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Innovative Approaches to Managing Longevity Risk in Asia: Lessons from the West

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Abstract

This paper discusses what is longevity risk, why it is important, approaches used by the West to manage longevity risk and what lessons can be learnt by Asian countries from the experiences of the West. Increasing and uncertain longevity has emerged as a key risk affecting individuals, pension plans, insurers and governments in both the developed and emerging world. I discuss progress in the field of longevity modelling and the merits as well as drawbacks of these models. In Western countries, attempts have been made by capital market and governments to deal with longevity risk, but the availability of solutions remain limited. Further developments should focus on creating a set of instruments that are effective, economically affordable, and transparently priced. It is important to understand, measure, and manage longevity risk. Moreover, further pension reforms are needed to address the root of the problem. For Asian countries, the experience of the West provides ample guidance in formulating their pension plans and promoting capital market developments to avoid the same predicament the West is now struggling with. Simple cost-effective solutions linking retirement ages to longevity, efficiently engaging women and older workers in the work force for longer, education and technology driven flexible work practices, along with preventing productive human capital outflows ought to be considered seriously in Asia.

JEL Classification: G17, G22, G23, E24

Contents

1. INTRODUCTION

In this paper I address the issue of longevity risk in terms of providing a learning perspective for Asia from the experiences of earlier-maturing and aging Western developed countries. Longevity risk is a large macro as well as micro risk faced by countries, pension plans, insurance companies and individuals in different ways. It has emerged as a major risk affecting pensions and insurance promises in the aging Western world.

The historically unprecedented aging of people, not just in terms of their life spans but in the quality and costs of aging against the backdrop of pensions promises, has made longevity risk a huge issue. The issue is made harder still thanks to the inaccurate predictions of human longevity made collectively by various experts. In a Watson Wyatt-Cass Business School series of lectures published on the "Uncertain future of Longevity"[1], leading experts of the world failed to agree on the future of human life expectancy. In this context I discuss why longevity matters in Section 1.

In order to appreciate and understand longevity risk, it is essential to examine longevity trends. These trends, surveyed in Section 2, place Asian longevity in the context of comparative developments in other regions while noting the existing heterogeneity of life spans across different Asian countries. Asian countries are in different stages of demographic transition resulting in diverse trends in life expectancy and age structure. I highlight the more important differences between life expectancy at birth and conditional life expectancy at age 60 as well as gender differences. Asia in general is much younger than the Americas and Europe and this leads to a natural focus on life expectancy at birth. However, as Asia ages, there is an increased need to focus on conditional life expectancy at age 60. I discuss trends in old-age dependency ratios and the oldest-old defined as the 80+ population, which in the Western world have been responsible for fiscal sustainability strains and corporate profitability declines.

Global longevity increases have been a result of improved health and sanitation conditions. Factors affecting longevity evolution and differences across countries are discussed in more detail **in Section 3.** The future evolution of mortality will shed light on trends in longevity, annuity values, pensions, insurance, etc. Attempts have been made to develop models which determine the path followed by mortality. In Section 4 I discuss progress in the field of longevity modelling and the merits as well as drawbacks of these models. Section 5 presents the recent attempts, to deal with longevity risk by capital markets and governments.

2. WHY LONGEVITY MATTERS

Benjamin Franklin said: "In this world nothing can be said to be certain, except death and taxes." While no one questions the eventuality of death, what has changed from the time Benjamin said this in 1789 is the uncertainty surrounding death and longevity. Longevity trends have undergone unprecedented changes throughout the world. Longevity has not only increased, it has become more and more uncertain, putting pressure on individuals, companies and governments to bear the risk of longer and more uncertain post-retirement periods.

[1] Towers Watson/Cass Business School 2005

Global life expectancy has increased dramatically from 47.7 years in 1950–1955 to 67.9 years in 2005–2010. Even though life expectancy is higher in the more developed regions of the world at 76.9 years (2005–2010), the less-developed regions have experienced greater increases in life expectancy from 42.3 years (1950–1955) to 66 years (2005–2010). Longevity increases have been particularly notable in Asia.

Will these past longevity increases continue in the future? Recent forecasting errors have largely undermined the answers produced by various models, and mortality is now recognized as being a stochastic process. Opinion on the future of longevity differs considerably among the leading experts. One group—the pessimists led by Jay Olshansky—argues that life expectancy might level off or decline, considering the impact of obesity, diabetes, global warming, etc. The other group—the optimists like James Vaupel—believes that there is no natural limit to human life and that past experience will be reproduced in the future driven by scientific advances.

