the fruit of years of research—is unaffordable even for a large building, but could be used by even a single house, once its cost is shared between thousands of homes.

These are examples of infrastructure for which a case for use could be made today let's say, for remote medical surveillance, where an electrocardiogram is the sensor output that is recorded in a network.

Indeed, it is the convergence of all of these cases for use on multiservice platforms which is going to define the home automation of tomorrow.

## MASS ADOPTION, BUT WHEN?

The next question is—if it is really so easy—why are these applications still only on the drafting board?

Nowadays, most of this equipment is in fact used, but only in specialised settings where a critical mass of people is present, thus enabling centralised systems that share the investment burden among a significant number of individual households. For example, there is Medetic, a project which relies on partnerships between industry and universities with the aim of testing these technologies in specific environments. Programmes like that are panning out and have led to reliable systems which can now be deployed at large.

The main challenge to adoption in individual homes—beyond issues of a perceived invasion of privacy—is the need to install side by side using the same infrastructure, applications which are currently completely foreign to one another, such as a medical one and an energy management one. Players capable of both providing the necessary capital outlay for infrastructure and guaranteeing the neutrality of their service platforms are far from common. However, the obvious candidates are today's telecom operators.

For its part, Schneider Electric is developing within its energy-efficiency offering, solutions that are likely to be easily integrated together in a context of open standards, which by the way, it is striving to bring into existence.

In sum, a combination of the wide availability of complex applications (via cloud computing) and the spectacular plunge in prices for sensors has opened the way to multi-domain home automation which in particular should enable significant enhancements in quality of life and safety for seniors. Without doing away with precious human contact, tomorrow's home automation will extend its reach both in distance and in time.

*“Without doing away with precious human contact, tomorrow’s home automation will extend its reach both in distance and in time.”*



## Yseulys Costes

*Chairperson and CEO of 1000mercis (France)*

***In 2000, Yseulys Costes founded 1000mercis, pioneering in advertising and interactive marketing for businesses, and today a listed company. She also teaches interactive marketing at HEC Paris, ESSEC business school, and the University of Paris IX Dauphine.***

1. Maffesoli, M. 1988. *Le temps des tribus - le déclin de l'individualisme dans les sociétés postmodernes* (éd. Méridiens, Paris).

2. Rogers, E.M. 1976. "New product adoption and diffusion" in *Journal of Consumer Research* 2: 290-301.

# THE GENERATION GAP AND TECHNOLOGY ADOPTION: INNOVATION'S CHALLENGE

By Yseulys Costes

*"The Web is more and more a way to create social bonds. Social networks are the best example."*

The increase in life expectancy poses the question of evolution in lifestyles and of a population's adaptation in a society marked by the increasing isolation of its members and slow deterioration in its institutional, social and spiritual structures (Maffesoli, 1988)<sup>1</sup>. In this context, the question of individual wellbeing for the person whose life expectancy is increasing appears to be of major importance. In addition, one has to think about the role of information and communications technology. The internet is based on continuous interactivity and lets individuals get informed and communicate by freeing them from boundaries of space and time. In only a few years, the Web has experienced tremendous growth. Today, we have to ask ourselves about the opportunities—and threats—which correlate to the adoption of this technology, and more generally, of innovation.

## THE INNOVATION ADOPTION PROCESS

One always tends to associate innovation with longevity. If one looks at this well-known chart (cf. Figure 1, following page), which is Roger's model<sup>2</sup>, one identifies different categories of subjects in the process of adopting innovation: the Innovators, the Early Adopters, and then the Majority (the Early and the Late), and finally, the Laggards, who adopt an innovation last. Despite it not being the model's original purpose, it has unfortunately often been correlated with age, taking a schematic view and saying that the Early Adopters are generally young people, usually boys more than girls.

Today, the trend has reversed. This vision of strong contrasts which wants to say that to be innovative, you must be young is no longer the order of the day. The figures prove it. We work essentially for advertising clients, companies, and we know that this change is already happening.

3. Study by Médiamétrie, 2010.  
L'Observatoire des usages Internet  
et Baromètre Internet, 4<sup>e</sup> trimestre 2001  
au 4<sup>e</sup> trimestre 2010.

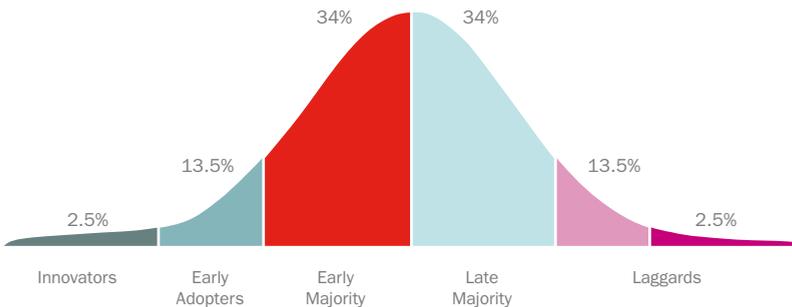
4. Study by Istrategylabs, 2010.  
www.istrategylabs.com

5. Study by IDATE for AFOM, 2010.  
Observatoire économique de la  
téléphonie mobile : faits et chiffres  
de la téléphonie mobile.

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## Figure 1: Rogers' model of innovation adoption, or how a population adopts innovation

Source: Rogers, E.M. 1995. Diffusion of Innovations, 4<sup>th</sup> Edition (New York: The Free Press).



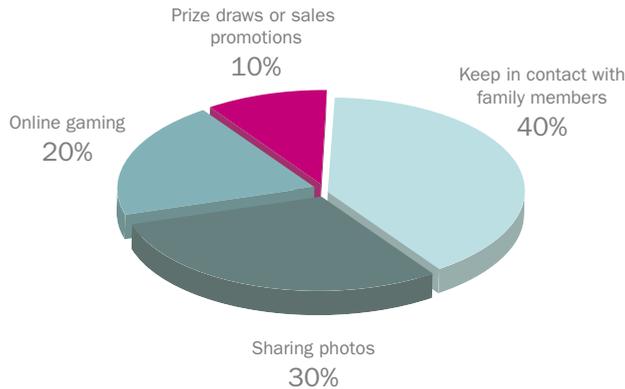
## INTERNET: A TRANS-GENERATIONAL TOOL

In 2010, French people under 25 were only 25% of the Web's population<sup>3</sup>. They were 40% in 2001. And the trend is quickly accelerating. Today, when we talk about the internet, we're not focused on the under 25... since 31% of people 65 and older have surfed the Net at some time during the last month, compared with only 4% in 2001. For the over 65, exact figures are still out, but the speed of adoption is spectacular. And not only for basic uses of the internet, but also for rather new uses, such as social networking. Today, 49% of 50-64 year olds<sup>4</sup> consider the internet like a communication tool, and 27% of Americans over 50 use social networks. Dr. Forette brought up social ties. The Web is more and more a way to create social bonds. And social networks are the best example. It has taken two years for the internet to enter into the lives of the over 60. Already using the Web, it took ten years to achieve a similar level of adoption for the same age group. The quickening in the speed of adoption for innovation by the over 60 is much faster than for younger age groups.

Seniors are an age cohort where one sees an absolutely phenomenal increase in adoption these last years, in large measure due to the presence of family which moreover motivates them to catch up with other users. Looking at mobile phones in France<sup>5</sup>, one sees that between 2007 and 2009, the rate of diffusion progressed by 9% among the over 70 and by 12% among people 60 to 69 years old. The elderly may not yet have reached the rate of adoption of younger generations, but the speed of adoption is nevertheless very quick. Regarding social networks, what is interesting to observe (cf. Figure 2) is that 40% of the over 50 use the tool to keep in contact with their families and 30% in order to share photos. Others are online gamers, fans of prize draws or are hunting for sales promotions. Finally, many stereotypes are being challenged by these findings, which show that not everyone is necessarily making very serious use of their interactive tools.

**Figure 2: Use of social networks by the over 50**

Source: *istrategylabs.com study, December 2010.*



Beyond the fact that the tool is used to stay in contact with one’s family, it is often the family who is at the origin of their discovery (60% of subjects go to social networks because a family member led them to make the discovery). In 2009, Professor Sum conducted a beautiful study which showed that use of the internet enabled a strengthening of family ties for seniors and ultimately of their wellbeing. In any case, there is clearly a correlation between family ties and the general wellbeing of an individual, in particular, among the most elderly.

**AGE IS LESS AND LESS A DETERMINING CRITERIA**

Today, the elderly are quite adept at using new technologies. When looking at Rogers’ model mentioned earlier, one notices that the curve is getting tighter; which is to say that innovations are being adopted more and more quickly. Furthermore, every age cohort now has members in the segment of the Early Adopters. The baby-boomer generation is becoming the generation of the Early Adopters. Among children today, 69% of 2-5 year olds know how to use a mouse<sup>6</sup>. That’s enormous when you know that only 20% of them know how to swim and just 11% can tie their shoes. How will they behave when faced with innovation at 80? And we can be sure that the process of adopting innovation can only but accelerate no matter which age group you consider.

Finally, it seems that technology’s adoption rests above all on the capacity of a company to offer a service no matter what the customer’s age. In this context, the priority is to target the Early Adopters, standing out more by the size of their networks and by their lifestyles than by their ages. They are in fact the essential pivot in the diffusion process in the measure where they serve as models for other members and are gradually imitated. Thus for companies, the future will be in identifying that population who, today and even more so tomorrow, will play a major role in improving our daily lives.



DISCUSSION BETWEEN CAROL JAGGER, STEPHEN COLES,  
FRANÇOISE FORETTE, PASCAL BROSSET, YSEULYS COSTES  
AND THE AUDIENCE

# LONGEVITY IN QUESTION

**Bruno Giussani (forum moderator): Professor Jagger, you said that attention and financing was more concentrated on life-threatening diseases than on debilitating ones. Isn't that simply because we have a fear of dying or, even more provocative, because cancer is better for public relations?**

**Carol Jagger:** That may be linked to two causes, two co-existing problems. First, we have tended to focus on life-threatening diseases, because that is what we have data for; it is much easier to get mortality data than data on disability. That's a first reason. The other is that we are less concentrated on disability during old age. In fact, cancer is not the most debilitating disease in old age—far from it.

**From the floor: Pr. Coles, I want to go back to your diagnosis that seven out of the nine super centenarians that you autopsied, died of a disease, called TTR Amyloidosis. Would you say that this disease is insufficiently diagnosed and that it is emerging as the next kind of cancer?**

**Stephen Coles:** About TTR Amyloidosis, we have just discovered that it increases exponentially with age, over several decades. Consequently, an autopsy of a person 50, 60, 70 or 80 years old reveals the development of this insidious process which affects our circulatory system by infiltrating all the organs in the body: lungs, heart, kidneys and liver. The result is increased resistance to blood flow, which makes the heart work harder to pump blood, and therefore to hypertrophy so as to compensate. However, the heart cannot increase its contractive strength indefinitely. That is why the person ends up dying of a congestive heart illness.

