LONGEVITY RISK AND FINANCIAL MARKETS[*]

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October 2006

"Then the Lord said, 'My Spirit will not contend with man forever, for he is mortal; his days will be a hundred and twenty years'." (Genesis, 6:3)

"Youth is sweet and well / But doth speed away! / Let who will be gay, / To-morrow, none can tell." (Lorenzo de' Medici "il Magnifico", Trionfo di Bacco e Arianna; trans. L. de' Lucchi)

"…the average duration of human life is proved to have increased in recent years. The calculations of various life assurance and annuity offices, among other figures which cannot go wrong, have established the fact … it is governed by the laws that govern lives in the aggregate." (Charles Dickens, Hard Times)

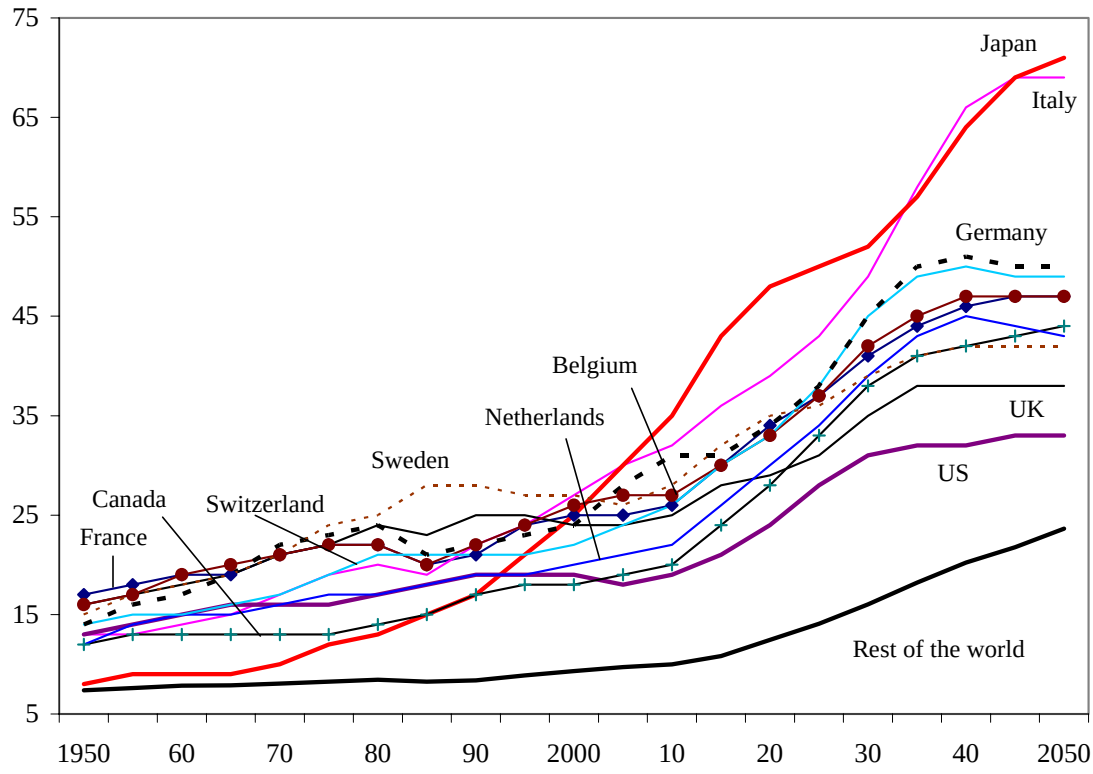
Introduction

In his millennial perspective on *The World Economy*, the eminent economic historian Angus Maddison underlined the spectacular rise of average life expectation that occurred in the nineteenth and in the twentieth century: from a life of 24 years expected at birth in the year 1000 in Western Europe, the Western Offshoots (United States, Canada, Australia and New Zealand) and Japan, a figure of 36 years is estimated for the year 1820, reaching 46 years in 1900, 66 in 1950 and 78 at the turn of the century. Less spectacular, but still very large, is the

[*] Keynote speech to the 26th SUERF Colloquium, Lisbon, 12-14 October 2006. In part this speech is based on material and ideas developed in a report on *Ageing and Pension System Reform* prepared for the Deputies of the Group of Ten in September 2005 by a group of experts that I chaired. I also wish to thank Fabio Panetta, Marcello Pericoli, Marco Protopapa, Carmelo Salleo and Pietro Tommasino for their help and many useful discussions.

progress in the rest of the world, where on average life expectation at birth is currently around 65 years. This result reflects for a large part the dramatic fall in infant mortality. Over the last half a century, however, life expectancy at old age has also increased dramatically. Following this secular rise in longevity, and partly due to the lower fertility rates, as the baby-boom generation reaches retirement the world population is now ageing at a very rapid rate (Fig. 1). This is particularly evident in OECD countries, but is also taking place in several emerging economies, most notably in China.

Figure 1 - Old-age dependency ratios
(ratio of the population aged 65 years or over to the population aged 15-64, in per cent)



Source: United Nations Population Division, *World Population Prospects: the 2004 Revision.*

Living longer and in good health is certainly a marvellous achievement, especially if one has the resources to enjoy it. It also poses, however, a series of challenges for public finances and the working of labour markets, with wide-ranging effects on consumer preferences and corporate strategies. With an increasing number of elderly people requiring care and the necessity of reforming pension systems devised in an era of lower life expectancy and higher fertility rates, the

consequences on age-related public expenditures might be severe, as many studies by the OECD, the European Commission, national agencies and academic economists have indicated.