How these longevity trends evolve will affect population structure, health, individual savings, government expenditure and company balance sheets, and the failure to predict these trends has resulted in the emergence of a major source of risk—Longevity Risk. Individuals planning for their retirement are unsure about how long they will live, how much they will need to finance their post-retirement consumption, and how much government support they will receive. Governments and companies in the Western world have made excessive pension promises to their employees and citizens leading to unsustainable budgets. Life insurance providers have broadly failed in terms of the accuracy of longevity forecasts in the past and risk doing so in the future. James M. Poterba in his book The Role of Annuity Markets in Financing Retirement said: "Uncertainty about length of life is a ubiquitous source of risk"[2.] These developments have made the study of longevity even more crucial in the present context.

3. LONGEVITY TRENDS

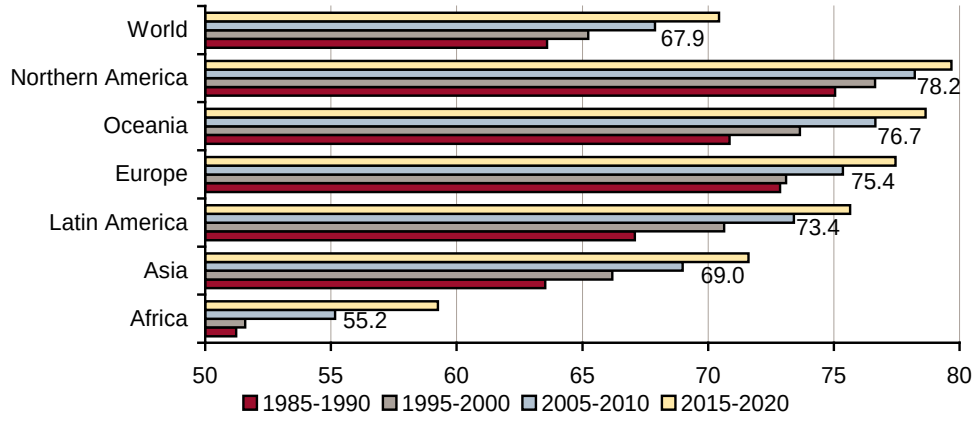
3.1 Asia vs. Other Regions

Life expectancy has continued to rise at a significant rate over the past few decades around the world, and the increase in Asia has been particularly notable, where life expectancy rose by 26 years from 1950 to 2010. According to UN estimates in 2010 (Table 1), average life expectancy at birth increased from 63.6 years (1985–1990) to 67.9 years (2005–2010) around the world, while the corresponding increase was from 63.5 years to 69 years in Asia. Despite its fast increase, life expectancy in Asia still lags behind all regions except Africa. At 78.2 years, Northern America still has the highest average life expectancy amongst all regions.

[2] Brown et al. 2001.

Table 1: Life Expectancy at Birth

Years, current numbers to the right of the bars



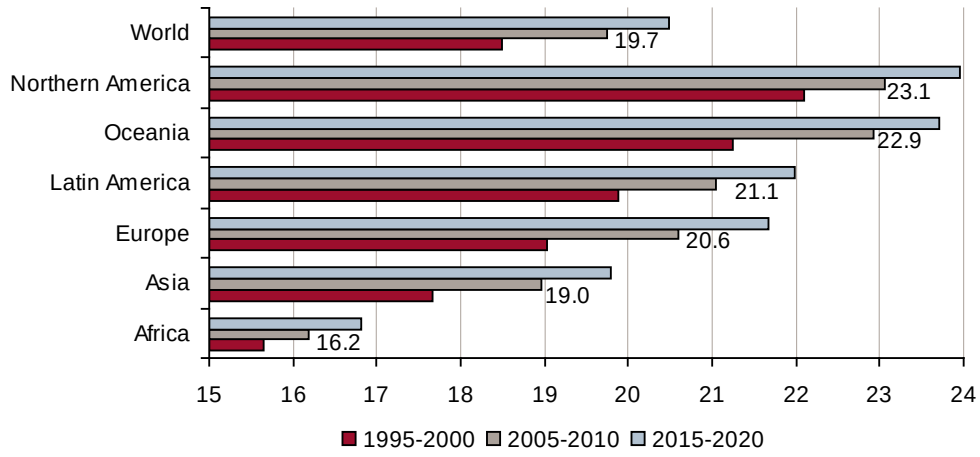
Source: UN Population Division (World Population Prospects, 2010 Revision), Crédit Suisse.