**B.G.: Dr. Forette, you are currently conducting several studies on prevention in and by corporations. Could you tell us a little about first results?**

**Françoise Forette:** Our project concerns five corporations. Our first three corporations are essentially white-collar environments, with almost no blue-collar workers. Consequently, these are people who already have a certain "health" culture. However, even among these subjects who, in principle, have a good level of education, one sees apparent results, after just 6 months. We expose these people to a programme of prevention. The study takes the form of a before and after questionnaire. We see on the one hand an improvement in their health culture, even if these are educated folk.... One sees a change in behaviour particularly

- > when it comes to physical activity. In two of these corporations, employees had sports facilities available, which were closed for a lack of participants. After our questionnaires, the workout room was reopened, because people now knew the importance of having a physical activity. In my opinion, it is the role of corporations to promote these kinds of programmes, because people don't have the time or the energy to take care of it themselves, outside the workplace.

*“Social networks are mainly used by the elderly, first to stay in contact with their families, and then to play.”*

**From the floor: I am in complete agreement about the fact that prevention has to happen where people spend the most time, i.e. in school and on their employers' premises. Nonetheless as you have also shown, people who are the most at risk are outside of the workplace and not in school...**

**Françoise Forette:** If you are referring to retirees who, effectively, are not in school and don't work, it is true that it is more difficult to communicate with them. And that is why the French government intends a programme—not yet in place—where everyone over 70 will systematically get a free consultation about prevention. As for other people, like those who are unemployed and who are not in any company, well, it is extremely difficult to get through to them. However, there is always the unemployment agency and a certain number of institutions where job-seekers come to register regularly. That might be an opportunity to offer them, at that time, programmes about prevention, if that were possible.

**B.G.: Mr. Brosset, is it the same story for tomorrow's technologies? And what's going to happen over the next 5 years?**

**Pascal Brosset:** What I described is coming to pass. Today, if someone asked me to install a 5-euro camera in their home, I wouldn't know how, yet that is what they are doing in our laboratories. Frankly, I think that it will take at least 5 years to deploy products for these new possibilities. Even if people are more and more technology-savvy, you still need infrastructure and changes in behaviour,

in particular on the part of installers. Therefore, what I described will take place over the next 5 years. And unfortunately, there won't be much else in between. Again I want to insist that despite all of our efforts, anything which moves around in a closed environment and provides physical assistance is still very costly and complicated. Otherwise, when something is part of the virtual world of information, providing information more easily, or recovering and disseminating information—that is where I think there will be the most progress.

**From the floor: Mrs. Costes, a lot of my student-friends waste time playing video games. I often hear people say that old folks play these games too and that when you ask them why they like it, they answer that it's because even if they are in a retirement home or physically disabled, they can run and jump in these games; they can fly and they can live second lives. Is there a budding market in the area of video games or gaming products for the elderly? And what is likely to please them in the twilight years of their lives?**

**Yseulys Costes:** You have seen that social networks are mainly used by seniors, first to remain in contact with their families, and then to play. Gaming is obviously something very important for the elderly, and I think that new generations will use this new resource even more intensely, living a second or maybe a third or fourth life. That is why I think this is very important for marketing managers to learn to talk with this new kind of customer.



# LIVING TOGETHER

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*Longer life,  
greater growth*

## INTRODUCTION

# LONGER LIFE, GREATER GROWTH

The lengthening of lifespans is above all a revolution in demography and human affairs. Although it is going to require economic and social adjustments in most countries, longevity cannot be reduced to a simple financial risk that needs managing. Through an international approach to the economic challenges and the different responses, which have been suggested to deal with longevity, this conference is offering an assessment of its challenges and opportunities, today and tomorrow.

According to conventional wisdom, our ageing society is set to precipitate a general fall in living standards for the entire population.

As an economist, Eric Chaney (cf. paper on page 134) has empirically analysed the correlation between per capita GDP and longevity. His study, which is based on statistical observations in 165 countries, shows that the correlation is positive between standard of living in different countries and long life in good health.

With the lengthening of lifespans in populations of the extremely elderly, long-term financing for the risk of dependency and care appears, today, as one of the major economic challenges of our ageing society.

Also an economist and a specialist in forecasting future needs in care-financing, Raphael Wittenberg (cf. paper on page 140) outlines the different challenges, and in particular, for equality and the sharing of risks. There then follows an exposé on the different options for financing, adopted by certain countries.

Profound transformations in the age structure of society, and a fall in the ratio between the working and non-working population, imperils traditional thinking on intergenerational solidarity. Edward Whitehouse (cf. paper on page 148) is an economist and responsible for analysing pension policies, working at the OECD. He explains that intergenerational solidarity is, at the same time, the bedrock in the functioning of society, and a philosophy of “living together,” which has to evolve in step with major demographic upheavals.



## Eric Chaney

*Chief Economist AXA Group, Head of Research, AXA Investment Managers (France), member of the Scientific Board of the AXA Research Fund (France)*

***Eric Chaney has been the AXA Group's Chief Economist since 2008 and Head of Research at AXA Investment Managers since 2010. Previously, he headed the economic forecasting unit of French statistics institute INSEE after having been responsible for global economic forecasts and analysis at the French Treasury.***

# OLDER YES, BUT RICHER TOO

By Eric Chaney

*“There is clearly a positive relationship between gross national income per capita and healthy life expectancy.”*

When I started working on the issue of longevity and the welfare of countries, I remembered very vividly that 20 years before, when I was at French statistics institute INSEE (French: *Institut National de la Statistique et des Etudes Economiques*), training as a young economist and statistician, a debate was raging about how we were going to fund the pensions of a growing population.

The Organisation for Economic Cooperation and Development (OECD) had started to draw policymakers’ attention to the consequences of ageing societies and the debate within that very honourable institute was “Well, maybe it will be productivity that will serve us, or maybe insurance companies through the provision of old age insurance.” However, I remember very clearly that nobody thought at that time that ageing was anything but an absolute burden for society.

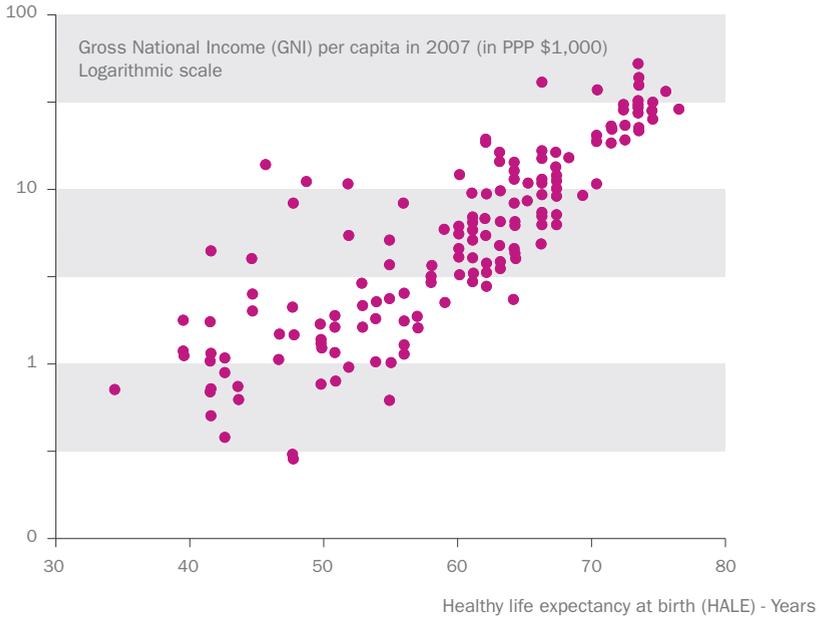
## THE LINK BETWEEN AGEING AND WELFARE

I therefore looked at the topic myself and thought that the best way of going about it was to look at data for a given year, but across a very large sample of countries. The quality of the data—and I am a former statistician—is much better when you look at fresh data than when you try to build time series over a long period of time. I have here (cf. Figure 1), therefore, the cloud of points that you get when you cross two very simple variables, taken from United Nations (UN) and World Health Organisation (WHO) statistics. On the vertical axis, we have gross national income per capita—which is not very different from gross domestic product (GDP)—, and on the horizontal axis we have healthy life expectancy at birth—called HALE. There is clearly a positive relationship and this is a sample of 165 countries. It cannot be a coincidence.



### Figure 1: Strong positive correlation between life expectancy and wealth

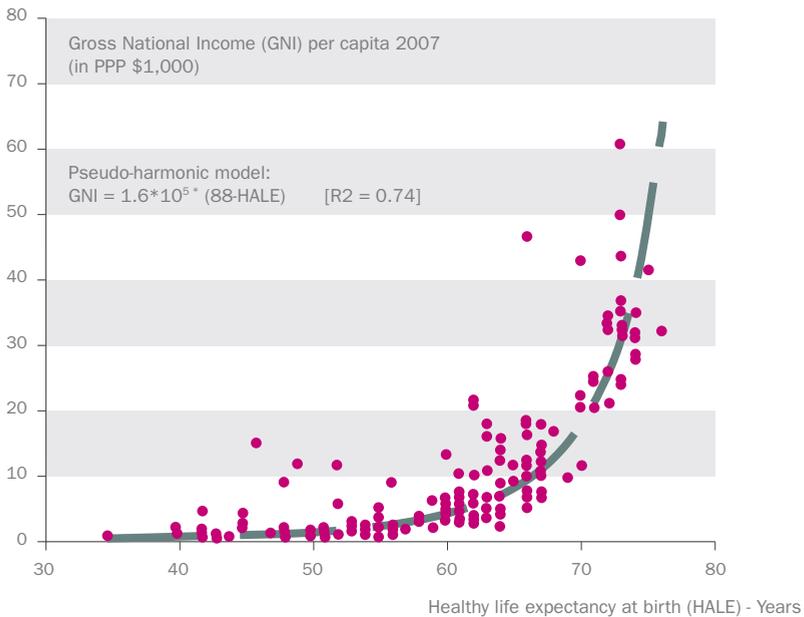
Source: UN, WHO, AXA IM Research (sample: 165 countries), 2007 data.



I then estimated the relationship between gross national income and life expectancy (cf. Figure 2). This is not a causality model, but one that aims to help us better understand what the functional relationship is because it is simply eye-catching—to say the least. We can see that there is in effect a relationship, but it is actually a very nonlinear one. It is here interesting to note that in estimating the functional form of the link, I had to estimate a sort of life expectancy “ceiling,” taken on average country by country, with a snapshot taken in 2007—and I found it to be 88 years by maximizing some loss function. What is interesting is that not only is there a very strong confirmation of the positive link between income and life expectancy in good health—and I have to stress that this is “in good health”—but that it is also strongly nonlinear.

**Figure 2: The link between life expectancy and wealth is positive and strongly nonlinear**

Source: UN, WHO, AXA IM Research (sample: 165 countries), 2007 data.