Macroeconomic effects of population ageing range from impacts on labour supply and its rate of utilisation to investment, productivity and consumption patterns, external balances and cross-border capital flows. Among them, an educated reading of some recent empirical work suggests that:

- Growth and saving rates might tend to fall relative to trend. However, if rather than relying on increases in pension contributions to balance pay-as-you-go pension systems, contribution rates were held constant, retirement age were gradually increased and replacement rates for new retirees were gradually reduced, savings might increase significantly over the next couple of decades in order for consumption levels to be sustained upon retirement.
- Without substantial changes in retirement age and in other public pension system parameters, strong public spending pressures would be observed, while general government revenues would be depressed. A considerable increase in age-related public spending would also come through the health chapter.
- As industrial countries age faster than younger developing countries, shifts toward current account surpluses might be observed for some time in the former, which would invest in the latter and shift to deficits as ageing becomes more acute. While this fails to match the current constellation of current accounts around the world (the large US current account deficit or the still rising current account in Japan, with China not being an obvious case), the prediction of current accounts moving towards higher surplus in industrial countries is widely shared.
- To the extent that retirees sell their financial assets to a smaller middle-aged generation in order to fund consumption, an increasing old-age dependency ratio may temporarily translate into downward pressure on asset prices, but the size of this effect is likely to be relatively small. Similarly, while changes in population structure may affect potential output growth, real interest rates and the importance of household wealth in the transmission of monetary policy, this

should not be such as to require specific policy interventions or framework changes.

On the pension front, the expected increase in life expectancy is being generally met with higher contributions, lower replacement rates and later retirement, even if the process is by no means linear, necessary additional reforms are under consideration, and the generation of sufficient consensus in society has often proved rather laborious. There is no question, however, that if life expectancy continues to grow at the rates we have been experiencing over the last decades, the exceptional rise in well-being that has been achieved so far, in particular since the Second World War, will be maintained only by keeping a balance between the increase in longevity and a higher age of retirement.

This said, overall the changes in public pensions are likely to imply, ceteris paribus, a noteworthy reduction in retirement income relative to wages. Therefore, demographic developments coupled with the growing need to provide for retirement privately will probably prompt an increase in the flow of saving directed to fund retirement, whether or not this is accompanied by an increase in national saving rates. Furthermore, increases in life expectancy seem lately to have consistently exceeded forecasts and life expectancy estimates have been repeatedly updated. This uncertainty over changes in life expectancy, which is a loose definition of longevity risk, must also be considered in order to ensure that the elderly do not experience significant drops in consumption. While changes in life expectation at old ages certainly still call for policy reforms, the longevity risk can be tackled with the help of financial markets, which have already developed an expertise in managing various forms of risk.

In this speech I will first define longevity risk and discuss some measurement issues; I will then illustrate how longevity risk affects individual behaviour, in particular savings patterns, and how this may impact on financial markets; finally I will discuss the availability and development of financial instruments and markets needed to deal with longevity risk. I will conclude by sketching a few policy implications arising from increasing longevity and the associated risk.

Longevity risk: definition and measurement issues

Demographic changes cause both accidental and systematic deviations of the number of deaths from their expected values. As observed in a fascinating lecture delivered a couple of years ago by Mervin King on *What Fates Impose*, the former is a proper insurance risk, the random variation around a fixed known mortality probability. By its very nature it is a pooling risk and can therefore be swept away by increasing the number of policies. The latter, a collective longevity risk, is due to unexpected changes in mortality trends, i.e. a systematic differential between the number of deaths per cohort and its expected value. This longevity risk is non-diversifiable across individuals, since it affects all of them in the same way and affects the whole portfolio of the insurance provider.

The dynamics of mortality over the last fifty years shows a consistent pattern across all high-income economies. In particular, data show:

- An increase in life expectancy at old ages (65 years and older).
- An increase in the mode of the age of death distribution.
- A decrease in mortality rates at old ages.

In terms of the shape of the survival function, which plots the number/fraction of survivors against age, and the curve of deaths, which plots the number/fraction of deaths against age, the following features are worthy of note:

- The survival function tends to shift towards a rectangular shape due to the increasing concentration of deaths around the mode (at old ages) of the curve of deaths.
- The survival function expands to the right, i.e. the mode of the curve of deaths moves towards very old ages.

Basically, the cohorts that show the greatest improvement in life expectancy are steadily moving upwards. Even more striking is the fact that the pace of mortality improvement at older ages seems to be accelerating over time. It is not clear whether this counters the view that assumes biological limits to the human life-span, say a limit of 120 years as postulated by the Bible (after the ages of

patriarchs….), and it may very well be that survival rates at old ages gradually approach some positive limit rather than converge exponentially towards zero.

To put numbers in perspective, life expectancy at the age bracket 65-69 was between 13 and 14 years for the French, the Japanese and the Italian populations in 1950, between 16 and 17 in 1980 and between 19 and 21 in 2000. This impressive improvement has been common to most industrialised countries as well as to the developing world (though to a lesser extent and with the grievous exception of Sub-Saharan Africa). In per cent, the ratio of life expectancy improvement between 1980 and 2000 has tended to be larger at older ages (85 years and older).

From a financial point of view, while the concentration of deaths around the mode reduces the variance of the distribution and so the related risk, the expansion phenomenon, i.e. the risk of systematic deviations of mortality from the assumed projected behaviour, together with the accelerating trend of mortality decline at old ages, increases risk. These trends highlight the importance of accurate mortality projections based on stochastic analysis in order to provide reliable measures of mortality and of its uncertainty.

Unfortunately, national statistical agencies in industrial countries seem to have systematically under-predicted life expectancy gains, leading to significant under-estimation of the numbers of the elderly, markedly the oldest old. Official mortality forecasts are traditionally based on forecasters' subjective judgments, in light of historical data and expert opinions. A range of uncertainty is indicated by high and low scenarios, built on the basis of subjective opinions. It is common practice to define some upper bound to improvements in mortality, usually in terms of a maximum level of life expectancy, based on biomedical considerations. This leads to a targeting approach, which consists in interpolating between current mortality rates and targets assumed to hold at a given future date, thus leaving room for subjective judgment, and perhaps excessive sensitivity to short-term trends in mortality. In the actuarial profession parametric methods are also popular: they assume a given distribution law for mortality, fit the parameterised curve to past data and project trends in the parameters forward; of course, parameter uncertainty

is crucial. Selecting different values for the parameters, one may construct different scenarios.