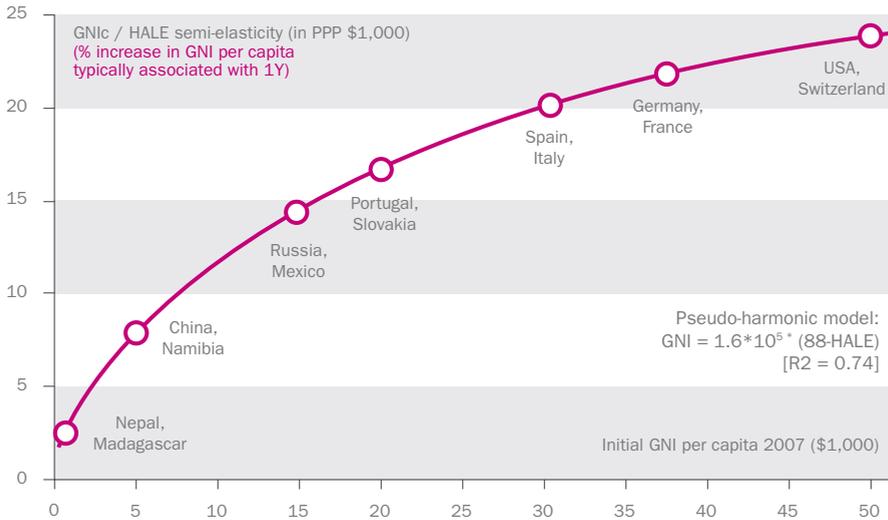
**LIFE EXPECTANCY IS MORE SENSITIVE TO INCOME IN LOWER-INCOME COUNTRIES**

If it is non-linear, it makes sense to look at the marginal increase of income associated with a 1-year increase in life expectancy (cf. Figure 3). For low-income countries, where life expectancy is lower, increasing life expectancy is much easier than for high-income countries—I must say again that this is just a statistical observation. But it makes sense: once you get closer to the limits I estimated earlier, then at the margin it becomes more and more difficult to increase life expectancy, assuming that this increase is linked to economic factors.



**Figure 3: Wealth and life expectancy: the decreasing return curve**

Source: UN, WHO, AXA IM Research (sample: 165 countries), 2007 data.



There are two caveats to this very humble—and humbling—study. The first is that, of course, correlation is not causality. I am not saying that when you get richer you automatically live longer or vice versa. There might be—and I believe that there is—a common factor and the most obvious common factor that comes to mind is innovation and technological progress. Both contribute to increasing national income per capita—that is the good old Solo model, with a residual—and, very obviously, to helping progress, so to speak, especially with regards to medical sciences, which is positive for life expectancy. I therefore suspect that these two variables, which show such a strong link, are caused by a common set of factors and I have mentioned one. The second caveat is that this is a snapshot taken in 2007, but it gives us an idea of history. That is the way to look at history—you look at countries that are not at the same stage of development.

For the full “Older yes, but richer too” article, please refer to AXA Investment Managers’ longevity booklet “The Future is Bright, the Future is Silver” published in Q2 2011 ([www.axa-im.com/en/multi-experts-booklets/](http://www.axa-im.com/en/multi-experts-booklets/)), which also includes

articles on the evolution of pension systems, as well as on retirement investment products—and what is on offer and by whom.

## FOOD FOR THOUGHT ON THE BASIS OF THIS STUDY

I really want to stress a point, which is extremely important for me. *Ex ante* is different from *ex post*. With *ex ante*, a lot of people worry about ageing societies, thinking that there will be a lot of negative consequences on productivity and innovation, and that it will be a burden on public finance, creating intergenerational conflicts. That is *ex ante*. *Ex post*, societies change. Human beings adapt to new conditions and think differently about what the challenge was before. I am a strong believer in this flexibility, this agility of human societies, seen from an economic angle.

I will conclude with a few thoughts, which are more food for debate than a hard science thesis. The first thing is that there is what could be coined a societal choice to be made between the length of time that somebody works or at least produces added value in the market economy and the length of time that is dedicated to leisure. This is a societal choice but as always, there is no free lunch. The more you work and the more you create value, the more you raise income per capita, and the more likely it is that scientific innovation will move forward.

My second point is a little more controversial, especially in societies that have reached a certain level of development. If you think about it, if people have to work more years in their lifetime—let us assume that the average life expectancy is 100 years, jumping forward a few years of course—then, of course, it makes sense to think that people will spend more time working than they would have done in the 1980s. There is no reason why income should rise in a monotonous way. It would even make sense to think that at some point, if productivity starts to abate, income should decline, or at least increase at a different speed from that at which it increased during the “best” years. This is not something that is easy to accept, but once you have done the math, if you accept this kind of assumption then you will maximise welfare—the average level of welfare for society. However, again, this is a societal choice.

My next point is that we are all quite impressed by the challenges created by ageing societies, which is not, by the way, only a question of longevity but also one of birth rates and immigration. I am a strong believer, as I said before, that the challenges might look very impressive, but in the end people change. Societies change. And there are winners and losers. My limited experience in terms of macroeconomic adjustment—what people call social reforms—is that when the mindset of a country and a given society is in a state of denial, the likelihood of seeing the changes that will help maximise welfare take place is weaker than in those countries where people accept the challenges—and changes. So I conclude: take a positive view and face reality.



## Raphael Wittenberg

*Senior Research Fellow at the London School of Economics and Political Science (UK)*

***Raphael Wittenberg is a Senior Research Fellow at the Personal Social Services Research Unit (PSSRU) of the London School of Economics and Political Science, where he leads a program of research on financing long-term care. He is also a senior economist at the Department of Health for England, but the views expressed here are the responsibility of the author alone.***

1. This presentation draws on research funded by the Department of Health for England, the UK Research Councils, the Joseph Rowntree Foundation and the AXA Research Fund. The research was conducted in collaboration with colleagues at the London

School of Economics, London School of Hygiene and Tropical Medicine, University of East Anglia, Universities of Leicester and Newcastle, University of York, Pensions Policy Institute, Nuffield Trust and University of Barcelona.

2. In fact, the Commission more recently said that it will actually be even more, given the economic crisis.

# THE ECONOMICS OF LONG-TERM CARE<sup>1</sup>

By Raphael Wittenberg

*“Any decision about financing long-term care requires very fundamental value judgments by society and government.”*

I would like first to clarify definitions. By long-term care services I mean not curative services, but longer-term services which help disabled older people and younger people maintain independence. In particular, they help with personal care tasks—eating, dressing and so on—and offer various forms of professional support, such as therapy services. Finding a common international definition tends to be a problem, although I believe that the OECD has formulated one to help in comparative work. By long-term care, I mean both informal unpaid care by families which, as we heard earlier, is in fact the majority of care in most if not all European countries, as well as formal services. I am including elements of social care, long-term healthcare and supported housing, both in people’s own homes and in specialist care homes and extra-care housing facilities. In many countries, with the growth of consumer-directed care, that includes cash payments in lieu of care as well as services, which have been developed, for example in Germany, the Netherlands and Ireland as well as in the UK.

## FISCAL SUSTAINABILITY

How are public funds and government going to pay for long-term care in the face of growing longevity that we have been talking about today? As you know, the European Commission, through Ecofin Council and the Ageing Working Group of the Economic Policy Committee, produces projections every couple of years. Recently, it looked at public expenditure on key services for the next 50 years. Its most recent projections (in 2009) show public expenditure across the European Union 27 (EU 27) projected to rise by 4.7 percentage points of GDP over roughly the next 50 years<sup>2</sup>. The figures that I want to draw your attention to, here, show considerable increases for health and pensions, while there are very slight projected reductions in education and unemployment. However, for long-term care, the OECD estimates just under a doubling, from 1.2% to 2.3-2.4% of GDP.

> Why so much higher a proportionate increase for long-term care? As we have been hearing, it is because it is concentrated so heavily on older people and on the very oldest of the old, particularly people aged 85 and over. That raises the question of how can this large proportionate increase be funded? I think that you have to avoid both extremes. I do not think that we should be talking about a 1.2 percentage point increase in GDP as some sort of time bomb, as it has sometimes been called. Nor, of course, is it trivial. How is it to be funded? One way would be by cutting other public services, but could that be health or pensions? That is a real problem. Alternatively, it could be funded by increased taxation, which means less private consumption. There is a very difficult decision for society to make.

## WHO WILL CARRY THE RISK?

The balance of risk is a big question for the insurance sector as well as for society at large. Who is taking the risk? How far is it the state and how far is it the individual? If the individual carries the risk, can the individual insure with the private sector and the financial services sector or not? Different countries in the OECD adopt different approaches and many are continuing to debate the issue, as we are in the UK. Some countries have turned to social insurance and Germany is often held up as an example of the way in which long-term care can be added onto social insurance. Other countries have tax-funded systems—in fact quite generous tax-funded systems—such as in Scandinavia. Other countries have more extensive private insurance which supplements state systems of which the two most prominent in (or near) Europe are France and Israel. The United States and England, in particular, have a means-tested system, where basically the richer pay for themselves and the poorer rely on public funding in a safety-net system. The issue of under what circumstances the state will pay has been at the core of the ongoing debate that we have had in the UK.

## ECONOMIC INCENTIVES

We have economic incentives to consider—which are close to the heart of economists—issues relating to efficiency and setting the right incentives for promoting the outcomes one seeks in the most cost-effective way.

The funding of long-term care has become almost notorious for some of the difficulties that have arisen with the economic incentives that it engenders. If you have a safety net, as we have in England and in the United States, there is always the problem of whether it acts as a disincentive to work or, more likely, a disincentive to save. In England for example, people ask, “What is the point in saving a bit if it just makes you ineligible for public support later?”

3. Raphael Wittenberg is the principal investigator of the AXA-LSE research project "How can private long-term care insurance supplement state systems?".

*“We have economic incentives to consider—which are close to the heart of economists—issues relating to efficiency and setting the right incentives for promoting the outcomes one seeks in the most cost-effective way.”*

That then becomes a big issue which many countries have grappled with and come to different conclusions on. So what about the incentives towards family care? Again in England, people involved in family care, particularly those living with a spouse, get less publicly-funded care than those who live alone. I remember a German colleague saying to me that, compared with the system in Germany, this was surely a disincentive for people to be willing to provide family care. Nevertheless, I should say that we have more than 5 million carers in England. That is another difficult issue for incentives.

There has also been a tendency in the area to create a bias towards one sort of care or another, either encouraging people to enter a care home or to be placed in a care home unnecessarily, before it is vital, or vice versa. In England, we have the situation where the house is taken into account in the means test for residential care but not for home care, which I think is unusual and of course may greatly affect people's decisions.

Finally and perhaps of particular relevance in the current context, there are the incentives to purchase private insurance, if it is available. The uptake of private insurance for long-term care in England has been so low that it is scarcely available at present. In brief, if countries have operated very generous state systems then there may be less incentive to take out private insurance, because people can genuinely rely on the state. If there is a means-tested system so that the wealthiest are excluded from state support, there is more of an incentive for private insurance, but it can, of course, be very costly. Of the countries that I mentioned earlier, those that have probably the most are where an arrangement exists that enables people to buy private insurance which supplements the state system. It is on the area of supplementing private and public funding that we are focusing as part of the study that the AXA Research Fund is funding.<sup>3</sup>

**4. MAP2030** (Modelling Ageing Populations to 2030) is an interdisciplinary research group which brings together several institutions that have the objective of evaluating the needs and resources of the elderly out to 2030. Its work was completed in 2010.

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## EQUITY OF TREATMENT AND FAIRNESS

Fourth and by no means least, there are issues of equity and fairness, which seem central to the debate in many countries. With any risk-pooling mechanism, whether private- or government-sector, we would expect that it would redistribute from those who find in the end that they have lower needs to those with higher needs. That is the essence of risk pooling. We can also have redistribution from wealthier people to poorer people through a state scheme where the contributions, such as social insurance contributions, depend on income rather than individual risk.

There are difficult issues in long-term care that relate to intergenerational equity. What is the expectation that children will care for their elderly parents, if necessary? In some countries, such as France, I believe, they are required to contribute to the costs of their parent's care. We can also have issues that relate to what people get out of the system in the way of benefits, particularly in a public-sector system, and whether that should in some way be related to the contributions which they have made. That is quite common in a social security context. However, these issues of equity and fairness remain difficult.

## THE FACTORS WHICH IMPACT ON PROJECTIONS OF SPENDING FOR LONG-TERM CARE

I am now going to refer to some of the drivers of demand for care and, in particular, to issues that we studied in the Map2030<sup>4</sup> project that Carol Jagger mentioned. We considered five drivers of demand. The first relates to the way in which rising life expectancy and numbers of older people will impact on the need for care. Second, there are issues about disability that have been discussed earlier, with the potential expansion of disability. Third, there is supply of informal care and whether the composition of households will vary over time and whether more people will live alone. Fourth, for a highly labour-intensive service, there is also the question of what will happen to its costs and whether there is any scope for efficiency gains. Technology may offer some way forward here. Finally, there is the unknown issue of public expectations. Will the baby-boomers be as happy with the quality of care that today's older people seem to be happy with or will there be a demand for increased quality of care?

Unfortunately, I will not have time to discuss the wide range of issues that we looked at in Map2030. I am just going to talk about the way we have found that projections of expenditure on long-term care are sensitive to projections of life expectancy and future mortality rates. Let me just give you a reminder, in that context, of the reasons for the growing numbers of older people: one is falling mortality rates, particularly in late old age, and another is the baby boom—that is to say, high fertility in the years after World War II. However, even taking that into account, you can see, by our estimation (cf. Figures 1 and 2), the proportion of GDP in England that is required to fund long-term care—both public and private—will rise from about 1.6% of GDP now to somewhere in the range of 2.7-3.0% in 2032, depending on the assumptions that we make about future life expectancy.

**Figure 1: Impact of different life expectancy scenarios on projected expenditure on long-term care in England, from 2007 to 2032**

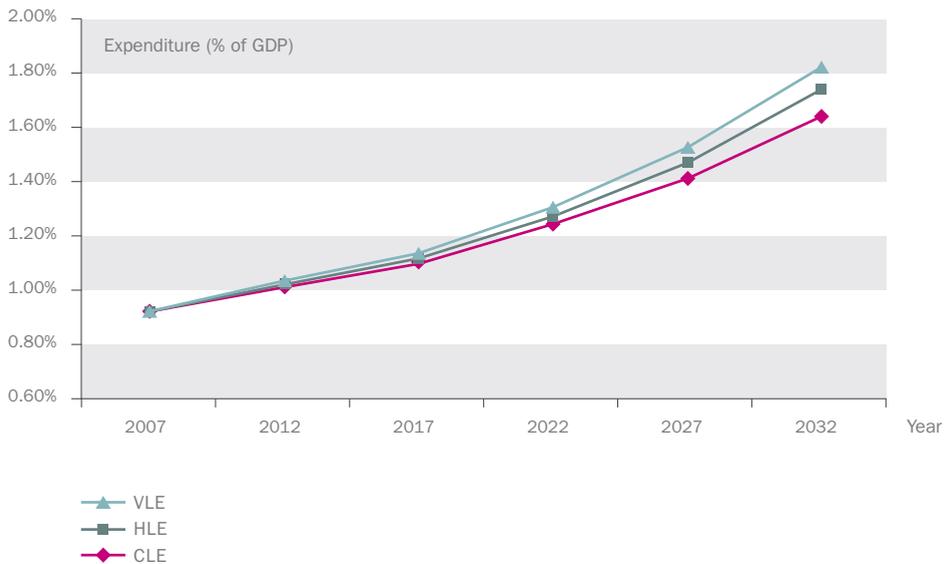
Source: MAP2030 research study.

	Central	High	Very High
Older population increase 2007 - 2032	64%	70%	75%
Disabled older population increase 2007 - 2032	75%	83%	92%
Total expenditure 2032 % GDP	2.7%	2.8%	3.0%

&gt;

**Figure 2: Projected public expenditures on long-term care (in % of GDP) under life expectancy variants**

Source: Wittenberg, R. *Global Forum for Longevity*.



Ours is clearly one set of assumptions and you could have a different set, but under a reasonably plausible set of assumptions our analysis shows considerable uncertainty. There is similar information for public expenditure only, which is projected to rise from just under 1% of GDP to somewhere between 1.65-1.85% of GDP in just over 20 years' time, which is a very substantial projected increase. There is therefore substantial uncertainty about its level in 2032, depending on the assumptions that we make on future mortality rates.

*“There are difficult issues in long-term care that relate to intergenerational equity.”*

## CONCLUSION

To conclude, I have briefly discussed four economic issues that I certainly find interesting in the area of the funding of long-term care. I hope that you have also found them interesting. We ask: (1) “How is it to be funded in the future?”... particularly in terms of the issue of fiscal sustainability for public expenditure in the present economic climate; (2) “What are the economic incentives in relation to the funding arrangement?” and “How do we get the incentives right?” (3) There are difficult and debatable issues of equity and fairness between different portions of society, not only from a cross-sectional, but also from an intergenerational point of view; and above all, (4) “Who is to carry the risk and how is that risk to be shared between the private sector, private individuals, social insurance and, ultimately, taxpayers?” Any decision, of course, requires value judgments. These are not just technical issues: they require very fundamental value judgments by society and government. As I see it, the role of the researcher is to provide relevant, robust evidence that will help decision-makers with those difficult choices.



## Edward Whitehouse

*Economist and Head of Pension Policy Analysis, Social Policy Division, OECD (France)*

**Edward Whitehouse heads the team at the OECD Social Policy Division, which analyses retirement-income systems in member countries. He is the lead author of an OECD report entitled, *Pensions Panorama*, the 4<sup>th</sup> edition of which was published in March 2011.**

1. This study was done for the OECD ministers' meeting on social policies, held in Paris, 2-3 May 2011.

*This paper is drawn from the transcript of a speech by Edward Whitehouse at the Global Forum for Longevity. Mr. Whitehouse reserves the right to make any amendments which he feels necessary. You can consult his complete speech in a video at [www.longevity.axa.com](http://www.longevity.axa.com).*

# PAY FOR THE PAST, PREPARE FOR THE FUTURE

By Edward Whitehouse

*“Intergenerational solidarity remains strongest in the countries where older people work and rely on a balance between public and private incomes in old age.”*

When the ministers of social affairs for OECD member countries<sup>1</sup> asked us to talk about intergenerational solidarity, I thought that they were giving us the task, because it is something that is difficult to define. Moreover, it is something where they all have a different idea in their heads of what they mean by it, and that is why they universally liked the idea for all the countries, which is very rare at the OECD.

Therefore, the first thing that we had to do was to try and find a good definition of intergenerational solidarity. Views about this are quite legitimately different between people. For some, it is a good thing in itself and is a value. Thus, we can think about whether the generations actually like each other, whether they are frightened of each other, whether they interact and spend time together, whether there is a consensus between generations and whether young and old agree on what the best way forward is for society.

However more importantly, I think that intergenerational solidarity is also a means to an end. It is about mutually beneficial exchanges between the different young and old generations. If we think in terms of public policy, some of these go forward towards the younger generations, such as investment in innovation, education, infrastructure and protecting the environment, while others go backwards towards the older generations, particularly pensions and long-term care. However, there are also intergenerational transfers going on within families, both of money (through inheritance and transfers between living people) and of time, with people caring for older parents and grandparents caring for grandchildren.

> **INTERGENERATIONAL SOLIDARITY UNDER THREAT?**

The important thing about intergenerational solidarity is that these mutually beneficial exchanges work really well when you have demographic balance. However, we are not in a time of demographic balance, but a time of demographic change and in particular of populations ageing. As has already been pointed out, a driver of that is the fall in fertility as much as increasing longevity. This year, the OECD celebrates its 50<sup>th</sup> anniversary. Back in 1961 when the organisation started, 541,000 babies were born in OECD countries. Now, relative to the population, it is about half that number which is driving the ageing of populations. That has a fiscal impact (I will come back to this point) and potentially an impact on labour markets. For instance, when people are working longer, will there still be jobs for younger workers? Populations ageing can also strain family relationships, when there are four generations around at the same time.

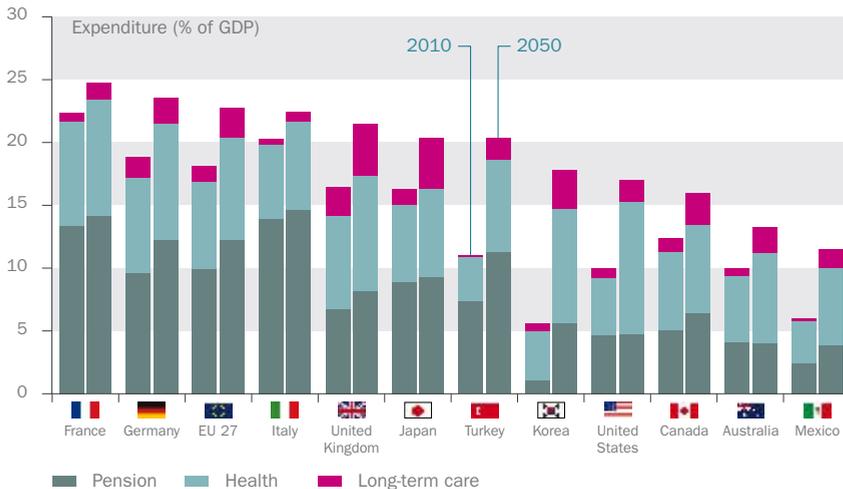
Socioeconomic change is also threatening intergenerational solidarity. More women are working, while they have traditionally taken on many of the “caring” roles in family life. Families are also smaller, more complex and with a lot more divorce and remarriage.

Finally, we need to look at public finance problems. In 2011, the aggregate budget deficit of the OECD countries will be 6% of national income, which is well above a sustainable level, and public debt will be 100% of GDP.

**Figure 1: Budgetary impact of populations ageing in advanced countries**

*Forecasted change in public spending for pensions, health and long-term care between 2010 and 2050, as a percentage of GDP*

*Source: OECD, IMF, EU, Standard & Poor’s, national authorities.*



Looking very briefly at the fiscal challenge (cf. Figure 1), I have added to the numbers the rest of the G20 advanced countries. We can see the situation in 2010 with three main areas of ageing-related expenditure (pensions, health and long-term care) and we can then add the forecast for 2050. We see that the European countries and Japan already have quite old populations, with quite high spending. South Korea, which is currently the OECD's third youngest country in terms of its population structure, will become the second oldest by 2050, so there are major changes going on there. Thus, we begin to see the scale of the fiscal challenge in three main areas of expenditure due to populations ageing.

## RELATIONS BETWEEN GENERATIONS

One of the issues of intergenerational solidarity is whether in the future the young will pay all the taxes needed for all these pensions and so on. *Eurobarometer* asked people in Europe the question, "Do you think that older people are a burden on society?" I have chosen to look at this question (cf. Figure 2), because it was the strongest in their survey. Only 14% of people agreed with the proposition that older people are a burden, with 85% disagreeing, many of them very strongly. Therefore, it looks overall as if the state of relations between the generations is quite good.