Even though multiple scenarios may then be produced, under these two approaches it remains difficult to attribute a probability assessment to each scenario and so obtain measures of uncertainty useful for evaluating financial risks, something akin to confidence intervals. On the contrary, methods of trend extrapolation, i.e. time-series analysis applied to project historical trends in the future, that are widely accepted among demographers, do not suffer from these drawbacks. Particularly popular is the model proposed by Lee and Carter in 1992, where the possibility of age-specific patterns in mortality decline (e.g. that old ages register stronger improvements) is explicitly taken into account. This might prove very useful in forecasting dependency ratios between retirees and active population. Furthermore, this method provides easily understandable uncertainty measures as it allows for a stochastic error term and seems to fit better the actual mortality trend at old ages, not only in terms of life expectancy but also in terms of age distributions of death.

For instance, the Lee-Carter model retroactively applied to US data up to 1925 projects a life expectancy for the year 2000 of 72 years at birth, reasonably close to the actual figure of 77 and much closer than the figure of 65 projected in 1930 by the National Resources Committee of the US government. Using this method, Tuljapurkar, Li and Boe produced in the year 2000 projections for the G7 countries that show average life expectancy gains by 2050 of about 7 years, twice as large as the average gains in official projections.

The Lee-Carter model assumes a constant rate of decline in mortality, a fact in contrast with the accelerating pattern of mortality improvement. Indeed, new recent research has suggested that the official forecast error might prove even larger than that implied by the Lee-Carter methodology. Indeed, there is strong evidence in favour of a historical linear trend in life expectancy across all high-income/low mortality countries: life expectancy has increased linearly at a very remarkable pace, with gains exceeding 2 years per decade. At this rate, life expectancy would rise by as much as about 11 years in 2050.

One should also observe that there are not only forecast errors but also lags in the production, adoption and disclosure of mortality tables. The cross-country variations in mortality assumptions used by company pension schemes seem to be too great to be justified by the differences in the profiles of their members, as a recent study at Cass Business School has convincingly shown. Indeed, this may have dramatic consequences on financial markets and institutions: according to a much quoted calculation by UBS, the FTSE 100 companies' combined pension deficit of more than £40 billion would rise to a £63 billion deficit using French mortality tables, but would become a £3 billion surplus using German mortality assumptions. These differences are simply too large, and call for substantial investment to be made in producing and updating timely mortality tables, as well as in better modelling the uncertainty around the projections.

So as the 2005 G10 report concluded: "Regulators should promote transparent disclosure of mortality and disability projections and pension actuaries should determine the extent to which these projections reflect actual plan experience and how they model and allow for the uncertainty surrounding these estimates in their funding strategies". Indeed, more could and should also come through the market process: in this respect the recent launch of the Credit Suisse Longevity Index for the US population is a major advance.

Obviously longevity risk is not only faced by company pension schemes but by public programmes as well. In order to provide a rough estimate of the longevity risk faced by the Italian pension system, for example, if we take the population aged 50 years and older (assuming that younger individuals would bear most of the cost of pension reforms aimed at correcting the effects of longer life expectancy), we can compute the extra pension payments that they would receive if they lived longer than expected. Applying from 2005 forward the same percentage improvements observed in life expectancy between 1990 and 2002 (year of the latest official mortality table) in net present value terms the cost of the shock would be a little under 320 billion euros, corresponding to about 10 per cent of the present value of pension liabilities implicit in the current system (22 per cent of 2005 GDP, with an average annual flow of about half a percentage point of GDP for the next decade, and one percentage point in the 2020s and 2030s). Note that this is a

conservative estimate of the total cost of longevity risk since it does not take into account the fact that households will be bearing more of it in the future owing to the decreasing substitution rates (pensions are projected to decrease from 60-80 to 40-60 per cent of the last wage, with households likely to fill the income gap with proceeds from their investments in second and third pillar instruments).

From this perspective as well, therefore, it is crucial to have better and timely updated mortality tables that would allow timely changes to be introduced in the pension schemes and the projections to be surrounded by an uncertainty band to better evaluate the longevity risk. In order to reduce the forecast bias, attention should also be given to smoothing the crude mortality rates published by government statistical agencies on the basis of observed cohort data. After all, we may agree with Charles Dickens' Mr. Gradgrind in *Hard Times* when he says "the average duration of human life is proved to have increased in recent years", while wishing that his faith in the "facts" and especially in the ability of "life assurance and annuity offices" to corroborate them will be reinforced when it is most needed.

Longevity risk and individual behaviour

When making their saving and portfolio choices, farsighted investors take longevity risk into account. However, their choices are constrained by the size and structure of public pension systems and by the degree of market incompleteness (in particular, by the limited availability of well-functioning annuity markets), which in turn may depend on the level of potential demand and the same longevity risk. Indeed, perfectly rational investors in an economy with complete markets are in any case exposed to the aggregate uninsurable consequences of unexpected changes in average longevity. It has also been convincingly argued that, in general, individuals and households fail to properly weigh the long-run consequences of their own present decisions. Therefore, longevity risk is likely to affect households' behaviour in many ways.

Under certainty, one not so surprising implication of the life-cycle model is that individuals should react to an unexpected increase in longevity by working longer and by saving more. When longevity itself is (perceived as) uncertain, there is

empirical evidence showing that the precautionary component of household savings is not negligible. Indeed, it is reasonable to assume that the saving rate of agents increases with the amount of longevity risk that they face. After all, the precaution motive ("to build up a reserve against unforeseen contingencies") was readily recognised by Keynes in *The General Theory* as one of the main "objects of a subjective character which lead individuals to refrain from spending out of their incomes". The strength of this relationship is also influenced by the institutional characteristics of the economy. In particular, if fairly priced annuities were available, savings would be only modestly affected by longevity risk (or at least its idiosyncratic component). The precautionary motive would also be less strong if a sizeable public pension system were in place (at least if we assume away intergenerational altruism); in countries where the social security system has means-tested elements and/or displays a high degree of progressiveness (as in the USA or the UK) this is especially true for the poorer groups in the population. Even without considering public pensions and privately provided annuities, implicit intergenerational contracts inside the household may act as a substitute for precautionary savings, by allowing the sharing of the parent's longevity risk with the children.

The amount of desired precautionary savings decreases if individuals can change their labour supply and their portfolio allocation. On the other hand, labour market uncertainty and financial market fluctuations can themselves be causes of additional saving. While it is reasonable to expect that an increase in expected longevity increases the desired portfolio share of risky assets, especially shares (as longer lived individuals benefit more from the equity premium), we do not know much about the impact of longevity risk on optimal portfolio allocation. It is plausible, however, to assume that investors should react to an increase in longevity risk with a reduced willingness to take other kinds of risks, even if they are unrelated to longevity. This in turn should imply that, when saving for retirement, investors may demand a greater amount of long-term securities, which have a lower reinvestment risk; the demand for stocks should also go up as short-period fluctuations tend to cancel out in the long run. Using the same logic, one should note that the size and design of social security arrangements determine the amount of risk (and in particular of longevity risk) suffered by workers. As a

consequence, social security reform could influence in subtle ways optimal portfolio decisions (a somewhat counterintuitive implication is that shrinking public pensions could actually discourage risk taking).

As has been widely documented, however, investors often behave in less-than-rational ways. This is especially true when economic decisions involve a long time horizon and face several sources of uncertainty, as in the case of adjusting one's saving and portfolio choices to face the risk of an uncertain lifespan. On one side, individuals may not discount future pay-offs at a constant rate. Instead, their discount factor for nearer periods may be larger than the discount factor applied to more remote periods. As a consequence, they may have a tendency to under-save, as saving implies short-term costs in term of consumption, while benefits arise only in the future. On the other side, a tendency to underestimate the role of uncertainty on the realisation of events in the distant future may reduce the perception of the size and impact of longevity risk on one's future needs and means. There is evidence that the decision to save for retirement is indeed plagued by myopia and procrastination, that participants of retirement savings plans rarely alter their contribution levels or rebalance their portfolios, and that default options have long-lasting effects on both variables. As reported by Choi et al. in 2001, in a survey of employees 68 per cent of respondents complain that they save too little for retirement, 24 per cent plan to raise their contributions in the future, but only 3 per cent among them actually does so. Voluntary investment in occupational pension plans seems to be boosted if the plan policy is one of automatic enrolment, and if the matching contribution of the employer is relevant.

As a consequence, mandatory public schemes could be important to reduce under-saving and the effects of inertial behaviour. Furthermore, a widespread presence of myopic saving decisions would imply that government laws and regulations should encourage the setting of default options which minimise the costs of investors' mistakes. In general, however, the understanding of financial products, concepts and risks should be encouraged through the promotion of well-designed programmes of financial education. Surveys of financial literacy and findings of behavioural economics not only show that financial education does not seem

sufficient to ensure adequate saving for retirement, but also that the awareness of the need to be financially educated is rather limited.

Under certainty, an economy in which there are relatively more elderly people with respect to the working age population (e.g. due to an increase in average longevity) should have a higher saving rate, a higher steady state level of capital per capita, and consequently higher wage rates and lower interest rates. Under uncertainty, if agents face an increase in uninsurable longevity risk (and if we exclude the very special case of quadratic preferences and certainty equivalence), there should be an additional demand for savings due to the precautionary motive. In the real world both the effects of increased average longevity and those of an increase in longevity risk are likely to be present and to reinforce each other. Market and institutional failures that may limit a proper response then deserve to be investigated in depth and duly removed.

Finally, besides these steady state effects, demographics can also exert transitory (albeit long-lasting) effects on interest rates and asset prices. An example is given by the danger of the so-called asset meltdown, linked to the retirement of the baby boom generation (here the problem would be caused by a transitory increase in fertility, as opposed to a permanent decrease in mortality). While these effects are theoretically clear, their magnitude is likely to be small, due to the two factors we have highlighted in the previous pages: the institutional features of many economies (in particular, sizeable public pension systems and underdeveloped annuity markets) and the myopic and inertial behaviour of many investors. These two effects are likely to be mutually self-sustained: more farsighted individuals would probably vote to shrink or at least to change the structure of social security systems in the face of worrying demographic perspectives; they would also demand more annuities, reducing their costs. Also the general equilibrium effects induced by demographic developments on financial markets are likely to be smaller in an open economy. Indeed, if capital is freely mobile among countries, it will move from ageing to young countries, reducing the volatility of interest rates and asset returns.

Longevity risk then poses a challenge to households that do not rely almost exclusively on public pension schemes to sustain themselves. If a significant fraction of their income is made of returns on real and financial wealth, individuals that live longer than expected may draw down their wealth too soon, thus entering their final years without enough income to support themselves. Privately funded pension arrangements then become a natural answer. Indeed, in several countries a tendency towards privately funded pension arrangements has already been observed, relying more heavily on defined contributions, and in some cases with pension funds becoming the largest class of institutional investors. Insurance companies also play an important role, and in some countries are currently the main provider of funded retirement saving products. A further substantial increase in the size of the pension fund industry will probably be observed in the coming years, accompanied by a greater influence on financial markets. In the G10 countries, aggregate pension fund assets already represent more than 20 per cent and 10 per cent of equity and bond market capitalisations, respectively, albeit with great variability across countries. It is therefore relevant to examine the recent developments and possible prospects of the pension fund industry.

Relaxed liability management experienced during the 1990s stock market growth, in conjunction with increases in longevity beyond earlier actuarial projections, the 2000-02 sharp fall in equity prices and declining bond yields (increasingly used as the basis for discounting liabilities), has led to the emergence of funding gaps in occupational defined benefit plans in several countries. In particular, relevant duration gaps have emerged between pension funds' assets and liabilities, due to the mismatching of maturities and the insufficient hedging of market risks.