*"Socioeconomic change is also threatening intergenerational solidarity."*

However, there are some interesting patterns within the data. If we look at individual characteristics (cf. Figure 3), women are slightly more likely to agree than men and there is a big effect of education on people's responses, with those with lower levels of education being more likely to agree that older people are a burden. However, I think the most interesting thing is the effect of age, where there is a rather strange kind of U shape. Among 20 year olds, there is a quite even split on whether people are a burden or not. People in their 40s and 50s are those who disagree most that older people are a burden, perhaps because they are looking a bit further forward. However, older people themselves are the most likely to say that older people are a burden on society.

If we look across countries, there is not an enormous amount of difference overall. In the Czech Republic, 70% disagree with the statement and in the Netherlands 95% disagree. However, there is quite a big cross-country difference between the Netherlands, Ireland, the UK, Denmark and Greece on the one hand and then on the other hand mainly Eastern European countries with the Czech Republic, Hungary, the Slovak Republic, Slovenia and Estonia. In the middle, we have Spain and Poland.



Figure 3: Impact of individual characteristics on responses

Source: Whitehouse, E. Global Forum for Longevity.

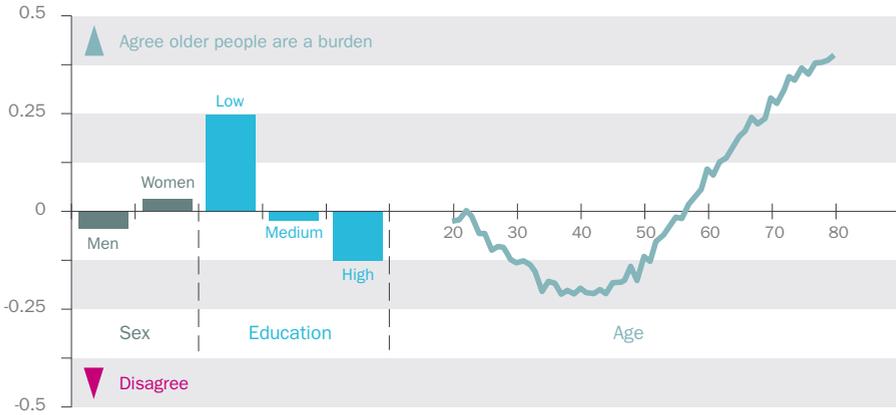
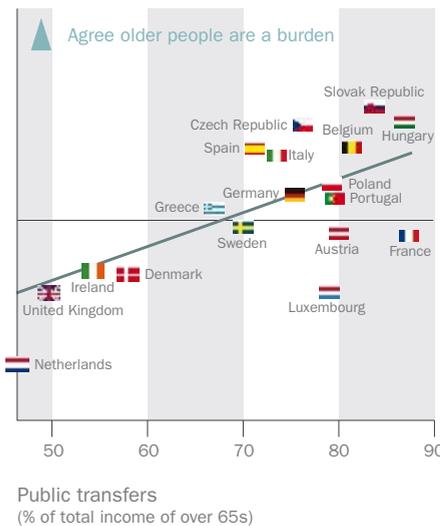


Figure 4: Impact of pension systems

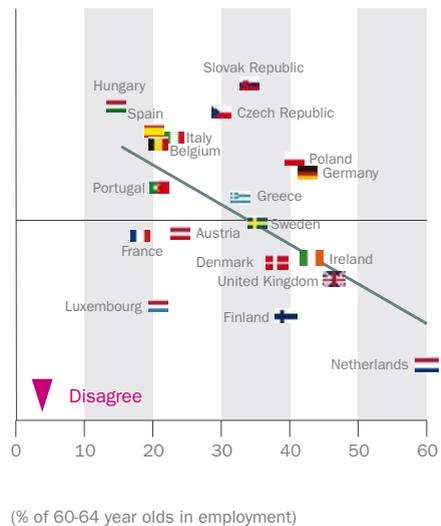
Figure 5: Impact of labour-market conditions

Source: OECD analysis of data, presented in Intergenerational Solidarity, Flash Barometer no. 269, European Commission (2009), Brussels. See Pigott, J. and Whitehouse, E.R. (2011), Intergenerational Solidarity and Population Ageing: Attitudes in Europe, OECD working paper: social, labour and migration questions, OECD (pending).

Pension systems:  
role of the state



Labour-market conditions:  
older workers



2. According to the OECD database on distribution of revenues.

3. KiwiSaver is a pensions savings system, financed by the state, employers and employees, subscribing to the KiwiSaver plan. Most participants build their retirement savings through regular withholdings on their earnings. A certain

number of advantages incite participants to save (1,000-dollar signature bonus, regular employer contributions, and annual tax credits granted to participants by the state).

4. A Riester pension is a private pensions savings plan, subsidised by public funding.

## > PENSIONS POLICY: A DELICATE BALANCE BETWEEN ADEQUACY AND SUSTAINABILITY

The OECD produces a report on pensions, called *Pensions at a Glance*, every two years and the most recent report came out in March 2011. In summary, this is our vision, as it were, for pensions policy in the future and the three solutions that we have: (1) longer working lives; (2) better targeting of public benefits on the most vulnerable; and (3) more private pensions savings. Pensions are all about balancing adequacy and sustainability, or having benefits that are enough to live on, but that are also affordable for taxpayers and contributors. That has become more of a problem recently with the financial and economic crisis, which has now turned into a fiscal crisis in a lot of countries.

*“Pensions are all about balancing adequacy and sustainability, or having benefits that are enough to live on, but that are also affordable for taxpayers and contributors.”*

What we are seeing in most countries is that there have been major cuts in benefits for future retirees. In the 15 countries where we have analysed these reforms in detail, someone starting work today will get about 25% less in benefits than someone who is retiring today for the same career pattern. We have therefore seen major benefit cuts but, as we have just seen, the cost is still projected to rise. What can we do about that?

I think that a longer working life is the best solution in that it is the least painful one. It has more support from people than having to pay higher taxes or having lower benefits in the future, with the risk of having a resurgence of old-age poverty. The second solution is better targeting of public benefits. If the public pool of resources available to pay old-age benefits is smaller, then it becomes legitimate that you want to have more “bang for your buck” and a better return. So it is best to target public support on the most vulnerable. The final area concerns private pensions savings. Currently, public pensions are on average about 60% of incomes in old age<sup>2</sup>. That is inevitably going to decline in the future because of fiscal pressures, and private savings will simply inevitably have to make up some of the difference. There have been some great policy successes in this area. The KiwiSaver scheme in New Zealand<sup>3</sup> has dramatically increased coverage of private pensions and Riester pensions in Germany<sup>4</sup> have had a very similar effect. The lesson is that you really have to keep putting those coins into the piggy bank for your retirement...

## **STRENGTHENING INTERGENERATIONAL SOLIDARITY IN AN AGEING WORLD**

In conclusion, intergenerational solidarity is a good thing. It is about mutually beneficial arrangements and involves the state, the market and families. Families and states are in the best position to help with intergenerational solidarity, because they can make sure that the young, and even the unborn, abide by contracts between the different generations. Intergenerational solidarity is beneficial and therefore if it breaks down, it will be costly for us all. However, it is under threat because of populations ageing and socioeconomic changes. To ensure that it remains robust, we should look at the cross-country pattern, which shows that intergenerational solidarity remains strongest in countries where older people work and rely on a balance between public and private incomes in old age.



DISCUSSION BETWEEN EDWARD WHITEHOUSE, ERIC CHANEY,  
RAPHAEL WITTENBERG, LINDA ZELINA AND THE AUDIENCE

# LONGEVITY IN QUESTION

**Bruno Giussani (forum moderator):** Professor Vaupel has mentioned the idea of redistributing work to match new lifespans. Do you agree with him on this point?

**Edward Whitehouse:** I think that employers are going to have to get used to the idea of having older co-workers. In 1966, the average age of an employee was 34. It is now 40 and is set to steadily rise to 45. Employers are therefore going to have to adapt to what older workers want, and what they aspire to, which in particular is more flexible working hours and changes in working conditions. About a better distribution (or a more even spreading of work to fit a longer life)—that is very difficult. First, there clearly exist jobs which can only be held on a fulltime basis, making it very difficult to adapt professional life. Second, if one takes a look at practical experience, for example in Germany, semi-retirement has long been available, but has been chosen by very few people and in Spain, semi-retirement has simply become a path to early retirement. Countries which have tried to put into practice this kind of system on a national scale have not yet found their way to success. So one must in all honesty take pause to consider...

**Linda Zelina, delegate of the European Youth Parliament, for Latvia:**

With a view to a necessary increase in retirement age (maybe even abolishing the notion of a legal retirement age altogether), correlated with the fact that people who hold white-collar jobs are the most likely to remain mentally sharp and keep their jobs, couldn't that pose a risk for intergenerational solidarity by prolonging the presence of certain individuals in leading positions? Isn't there a chance that it would lead to excessive "greying" in corporate governance, along with increased ageing among other social leaders? And how would you handle the question of innovation?

**Eric Chaney:** I want to insist on the fact that the question concerning the extension of working lifetimes is above all about flexibility. I think that we all agree that flexibility is a good response, because the situation is in flux. Long life is a fact; however, we also have to mention other demographic factors. Rigidity impairs change. To answer your question more precisely, it seems to me that corporations are going to have to reinvent what they can ask and what they can obtain from their older workers in terms of value-added. I have in mind this image of a mentor. What I have observed during my career is that the people who have the most experience in a sector or a company can increase, at the same time, their own value-added and that of younger workers by imparting to them that experience, which cannot be found in any book. That is

> flexibility and I think that corporations are going to have to think about it. How can one draw the value-added out of other co-workers? It is precisely by thinking about it as human capital that it is saved. The analysis of human capital is widely accepted in economics, and is an integral part of each company and those who fail to use it wisely risk becoming victims of the gerontocracies which you evoked.

**From the floor: You have introduced the concepts of intergenerational solidarity, but also of conflict. However, if one looks at all of the current trends, shouldn't we rather be talking about an intergenerational contract between the elderly and young people? For example, Great Britain is currently trying to put in place a plan, according to which youth can care for the elderly and accumulate healthcare credits.**

**Edward Whitehouse:** That is a very good question and I would very much like to know the details of that plan. I did not know that such a system existed. I chose to use a sharp comparison between solidarity and conflict simply as a ploy to perk up everyone's attention, since it is the end of the day. Youth also stands to profit. In terms of an intergenerational contract, one of the things that I put forward was the fact that about pay-as-you-go pension plans, even people who are not yet born implicitly sign the contract. I was recently at an event in Paris, where people were discussing retirement reform in France and a young man stood up and said, "I never signed any contract. I never signed anything which said that I had to pay astronomical taxes to finance all these retired folks." Therefore, I am not sure that a contractual approach can solve everything, because the system rests in large part on youngsters who are too young to sign contracts and even on people who are not yet born.

**Raphael Wittenberg:** I do not know where we stand when it comes to writing formal contracts. However, I know that studies have determined whether or not it is realistic in the coming decades for children as adults to take charge of their parents in an adequate fashion. That is the real issue, not whether there is proof that children are less and less inclined to care for their parents in old age. That is the issue simply because the figures are grounded in demography. For example, one of my colleagues studied growth in demand for care, based on the same criteria as those which I presented to you, about the number of elderly people who are going to need care. My colleague then compared that with the number of people in the following generation who would have to provide the care, supposing their will and capacity to do that as well as their age, sex and level of education remained constant. Findings suggest a wide gap was forming. I think that one of the points which worries us, whether there is a contract or not, is knowing whether there will be a decline in the quantity of informal care, provided by the following generation, in relation to needs.