Policy initiatives have aimed at increasing the viability of defined benefits pension systems in the longer run, including through strengthened supervisory oversight and the adoption of more rigorous risk-based approaches. A notable trend has been the continued move in several countries towards defined contribution schemes. Market-based, fair value accounting standards have been introduced. On the regulatory front, measures increasingly require pension plan managers to assess

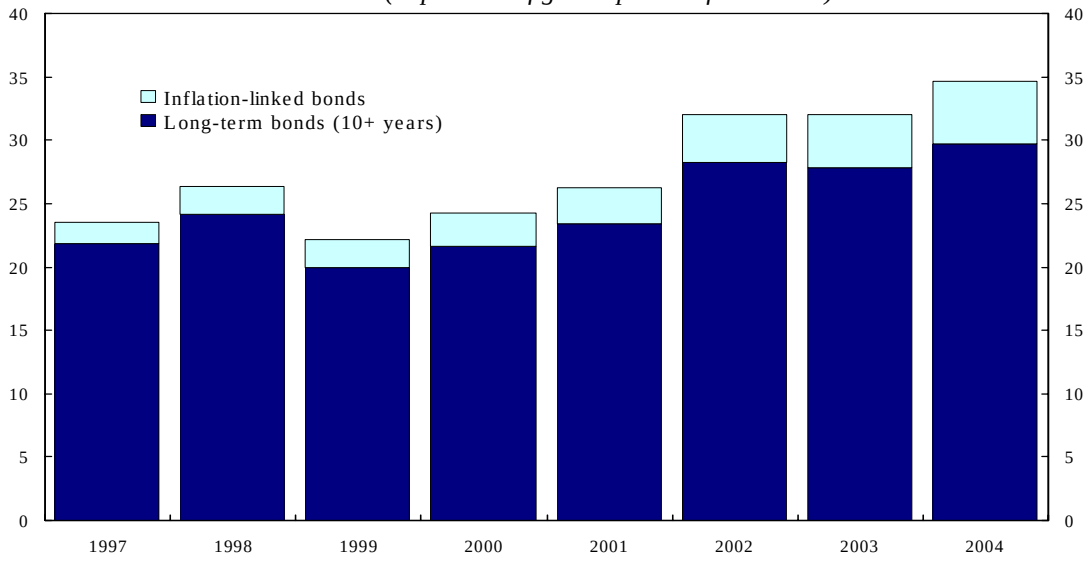
more fully the financial cost of the pension benefit promises offered to plan participants, review pension fund investment strategies and increasingly focus on asset-liability management considerations.

Long-horizon, index-linked and longevity bonds

Currently, however, there is a perceived lack of instruments for pension funds to properly hedge interest rate, inflation and longevity risks. The evidence shows that:

- Most advanced economies' markets for long-dated bonds are still too small relative to the size of pension fund and insurance company portfolios (Fig. 2). Even in the United States, the deepest market for long-term bonds, the market size for maturities beyond 10 years is relatively modest. In the most recent years there has been a return of interest in issuing long and ultra long government bonds but, at around 5 years, the duration of public debt in most countries is still rather short. In most mature markets private corporations, such as capital-intensive industries, utilities, and financial services (banks and insurers), may also wish to issue longer-term securities. So far, however, price uncertainty resulting from the lack of public benchmarks, tax disincentives in some countries, as well as more cyclical factors may have been an obstacle.
- As in the case of long-dated bonds, the supply of index-linked bonds also remains insufficient to meet potential demand. The scale of the shortage of indexed securities is illustrated by the fact that occupational pension funds and life insurance companies in the United Kingdom already have 80 per cent of outstanding long-dated and index-linked gilts. This holds even with an asset allocation to bonds at many funds of only 20-30 per cent of their total portfolio. Indeed, the potential demand for pension funds and life insurance providers may exceed current supply by three times or more (Table 1). Given the limited supply of long-dated and index-linked bonds, fund managers have increasingly employed derivative instruments in order to improve the consistency between portfolio duration and pension liability structure and/or to obtain protection against inflation or interest rate risks. It is not clear how far trustees are aware of this action.

Figure 2 - Size of the G10 long-term and inflation-linked bond markets
(in per cent of global pension fund assets)



Sources: Watson Wyatt; International Financial Services, London; OECD; Barclays; Merrill Lynch; and IMF staff estimates.

- Also, longevity risk management could benefit from the availability of longevity bonds, which could, in turn, encourage insurance and reinsurance companies to increase their supply of annuity products. Mortality-linked securities could also provide some hedge against longevity risk, even if not a perfect one as mortality, while certainly correlated with longevity, is unfortunately not limited to the very old. Another possibility, to date still hypothetical, might be the recourse to macro-swaps, through which (for example) the pension fund and health care industries may exchange their opposite exposures to longevity.

It is a fact that financial institutions which are exposed to longevity risk and need ways to manage it have traditionally been hampered by a scarcity of hedging instruments. The first market instruments suitable for hedging longevity risk have recently been introduced by financial institutions: e.g. the 3-year mortality bond issued by Swiss Re and the 25-year longevity bond presented (but not placed yet) by the European Investment Bank. The first instrument is a bond whose principal payment is tied to an international mortality index. The second is a (group) annuity bond whose annual coupon payment is tied to the survivorship of some reference

population; as the members of this population die off, the coupon payment gradually falls.

Table 1 - Potential demand for long-term and inflation-linked bonds: Selected countries
(in billions of US dollars; amount outstanding at the end of 2004)

	Current supply		Potential demand		
	Corporate and government long-term bonds	Inflation-indexed government bonds	Life insurance investments and pension funds total assets	50 per cent asset allocation to bonds, in per cent of long-term and inflation-indexed bonds	75 per cent asset allocation to bonds, in per cent of long-term and inflation-indexed bonds
United States	1,266	223	13,432	451	677
United Kingdom	241	155	2,476	313	469
France	178	92	1,055	195	293
Italy	241	28	370	69	103
Japan	427	22	2,251	251	376

Sources: Ageing and Pension System Reform, Report to the G10 Deputies, 2005; *Pension Markets in Focus*, OECD Newsletter, December 2005.