*“The people who have the most experience in a sector or a company can increase, at the same time, their own value-added and that of younger workers by imparting to them their experience.”*

**Eric Chaney:** I think that the term, “contract,” and its presence in the debate is an important point. Solidarity is an excellent idea and, as you have said, we should do nothing which goes against the natural solidarity which exists between people, whether that be incentives or anything else. Conflict never lasts. It merely signifies what is not optimal from the point of view of the distribution of wealth. The answer is a social contract. Nonetheless, a social contract is not necessarily a private contract between two people; it can also be the law. That is how I understand your argument. On the one hand there is solidarity, which is our ancestral heritage. It should be paramount, but has grown less important than before—look at the example of Japan, a country which is already feeling the consequences of an ageing population. And on the other hand, there is conflict, which may simply mean that youth is destined to quit a country, because young people won’t accept to pay for old people, who have imposed their vision, in some cases, on people even not yet born, using contracts which everyone does not even accept. It seems that this is what will happen: the response is a legally-binding contract. It has to be the product of the law.



1. The World Bank is an international organisation, directed by its 187 member states. It is committed to combat poverty and fight for economic growth, notably by offering financial and technical support to developing countries.

2. In France, it has taken over a century for the proportion in the total population of citizens over 65 to increase from 7% to 14%. This same transition will only take 26 years in China (source: "An Aging World: 2008 International Population Reports," U.S. Census Bureau: June 2009).

DISCUSSION BETWEEN WORLD BANK<sup>1</sup> PRESIDENT  
ROBERT B. ZOELLYCK AND AXA CHAIRMAN AND CEO  
HENRI DE CASTRIES

# LONGEVITY AND EMERGING ECONOMIES

Longevity is a world-wide phenomenon. Today, it is a major challenge for society in all of the northern hemisphere developed countries. Tomorrow, which is to say out to 20 or 30 years, it will be the turn of China and India to face a quickening in the ageing of their populations, under the combined effects of a plunge in birth rates and a lengthening in lifespans. And the day after tomorrow, every country will have known a demographic revolution.

The economic, social and family challenges, posed by longevity, will be still more acute in the southern hemisphere countries than in those in the north. Although strong regional differences may persist, in particular, because of still high fertility rates in certain southern hemisphere countries and of high adult mortality in Sub-Saharan Africa, linked to the HIV/AIDS epidemic, developing countries are globally already entering into the demographic transition phase which is going to modify their age pyramids profoundly. And the transition will be a lot quicker than in the northern hemisphere countries. For instance, the Chinese population<sup>2</sup> is set to age four times quicker than the population in France—a fact which has sparked fears that the burden of caring for a population, both ageing and continuously growing, could apply the brakes to the country's economy. In the less-developed countries of the south, which are still struggling with economic and social fragility, making a growing population of old folks live side by side with a population of underemployed youth risks weighing on everyone's development outlook.

In a context where migrant and financial flows are global, longevity and ageing in southern hemisphere countries are now world-wide challenges.

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**FOREWORD BY ROBERT B. ZOELICK**

Although most of the problems that I and other people have to manage are very difficult to anticipate, you only have to open your eyes to see the demographic one, because demography is destiny. This is true both in developed and developing countries. And I hope to shed light on a certain number of problems, revealing certain interrelations between the developed and developing world. Nick Eberstadt, an economist at the American Enterprise Institute, is doing very important work on demography. Please allow me to illustrate this conversation by citing a few of his studies.

If one analyses projected changes in demographics out to 2030, one uncovers astonishing data, like the fact that Latin America and the Caribbean are part of regions where ageing in the population is quickening the fastest in the world. At the same time, one notes a general decline in the population of working-age individuals in Europe, with a very pronounced fall in the Baltic countries, Russia and China. Still more astonishing, one observes that the “youngest” countries are also those which age the fastest. More than a simple demographic curiosity, this poses a very real challenge for these countries, which risk becoming old before they can become rich. For individuals, the increase in longevity is good news, but for society, it means just that many more retirees. In these countries, like the US and the EU, demographic upheavals will have considerable implications. For example, we know that during the recent financial crisis, specialists pointed their fingers at excessive savings at the level of the world economy. However, looking at the news today, it is now a “lack of savings” which is faulted, with as an unexpected consequence a probable mismatch between financial policymaking today and the economic situation in the years to come.

**Henri de Castris:** I first want to talk about China, because today it is considered as the main growth locomotive in the world economy, or at least, one considers that it plays an increasingly important role and that its contribution to world growth is identical to that of the United States. You have been an expert in Sino-American relations for a very long time. China’s economic leadership is supposedly long-term. Otherwise, the country is going to be confronted with an unprecedented upheaval in its demographic structure under the influence of quickening ageing in its population. How will the Chinese manage in political terms? And is it possible that Chinese growth will slow earlier than we anticipate?

**Robert Zoelick:** Different variables come into play when one talks about problems in the future. First, I think that China is on the verge of reconsidering its one-child policy. Moreover, one notes that a change is already in progress in urban areas—a certain loosening in this key policy, based on decisions made by Deng Xiaoping and which go back even to Mao. There is also a debate over how to balance consumption and savings in the context of a world economy. If one examines their next 5-year plan, for reasons of their own, the Chinese are trying to find out how to proceed with that balancing act, including devoting more

resources to health and retirement. Next, they then must decide how to guarantee appropriate outcomes. Consequently at the level of Chinese internal policy dialogue (but also with an international twist), there is an ongoing debate on the best way for the country to benefit the most effectively from the experience of other countries. Daniel Vasella made a very interesting presentation on the ways countries showcase differing performances in matters of care for various diseases. Like in many other fields, China is actively interested in what others are doing. The third aspect is savings. Chinese savings are likely to be more and more necessary within the country's own economy and in other emerging markets. That suggests that the EU and US, which depend heavily on savings to finance both public spending and investment, should be asking themselves, over the next 10 years, where they are now going to find the money.

*“One observes that the ‘youngest’ countries are also those which age the fastest.”*

**Henri de Castries:** Consequently, structural reforms are more than ever necessary in the US and Europe to face this situation. One important change in developing countries was the extraordinary growth in the working age population, between 2010 and 2030 in Sub-Saharan Africa. What does that imply? We also know that the level of savings is not the same in Sub-Saharan Africa and we are aware of the important challenges in matters of health. How will all these factors affect Africa during the next 10, 15 or 20 years?

**Robert Zoellick:** There are several challenges to take under consideration. The World Bank and groups, such as the Bill Gates Foundation, have worked hard on contagious diseases in terms of return on investment; we now know that enormous progress can still be made in managing certain illnesses, such as malaria or tuberculosis. However, we are also seeing the danger increase at the level of non-contagious diseases in all of the developing countries. Daniel Vasella spoke of diabetes, heart disease and others. These diseases are set to play a role in creating new challenges, linked to their own development in the field of healthcare.

In association with the Bill Gates Foundation, we have studied the way that medical care is provided in Sub-Saharan Africa and, to everyone's surprise, we remark that 50-60% of treatment comes from the private sector. Certain groups, in particular in Europe, are ill at ease with the situation, because they would prefer that it were the public sector, shouldering the burden, but in that case, the care-giving would not be of good quality.

In fact, the public sector does not have the resources to ensure the service. One of the facts that we are studying also reveals certain changes in the international system. In India, 80-90% of medical treatment is supplied by the private sector and the different schemes essentially depend on the hospital system. They exhibit

> extraordinary productivity factors and quality in certain areas, such as heart surgery and treatment for cataracts. Their laws are very different in matters of doctor responsibility. Consequently, their fee scales are much more reasonable for the same kind of preventive medicine, while to be frank, they use their equipment 24/7. We are working with Indian medical care providers in order to see if their different economic models can be transposed to Sub-Saharan Africa—which illustrates growing south-to-north and south-to-south movements in what used to be thought of as a north-south world.

*“It would be a good idea to discuss prolonging the process for 50-year-olds.”*

Another challenge is human migration, and it concerns not only countries in Sub-Saharan Africa, but also the developed countries. While the working-age population is declining in Europe, it is going to grow considerably in Sub-Saharan Africa.

There exist different types of migration. One type (unplanned and which can be perceived as a kind of “invasion”) is often the result of social unrest. However, human migration can also have mutually beneficial effects. This is a political challenge for today’s leaders.

Data from current projections suggest (and this concerns both the developed and developing countries) that it is already today when politicians will have to begin to make choices which are going to determine whether demographic changes will be a burden or an opportunity.

In general, one quickly realises that older workers often offer more understanding, experience and know-how. Correctly employed, they boost productivity. Consequently, it is time to think about how to grow savings in order to fuel investment, which improves the productivity of workers, and how to manage these workers so as to increase their productivity.

Of course, that raises questions of employment policy and flexibility, with the facts now contesting certain arguments in the classic debate on the topic. For example, Europe and the US have always had the feeling that retirement was necessary in order for youth to have their chance.

A growing number of studies by the OECD reveal that this is not a zero-sum mechanism. Even if you give older workers the possibility to add value and productivity, that still creates opportunities for youth. The concept is logical if one considers that a company’s business is not like a zero-sum process, but rather like the creation of growth opportunities and economic choices. However, it is also good to know how to manage change and consider all of the possibilities. In countries which are more favourable to part-time work or to women and the elderly working, these levers can have an even greater influence on productivity. One also has to take into account the fact that older workers cannot do the same

physical work and in some cases need to work closer to their homes. Daniel Vasella evoked urban strategies. One might begin to involve the elderly in the planning process. It is also a plus when countries foster a return to the job market for women who have been temporarily unemployed, such as when raising their children. As you see, there is a whole spectrum of different measures that favour a variously active population. Let's talk about training. When people say training, after the end of years of education, in developed countries, they tend to focus on the age group of 30-40. It would be a good idea to discuss prolonging the process to 50-year-olds, in order that it might also profit ongoing training. Therefore, a part of the solution (both for developed and developing countries) consists in getting out of the rut of outdated policies in matters of work, savings and healthcare.

**Henri de Castries:** In response to your argument that it is not a question of a zero-sum mechanism, I would like to evoke with you some European data. France is currently the country where the rate of unemployment among the elderly is the highest and also is a country where unemployment among youth is the highest. Compare that with Nordic countries which have employment rates among seniors and youth which are much better. What are the lessons learned here?

**Robert Zoellick:** This is a good example of the legacy and weight of history. However, we have to know when to call into cause basic precepts when situations evolve. Financial Times economics commentator Martin Wolf has explained to me the historical origins of this situation. In substance, he explained that after the 1930s, when unemployment was very high, the basic social contract in most Western European countries consisted in saying that people should not enter the job market too quickly. They were encouraged to spend more time in their studies and in other activities. What is more, they retired earlier. Consequently, Western Europe made at that time the choice of targeting an age group, mainly made up of men, who were the most productive, since they benefitted from targeted measures. Associated with both an upstream and a downstream social system, these measures made it possible to reach a certain level of productivity and a return to growth. The difference in Scandinavia, even in those days, was (and still is) that more effort has been made to bring women into working life. Those countries have had the best rates of employment throughout this era, which has allowed them to adjust for a portion of the other variables.

That is why we now have to deal with a body of work legislation, a social contract and a system of public policymaking which was conceived to solve the problems of the 1930s, which is understandable. However, one can now legitimately think (given today's data) that it is useful to revise certain aspects of that social contract. The objective is not to make the situation more difficult for people. As I already said, concerning certain policies that relate to work, the objective is to try and find solutions to help people remain productive at work or in society longer than previously, whether that is women raising children, part-time workers or others. In the same way that we are relying on information technology to create flexibility, we can also rely on it here.

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**Henri de Castries:** You work with governments daily, in developed as well as developing countries. Why is it so difficult to sway opinions? Why is it so difficult to change policies in place, so that they take into account current data?

**Robert Zoellick:** To be honest, people are often afraid of change, and when they finally accept it, they tend to have high expectations. A co-worker who has looked forward all of his or her life to retiring at a certain age, with a certain standard of living, is probably not going to be keen to work a bit longer. However, when people realise that their standard of living and the public or private benefits hoped for are perhaps not on the cards... well, their expectations change and the people themselves change to adapt to the new deal. And it is no fault of politicians that this is not easy. One must first explain to people how circumstances have changed, and then make them understand that it will help if they can adapt to that change.

Certain countries are models, even in the European Union. For example, the Netherlands are ahead of the game in terms of flexibility for their working population. They have also made interesting progress in the area of healthcare. So to come back to Daniel Vasella's arguments, the costs and services provided vary considerably from one country to another. Some rely on institutionalised systems, whether based on public hospitals or other resources, which allows the elderly to preserve to some degree their lifestyles or to get relief for a portion of their care. One can thus hope that other countries will take a long look at these examples. Of course, each country thinks that it is unique; however, since the World Bank federates 187 members, it naturally has an interesting outlook in so far as its vision encompasses different countries and different situations. Sometimes, there are interesting best practices in developing countries which can offer a wealth of teaching for developed nations.

**Henri de Castries:** Japan and South Korea are ageing societies with a high degree of innovation. One has the impression that they invest more in technology than any other developed country, confronted by challenges of ageing. Have you studied the cases of these countries and what is your opinion?

**Robert Zoellick:** My knowledge of Japan is more from past experience than from the World Bank. Japan faces a complex situation, while it also has a relatively unique social order. Personally, I think that one factor, which poses the biggest problem in the country, is immigration and how to integrate foreigners with the active population, because Japanese society is fairly closed in this sense. Even Koreans, whose families have lived there for several generations, are not always truly integrated. It is a considerable disadvantage.

Obviously, there are different types of retirement systems in Japan as well as relatively high levels of savings; however, all that is at loggerheads with government policies that have resulted in rather large deficits for the last 10 years.

The upshot is both good and bad. As a percentage of GDP, the Japanese national debt is very high, although mainly carried by the country's financial institutions. That means a certain level of financial security, but also creates a problem, because one might wonder if the money is invested in productive development or in what economists are calling a form of financial oppression, which uses the savings system to finance perpetual debt. More generally speaking, and a problem that arises the moment when governments attempt to manage these side effects, how do we know if the policies adopted incite or not financial institutions to hold even more public debt? World leaders are not about to use terms like "financial repression," because that would not be very reassuring. However, they can say that it is necessary to hold a large portion of public debt for reasons of financial strength and national security—which is just another way to say the same thing.

About South Korea, the statistics on ageing are rather striking. Koreans have come to grips, already for a certain time, with the need to adapt to those problems, to change the nature of their workforce and its training.

They are a case in transition to the extent that per capita income 50 years ago was probably below that in Egypt. South Korea has been particularly successful in terms of its growth and development. The process was at first in the hands of government; however, the fallout from the 1997 financial crisis led it to recognise that government control of financial capital had gone as far as it could. Now, the nation is trying to enable more flexibility in investment spending and direct it towards more productive uses.



# REPORT FROM AXA AND THE ECONOMIST INTELLIGENCE UNIT

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*Rising longevity and its implications  
for business: a silver opportunity?*

# RISING LONGEVITY AND ITS IMPLICATIONS FOR BUSINESS: A SILVER OPPORTUNITY?

By Aviva Freudmann

*Research Director*

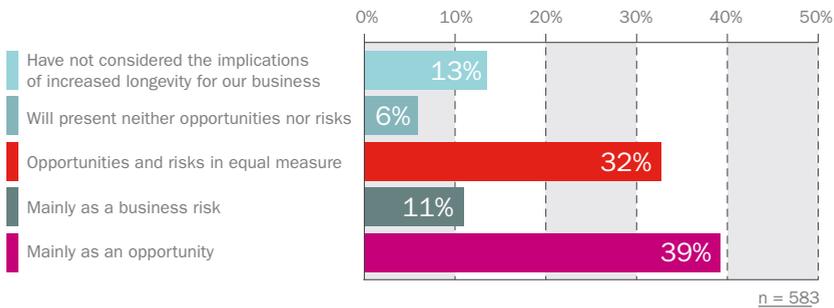
*Continental Europe, Middle East and Africa*

*The Economist Intelligence Unit*

We started the research with the assumption that a great deal is known about the impact of an ageing population on public finances, but what are less known are the implications for business of having a substantially higher average age for both consumers and employees. Therefore, in this report we looked at the business impacts of rising longevity as well as the degree of corporate preparedness for it. This focuses both on the risks and the opportunities and looks at both the internal workforce and consumers.

## BUSINESS IS LARGELY OPTIMISTIC ABOUT LONGEVITY'S BUSINESS IMPACT

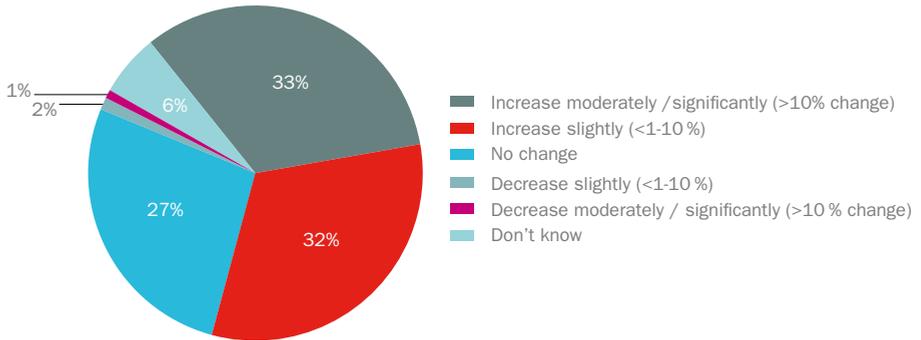
If your company has thought about the implications for its business of increased average longevity, does it view this change as mainly an opportunity or mainly a change for the business over the next five years?



Business is largely optimistic about the implications of longevity for their marketing purposes, their roles as sellers of goods and services, and their roles as employers. Longevity is mainly seen as an opportunity. Out of our sample of close to 600 senior executives worldwide, 71% saw opportunities in longevity, compared with 43% who saw risks. Nearly four times as many saw only opportunities compared to those who saw only risks; 39% saw mainly opportunities compared to 11% who saw mainly risks.

> **BIG GROWTH OPPORTUNITIES AHEAD**

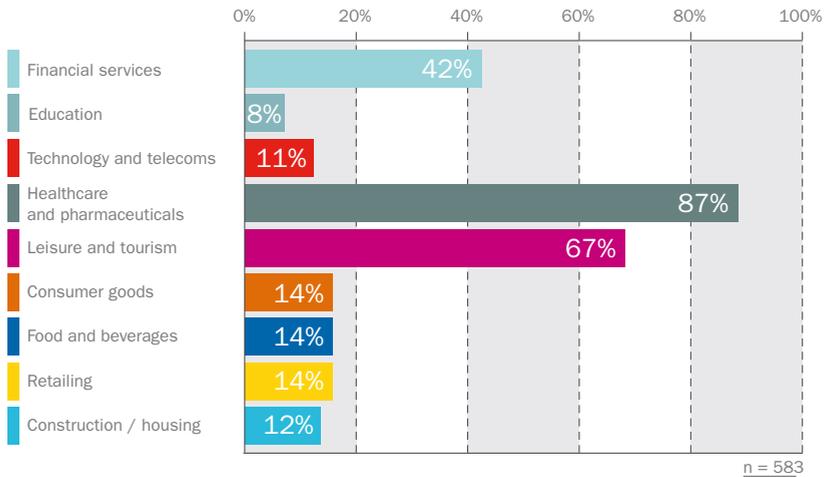
How do you expect the proportion of your revenue that is derived from older customers to change over the next five years?



There are big growth opportunities ahead, particularly for those companies aware of changing demographics and doing something to prepare for them. We found that it is a big challenge for governments but represents quite a goldmine for business. Two-thirds of the companies we interviewed expected older consumers to account for a greater proportion of their sales within the next five years. We found, in a separate question, that 40% of executives will market an increasing proportion of their products and services specifically to older consumers during the same five-year timeframe.

**SPECIFIC GROWTH OPPORTUNITIES FOR CERTAIN PARTICULARLY IMPORTANT SECTORS**

Which, if any, of the following industries is likely to benefit most over the next five years from the prospect of increased longevity?



We looked in a little more depth at which sectors are more likely to benefit, and we found that these are healthcare and pharma above all, 87%; the next was leisure and tourism at 67%; financial services are also likely to benefit from the new demographics. Interestingly, there were a few companies that said there was not any particular sector which would suffer as a result of the increasingly older demographics of the consumer base. The only companies deemed likely to suffer as a result would be those which would fail to adapt to it and change their marketing and products mix.

> **SMALL COMPANIES ARE MORE RESPONSIVE**

We looked at the same question from the point of view of small versus large companies. The question we asked was in which ways they took increased longevity into account, and we found that small businesses seemed more responsive than the larger ones in creating entirely new products and services. However, when we looked at creating marketing campaigns aimed at older customers, the larger companies seemed to have the edge, and when we looked at training sales forces to understand the needs of older customers, the larger companies also seemed to have the edge.

**A VERY HIGH LEVEL OF AWARENESS OF THE POTENTIAL IMPACT OF A HIGHER AVERAGE AGE IN THE WORKFORCE**

In which of the following business functions, if any, does your company take increased longevity into account?

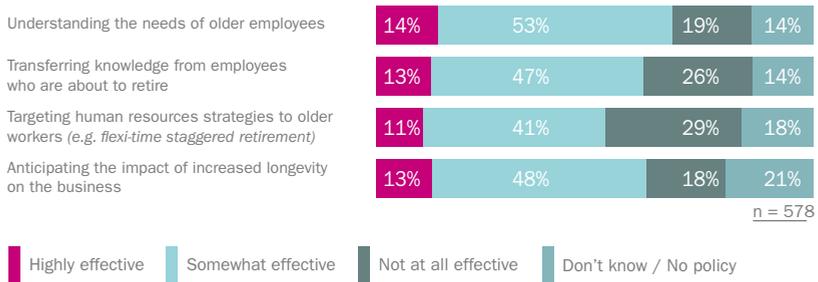


Then we turned our attention to companies in their role as employers of an increasingly older workforce, and we found that the labour force challenge is indeed the highest profile issue for business. The workforce and human resources issues occupied 45% of the sample, and we asked the companies concerned to select all that applied. We asked in which business functions, if any, does the business take longevity into account; 45% said workforce and human resources and 42% said overall corporate strategy.