Although it raised a strong interest in the financial community, the EIB longevity bond did not meet market demand and had to be withdrawn for redesign. This experience has raised a number of issues which must be dealt with in order to create a proper market for longevity risk. Among them, as capital is costly and there are further risks to hedge (e.g. interest rate, inflation, investment risks) which already absorb capital, it might be difficult to stand by the requirement to commit the entire principal. Longevity securities must have a high degree of gearing in order to raise sufficient demand from longevity exposed financial institutions. This makes a case for mortality derivatives like swaps or forwards. Furthermore, demand is potentially large, calling for issues of significant size, suitable to create adequate liquidity (the EIB bond was a mere 540 million GBP issue). Also, as longevity risk tends to concentrate in the long term (due to the difficulties of projecting long-term mortality), 25-year maturity bonds might not be long enough. Finally, basis risk (i.e. imperfect hedging capacity) stems both from the maturity mismatch and the imperfect matching between the mortality experience of the reference population for the security and that of the group of annuity or pension

fund claim holders. From this experience, however, much has been understood, and this is the foundation of progress.

In order to allow some degree of intergenerational risk sharing, an intriguing proposal (by Boeri et al., 2006) consists in promoting collective pension funds that mix older and younger generations of participants. The main idea is to shift from final-pay with recovery premium schemes (which, by the way, distort labour markets by charging larger contributions in case of a shortfall of assets with respect to liabilities) to career-average with conditional pension rights schemes that allow younger workers to share wage risk with older ones and reduce the increases in contributions that would be needed should the fund experience a shortfall in assets with respect to its liabilities. In essence, older participants would have senior claims on the fund's assets, while younger ones would have equity-type claims. While a difficulty might be raised by the fact that the attribution of participants to the older and younger generations might itself depend on the demographic changes, a question linked to the preceding discussion is that the shift from an equity to a bond portfolio is essentially a shift from a variable to a fixed return. Again, sufficiently deep markets for long-horizon and index-liked bonds would be needed.

Annuities

As observed, households will increasingly face longevity risk, directly or indirectly. Much can be done to provide insurance against its idiosyncratic component, to maximise the share of wealth allocated to face it and to share it with future generations. In general, as individuals and households are increasingly charged with the responsibility of managing their own retirement savings, the availability of a variety of retail products becomes crucial. For instance, "life cycle" funds have been developed that allow portfolio rebalances consistent with the changing risk profile of workers as they age. In principle, structured products (including capital or performance guarantees) offer diversified risk/return profiles; however, given their higher complexity and risk exposure, they are likely to require the introduction or strengthening of consumer protection measures. Increasingly important for individuals and households would then be the existence of well

developed markets for annuities, financial contracts that convert long-term savings into dependable income streams after retirement.

Given the magnitude of longevity risk, one would expect individuals to insure themselves against it; however, the markets for annuities, the most widespread instrument devised for this purpose and a product that has been sold for centuries, are generally underdeveloped (especially for individuals) and the number of institutions providing annuity products is declining. For example, in the United Kingdom, a country in which Social Security offers only a small coverage and individuals are expected to live off their (adequately invested) savings, annuities cover less than 10 per cent of longevity risk in the private sector.

There are many possible reasons, on the demand as well as on the supply side, why annuity markets are less developed than expected. Among them:

- The existence of annuitised resources from (public or private) defined benefits plans; bequest motives; lack of understanding of annuity products by households.
- The taxation design; in some countries, for instance, fiscal rules have historically favoured lump-sum withdrawals at the expense of annuities.
- Real or perceived cost issues, due in part to adverse selection effects, although these can be partly overcome via mandatory annuitisation, as suggested by some recent experience, as well as opaque or inefficient pricing by insurance companies.

However, on the money's worth of annuities the evidence is mixed: adverse selection certainly plays a role but the discount on the fair value is not very high in many countries and seems to be shrinking (it is almost never higher than 10 per cent, often lower than 5 per cent). Furthermore, risk averse customers should be willing to pay for a product that does not give back 100 per cent of its money's worth in order to be insured.

A further issue might be that annuities insure against longevity risk but, as they are sold now, they do not protect against other risks, which might be deemed more

relevant by many households. For example, most annuities do not protect against inflation risk, while investing one's wealth in equities does, to a large extent. Standard annuities distribute income in an inflexible way and do not provide protection against liquidity shocks, for example related to health issues. Finally, annuities do not give back any upside of higher-than-expected investment returns and are therefore an inferior investment vehicle (although they should really be considered an insurance product).

On the supply side, in order to match assets and liabilities insurance companies should invest in assets with a duration that is comparable to the duration of an annuity. However, the latter is high and, as we have seen, there are not many assets with a similar duration; therefore, insurance companies would be taking on some financial risk on top of longevity risk. A more subtle issue, perhaps, is the systematic nature of longevity risk, which can only be shared across generations. Only the idiosyncratic component is diversifiable, the collective risk has no obvious hedge; sectors that might benefit from increased life expectancy, such as pharmaceuticals or health-care related industries, are much too small compared to the extent of risk carried by the private sector – even if they issued liabilities contingent on longevity they would take on at best a small fraction of risk.

Reverse mortgages

Annuities are the classical answer to longevity risk, but not the only one. In fact, annuities make sense only for people whose financial wealth is sufficient to buy them a significant income, but given that the distribution of wealth is skewed the number of eligible households is relatively small – and composed of the wealthiest ones, which hardly represent a concern in terms of old-age poverty. On the other hand, since real estate is for households both a major savings vehicle and a currently consumed asset, financial instruments that support these two functions may also play an important role. In this regard, the introduction of products that allow price risk to be hedged to protect both existing home-owners (and institutions) and prospective purchasers (saving to buy a home) as specifically as possible, yet providing liquidity as well, might become a fruitful enterprise.