We also asked whether our respondents agreed or disagreed with the statement that they expected to have a significantly higher proportion of older workers, that is 65 or older, five years from now, and 31% agreed. Therefore, there is considerable belief that there will be an older workforce in the years ahead.

## BUT A TIME LAG BETWEEN AWARENESS AND ACTION

How effective is your company at managing the following aspects of dealing with older customers and employees?

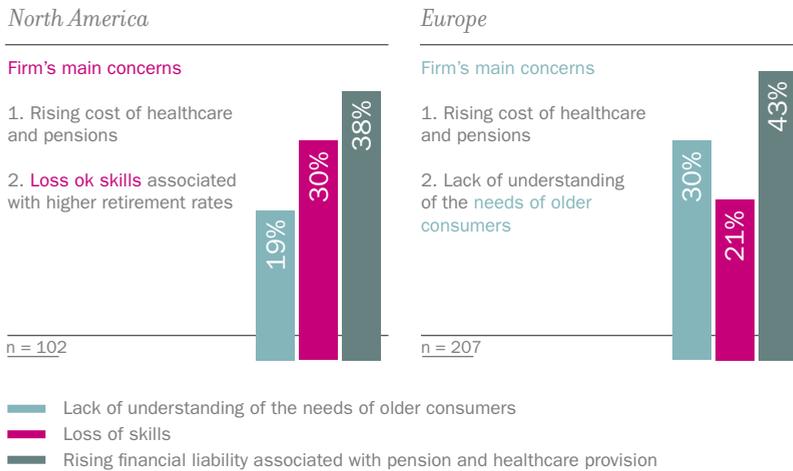


Although there is such an awareness, there is less of a focus on what companies need to change in their HR in order to deal appropriately with their older workforce. Companies said that, indeed, their main weakness was their outdated HR policies and practices. Nearly one in three, 29%, said that their firms were not at all effective at targeting HR strategies to older workers, and 18%, nearly one in five, said they did not know, that it was not applicable, or that there was no such policy in place. Therefore, quite a considerable proportion of companies are really not dealing with the HR resources management implication of the coming ageing of their workforces.



> **THEIR BIGGEST WORRY: BEING ABLE TO MEET THEIR FINANCIAL OBLIGATIONS IN TERMS OF HEALTHCARE AND PENSION COVERAGE FOR OLDER WORKERS BUT THERE IS A DIVERGENCE BETWEEN NORTH AMERICA AND WESTERN EUROPE**

What, if any, are the biggest risks for your business associated with greater average longevity?



Finally, we looked at what concerns companies most of all in light of future ageing in demographics, and here we compared North America and Western Europe. The greatest concern on both sides of the Atlantic appears to be increased healthcare and pension costs that are likely to face companies. There is some divergence when you look at the other questions of loss of skills versus failing to understand the needs of older consumers. The greater concern in North America was loss of skills, that is, not being able to effectively transfer the skills of retiring older workers to incoming younger workers. The greater concern in Europe was lack of understanding of the needs of older customers, and being prepared with marketing campaigns and products that are suitable to an older consumer base.

## CONCLUSION

We found, in conclusion, that corporate leaders will need to assess the impact of rising longevity across several key aspects of their business. One is, of course, their overall corporate strategy and the need to adapt business models. The research identified HR policies as a key weakness, that is, they need to create greater job and career flexibility. We asked the respondents as individuals whether they would work beyond the retirement age if they had the opportunity to do so, and the overwhelming majority, 79%, said that they would like to work beyond a mandatory retirement age if they had the opportunity to do so, as long as the work was structured in a flexible way.

We also found that R&D is an area that companies need to look at more in order to tap into the changing needs of an older consumer base; sales and marketing also need to create more appropriate marketing campaigns for new demographic segments and to train sales teams appropriately.

I would like to leave you with a quote from one of our in-depth interviewees, Jan Willem Kuenen, from the Boston Consulting Group, who said that the coming demographic changes will require companies to shift gears and adapt.

## ABOUT THIS REPORT

*A silver opportunity? Rising longevity and its implications for business* is an Economist Intelligence Unit report, sponsored by AXA. It looks at the risks and opportunities faced by businesses as they start to grapple with changing demographics, both in terms of their internal workforces and the changing nature of consumer demand. This report focuses on trends in developed countries.

To support this study, The Economist Intelligence Unit conducted a global survey of 583 executives during January and February 2011. Of the respondents, 36% were based in Europe, 33% in the Asia-Pacific region and 18% in North America, with 13% from the rest of the world. It covers a wide range of sectors, including financial services, telecommunications and technology, healthcare, pharmaceuticals and biotechnology and professional services. All company sizes were represented: 56% of firms polled had an annual revenue of less than US\$500m, while 35% had an annual revenue of at least US\$1bn. All respondents worked in management functions, with just over half (55%) representing the C-suite or board. The majority (62%) were aged between 35 and 54, but 24% were aged 55 and over, with 14% under 34.

To supplement the survey findings, The Economist Intelligence Unit also conducted wide-ranging desk research and in-depth interviews with a range of experts and executives.

This report in its entirety is available at  
[http://longevity.axa.com/en/ecomist\\_report.php](http://longevity.axa.com/en/ecomist_report.php)

# OPENING THE DOORS TO THOUGHTFUL CHANGE

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EUROPEAN **YOUTH** PARLIAMENT  
PARLEMENT EUROPÉEN DES **JEUNES**

# AGEING CHALLENGES AND GROWING OPPORTUNITIES



The ageing population will question social structures and lead us to reconsider our ways of living and organising society in general. Europe will soon have more citizens over the age of 60 than under the age of 20. This change will pose a considerable economic challenge, but it should not only be considered in economic terms. Today's youth will live longer and in better health than previous generations and this progress is a real opportunity for our world. This trend and its potential positive consequences must however be clarified and publicised for the new generation not to perceive seniors as a burden on their own living conditions.

Young people from Western countries are currently faced with a great paradox. They have more and more years to live, but also more and more difficulty in ensuring suitable living conditions. Intergenerational conflict must be regarded as a serious scenario, as access to stable jobs is tight and gaps between generations are increasing.

As members of the European Youth Parliament, we believe generalised demographic change may well be an opportunity, if bridges can be built and new models adapted accordingly. In this perspective, we think future solutions will have to be inclusive in three ways:

1. They cannot be detached from strong investment in youth because, even if they will not be the more numerous, youngsters will always remain a great resource in terms of innovation and ambition for our world,
2. They should avoid drops in social status and facilitate youth's integration within working life so as to allow new generations to reach the same socioeconomic treatment as the previous ones in a comparable lifespan,
3. They should aim at strengthening links between young and old in order to turn competition between senior and junior workers into supportive and profitable cooperation.

We believe that in developing new inclusive models, which deal with the challenge of an ageing population, civil society can definitely be a key player. Organisations, unions and informal groups of all kinds have the capacity to prevent intergenerational conflicts. They help all individuals to play an active part in the resolution of the world's pressing issues, thus promoting and supporting the inclusion of all within society. The increased mutual understanding and lifelong learning opportunities which these players can provide, is definitely one of the keys to better integration between youth and ageing populations.

Ageing populations will jostle our society. The lack of investment in favour of youth cannot be an adequate solution to tackle future challenges. Convinced that civil society is part of the solution to upcoming challenges, we will carry on working to reinforce the social links between all Europeans regardless of their age.

**Ville Vasaramaki** (Finland):  
Executive Director of the European  
Youth Parliament – Finland

**Ance Kaleja** (Latvia):  
Former President of the European  
Youth Parliament – Latvia

**Marco Di Giusto** (France):  
President of the European  
Youth Parliament – France

**Lacina Kone** (France):  
Executive Director of the European  
Youth Parliament – France

**Jörg Körner** (Germany):  
Former Member of the Board of the  
European Youth Parliament – Germany



**AXA**  
Research Fund  
Through research protection

# FOSTERING NEW UNDERSTANDING AND PREVENTION

The AXA Research Fund is a major initiative in favour of scientific patronage to support different researchers, who are striving to understand and prevent risks, which weigh on the environment, the human condition and society. In the last 3 years, the Fund has already financed more than 250 fundamental research projects, including money for 200 young researchers (writing thesis papers or conducting postdoctoral research) who are working in laboratories around the world. AXA's support enables them to work and learn under the best possible conditions. In addition to funding, AXA gathers together every year its young grant recipients in order to meet a celebrated researcher, to exchange best practice and to help them establish strong ties in the scientific community.

The Fund has also made 11 donations of several million euro each to worthy research institutions. These endowed chairs (or professorships) aim to attract today's most noteworthy scientists, so as to ensure exceptional training for their future colleagues.

## RESEARCHERS REPRESENT 4,2 DIFFERENT NATIONALITIES

The AXA Research Fund provides support for 257 research projects in 22 countries. For instance, the National University of Singapore has received financing for research into a possible genetic predisposition to risk-taking. The research project aims for a better understanding of biological mechanisms, as sources of difference in individual behaviours, when confronted with risk. It uses methods from behavioural and experimental economics as well as from biological science.

The AXA Research Fund also makes it possible to attract to the "Old World" talent from outside Europe, notably with its creation of an endowed chair at French state-run institution of higher education and research *École Polytechnique*. An endowed professorship in cardiovascular cellular engineering is now held by American researcher Abdul Barakat. The intent is for engineers to forge ahead with medical

devices that help prevent cardiovascular accidents, the world's leading cause of mortality. For the first time, atherosclerosis will be the subject of an interdisciplinary approach, combining biology and engineering. Today, 20% of devices in cardiovascular surgery (stents and small, coiled springs, etc.) generally fail in the year after they are inserted. The creation of the AXA-Polytechnique endowed chair in cardiovascular cellular engineering encourages a form of research at a time when few European engineers are working in the field of biology. The goal is to attract upcoming engineers to biology and to create a Master's Programme, focused on teaching about basic interfaces between biology and mechanical engineering.

In another field, this time at business school *HEC Paris*, the Fund has made a donation to research into understanding decision-making processes. Through an endowed chair held by Israeli professor, Itzhak Gilboa, the objective is to develop at the same time academic research, workshops and conferences, bringing together researchers from different disciplines. This should bolster the capacity for research at *HEC Paris* in social and decision sciences, thus reinforcing training for its students in leadership skills.

The AXA Research Fund has also endowed a permanent chair at the University of Strasbourg, France. Work follows research into supramolecular chemistry, initiated by Jean-Marie Lehn, co-winner of the Nobel Prize in Chemistry in 1987. The endowed chair aims in particular to develop applications in medical science for supramolecular chemistry in a quest to find new solutions for therapies to treat age-related diseases.

## A MAJOR THRUST OF THE AXA RESEARCH FUND IS INVESTIGATIONS INTO LENGTHENING LIFESPANS AND THEIR CONSEQUENCES.

In that area, €12.5 million was granted over the last 3 years to finance 61 researchers and their teams:

- 52 doctoral and postdoctoral awards made for a total amount of €4.35 million;
- 5 international research projects financed (3 in France, 1 in Switzerland, 1 in the UK);
- 3 chairs endowed in France and 1 in the UK for a cumulative amount of over €6 million.

For more information and to see videos of all the speeches, rendezvous at our website at <http://longevity.axa.com>



For more information about AXA, visit [axa.com](http://axa.com)

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