If one looks at Italian data on, for example, households headed by a person aged 65 and up to 80, three things stand out:

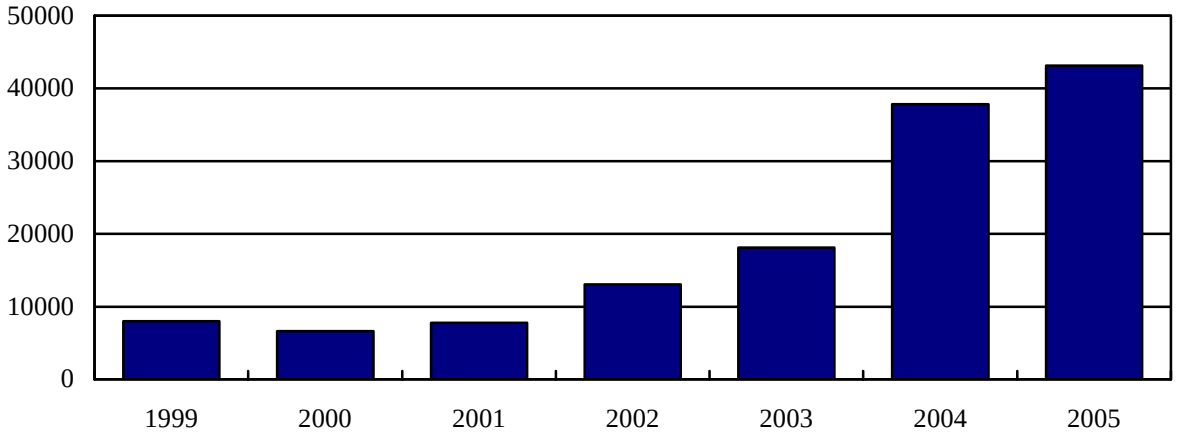
- The share of disposable income derived from a pension is more than two-thirds for 75 per cent of them: in effect they are already annuitised to a large extent.
- Even for the 25 per cent in the highest disposable income quartile, a rough measure of annuitisation of half of their financial wealth (a rule-of-thumb indication of how much they could annuitise) would only yield something around 20 per cent of their disposable income.
- On the other hand, most '65-80 year old' households have substantial wealth invested in real estate: more than 75 per cent of them own some property (55 per cent in the lowest quartile of the disposable income distribution) and a rough measure of annuitisation yields at least 25 per cent of disposable income, even for the households in the lowest quartile (and it could be much more if one assumes that this real estate consists mainly of a home and that it is possible to extract its full equity value).

Obviously today's wealth composition and distribution depends on the current older generation's expectations as to their situation at retirement and is likely to change in the future, but the weight of real estate will probably always be significant. In Italy housing wealth already constitutes the largest part of total household wealth (60 per cent). In other countries such as the United States, the United Kingdom, Japan and the Netherlands, it ranges between 30 and 40 per cent of total net worth. Therefore, if we want households to contribute more towards sustaining themselves after retirement, we must think of ways to extract wealth from where it is: in real estate.

In this respect it is perhaps surprising that reverse mortgages are still rare. Even in the United States, where the market is most developed, the volume of loans is still rather low (Fig. 3), even if it has been increasing substantially in the most recent years (from 38,000 in FY 2004 it has risen to 43,000 in FY 2005 and to 56,000 in the first nine months of the current fiscal year). Sound policy would remove whatever regulatory and tax impediments there are to buying and selling them. Furthermore, reverse mortgages presumably offer a stream of income precisely to some of those that need it most, i.e. the elderly that do not have close relatives who

could provide assistance. This is because those who do have close relatives would probably like to bequeath their real estate to them in exchange for care (a sort of unwritten social contract), while those who do not have relatives but hold some real estate are reluctant to sell it if their real estate provides housing services. A reverse mortgage would allow this class of elderly to live in their own home while consuming its equity value.

Figure 3 - Reverse mortgages in the United States
(number of federally-insured reverse mortgage loans, fiscal years)



Sources: U.S. Department of Housing and Urban Development; U.S. Mortgage Bankers Association.

With standard reverse mortgages, the issuer faces two risks: longevity risk and housing price risk. On the other hand, the buyer forfeits the possibility of leaving his or her home as a bequest. Longevity risk is not currently hedgeable, but housing price risk could be diversified away, especially if it were possible to trade on housing price indices – some of which are starting to be used in the United States. As for bequests, some companies already offer the possibility of keeping a share of the property's value for this purpose. Making reverse mortgages possible, affordable and desirable would go a long way towards enabling households to insure against longevity risk.

Policy implications

By way of conclusion, the prospective development of private pension systems, and the increasing need for institutions and individuals to improve management of

longevity risk, require a comprehensive and coherent set of policy actions. Policy recommendations can be grouped under four headings:

- Support economic growth, including by increasing national saving and its efficient allocation.
- Facilitate the development and expansion of markets for under-supplied financial instruments that will be useful for retirement savings and the provision of pension benefits.
- Develop regulatory and supervisory frameworks that encourage more rigorous risk management, greater transparency, and better governance at private pension funds, including by ensuring consistent accounting standards and tax rules.
- Provide adequate protection to pension beneficiaries, among other through financial education programmes.

Saving and growth

First of all, in order to offset the possible negative effects of ageing on living standards and fiscal balances, policies should support economic growth and the efficient use of resources. In this regard, measures that promote the supply of labour and increase its productivity are crucial; national saving should be increased and its efficient allocation encouraged (relaxing regulations restricting the amount of foreign assets held by domestic pension funds is an example).

Incentives are essential in order to facilitate later retirement; further increases in statutory retirement ages may also be necessary. Private pension system coverage should be broadened, especially in cases where it is still too low. In this respect, making enrolment mandatory and automatic would be of help, as already demonstrated by the experience of several countries. Tax systems should guarantee a level playing field between different retirement income products; deductions for contributions are important but the exploitation of tax deferrals should be avoided.

Financial instruments and markets

Second, as long-term matching securities are needed, while supply should eventually be forthcoming to meet the emerging demand, policy-makers might

consider how to promote the development of markets for the transfer and pooling of investment and longevity risk between private agents. Governments might issue inflation-indexed and ultra-long fixed income securities, also recognising, for market building purposes, that the objective of their issuance strategies goes beyond the minimisation of borrowing costs.

Regarding the difficulty of hedging longevity risk (related to the scarcity of natural buyers), public longevity-indexed bond issues could play a catalytic role in developing the market, by limiting price uncertainty and information costs for potential issuers. Government issuance would not only provide a benchmark but might stimulate the improvement of mortality tables and projections in order to develop better indices. Even if at this stage issues of such bonds do not show evident net benefits from a purely public debt management perspective, governments may have an advantage over the private sector as underwriters, given the benefits of the intergenerational sharing of extreme old-age risk.

Measures that improve the taxation design, favour a higher degree of financial literacy and reduce adverse selection in the market for annuities to provide insurance against idiosyncratic longevity risk would be welcome. Insurance companies are good at pricing risk almost at an individual level, but for some reason they do not do it for annuities. There is a trade-off between encouraging them to apply their industry practices to this market, thus reducing adverse selection, and going too far, thus putting out of the market those most in need of insurance. Some level of cross-subsidy should be allowed in order to keep annuities affordable for everybody. In this perspective, the development of a market for longevity bonds to reduce the systematic component of longevity risk in the market for annuities would probably be helpful.

Policies that would help develop a market for reverse mortgages should also be encouraged. The market for mortgages has greatly benefited from actions such as better data collection on housing prices and default rates, securitisation (which allows mortgage issuers to offload unwanted risk), government guarantees, favourable tax treatment of interest payment. The market for reverse mortgages would benefit from the same set of policies, adapted to this specific product.

Prudential regulation and supervision

Third, it is necessary to strengthen the oversight of pension providers to ensure solvency, satisfactory performance and good governance. Possible gaps with respect to regulation in banking and insurance sectors must be closed. Prudent asset-liability management principles should be encouraged. Mark-to-market valuations to preserve funding targets are generally desirable but may increase the volatility of funding requirements and, in turn, of financial markets. A certain degree of regulatory forbearance, coupled with sufficiently long recovery periods for eliminating funding gaps could alleviate the effect of under-funding on volatility.

The disclosure of mortality and disability projections should be made transparent and better modelling of mortality projections, as well as the uncertainty surrounding demographic estimates, should be promoted. Disclosure of their use in funding plan strategies should also be pursued. Tax incentives and possibly even mandatory provisions should push pension funds to hold buffers above full funding in order to resist adverse variations in assets and liabilities.

The growing savings intermediation role of pension funds and other non-bank financial institutions, while positive for the breadth, depth and efficiency of financial markets, may make it harder for supervisors and policy-makers to assess accurately the distribution of risks and the possible threats to the stability of the financial system. Moreover, regulatory and accounting changes may lead to greater short-term trading activity (with the risk of "herding" behaviour) and the development of dynamic hedging techniques, with potentially destabilising effects on markets. In this regard, policy changes should aim at preserving the long-term perspective of pension funds' investment strategies (which may help dampen rather than amplify volatility).

Protection of pension beneficiaries

I have already addressed the issue of the role that the government might play in addressing market failure, for example with reference to annuities and reverse mortgages, and in providing for a better market response to risk taking, from market building to perhaps some further risk taking in direct issues of ultra-long

and index-linked bonds as well as in the case of longevity risk. The role of government as "insurer of last resort" is possibly even more delicate. As investment risks and responsibilities are increasingly shifted to individuals, policy measures should aim at ensuring an adequate level of pension beneficiaries' protection. Prudent funding is the fundamental safeguard against possible plan bankruptcy. Additional protection could be provided by collective pension guarantee arrangements, but premiums charged by guarantee funds should adequately reflect the risks to which they are exposed.

This does not seem to have been the case in recent experience, suggesting that careful design is required. For instance, moral hazard can be reduced by limiting the type and amount of benefits covered, unwarranted cross-subsidies can be avoided by charging risk-based premiums and the investment of the guarantee funds may also need to ensure a good duration match with their liabilities. Special treatment such as call on collateral from the plan sponsor and priority in bankrupt proceedings may also be considered. In general, however, one might argue that providing an insurance against the collective component of longevity risk might be a proper use of public resources. This would call a reduction in the exposure of the government to the more idiosyncratic components of this risk, for instance by encouraging a more balanced composition of pension pillars, limiting the role of the State and encouraging the insurance of idiosyncratic longevity risk in financial markets.

Transparency in the information provided by financial institutions should be enhanced and possible conflicts of interest fully disclosed. Investment in plan sponsor securities should be limited. Correct incentives for sales agents and distributors should be promoted, including through codes of conduct and adequate remuneration. Financial education programmes are useful; they increase consumers' financial consciousness and so help them avoid abuses and fraud, improve their investment choices, and raise their contributions to private pension plans. However, as witnessed with defined contributions plans in several countries, even rational individuals who understand risks and expected pay-offs may exhibit inertia in their decisions and are sensitive to how choices are framed. This may

argue for encouraging some degree of automatic enrolment, opt-out requirements and default options.

To conclude, as Lorenzo il Magnifico emphasised over half a millennium ago, it is true that "tomorrow none can tell". However, it is exactly his hyperbolic discounting (if not moral hazard) of just enjoying "youth [that] is sweet and well" without caring for the future that should be avoided. Otherwise, for the average human being, with the obvious exception of the Medicis of our time, and for societies at large the costs of dismissing "what fates impose" might be very high indeed.

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