There is generally a positive gap between female and male life expectancies because females on average outlive males. This female-male life expectancy gap is highest in Europe and Latin America, but much lower in Asia. However, while the gap is decreasing in other regions (i.e. male life expectancy is catching up with that of females), Asia has witnessed a widening gender gap. Women born in Asia between 1985 and 1990 were on average expected to live 2.8 years longer than men, and that difference has increased to 3.7 years in 2005–2010.

What matters more for longevity risk is conditional life expectancy, which measures the length of remaining life at a certain age. Life expectancy at 60 exhibits similar trends as life expectancy at birth. 60-year olds in Northern America are expected to live 23.1 years in 2005–2010, the highest in the world, while those in Asia will live 19.0 years (Table 2).

Table 2: Life Expectancy at 60

Years, current numbers to the right of the bars



Source: UN Population Division (World Population Prospects, 2010 Revision), Crédit Suisse.

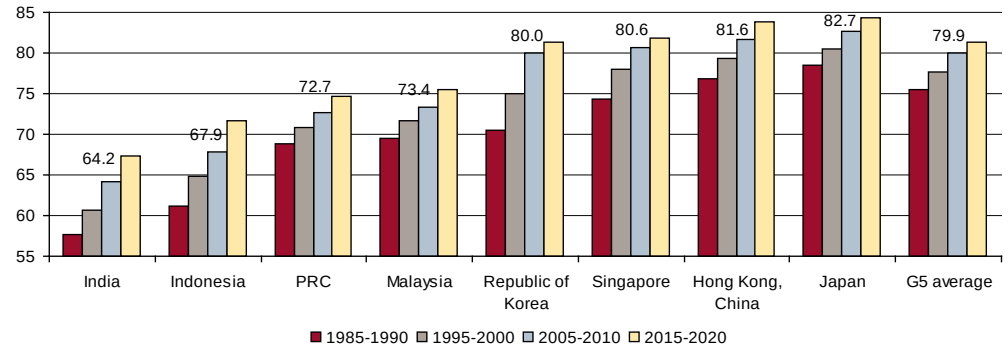
3.2 Selected Asian Countries

Significant differences exist across Asian countries that are at different stages of social and economic development. Table 3 presents the life expectancy at birth for major Asian countries and illustrates wide divergences. While Japan boasts the highest life expectancy in the world (as well as in Asia) with life expectancy at birth of 82.7 years, India's life expectancy at birth was only 64.2 years in 2005–2010. Both Japan and India have experienced massive increases in their life expectancies from 62.2 years in Japan and 37.9 years in India in 1950–55. The G-5 set of countries' life expectancy average is also displayed for ease of comparison.

The female-male gap in life expectancy at birth has been widening in the PRC; Indonesia; Hong Kong, China; Japan; and especially in India, while narrowing in the Republic of Korea. Note that the Republic of Korea[3] has seen a dramatic increase in life expectancy and a dramatic decrease in fertility rates, which is probably related to the rapid increase in female labor force participation.

Table 3: Life Expectancy at Birth—Asia

Years, selected Asian countries, current numbers on top of bars



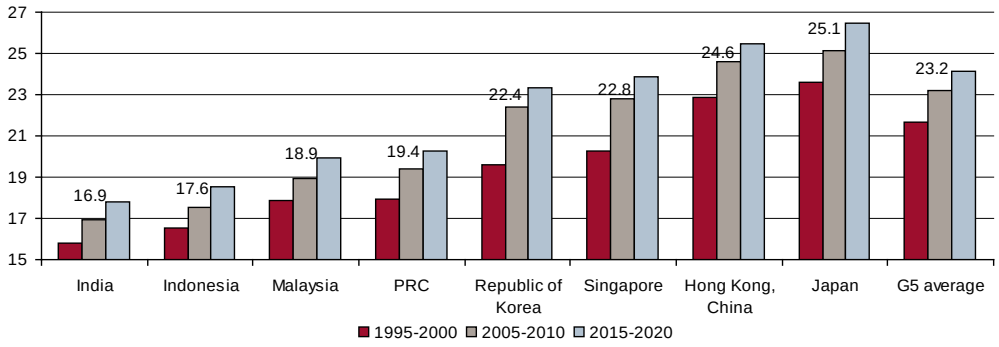
Source: UN Population Division (World Population Prospects, 2010 Revision), Crédit Suisse.

Similarly, life expectancy at 60 is highest in Japan (25.1 years) and lowest in India (16.9 years) in 2005–2010 among the major Asian countries (Table 4). The male-female gap in life expectancy at 60 has increased in all these Asian countries.

[3] Crédit Suisse 2010.

Table 4: Life Expectancy at 60—Selected Asian Countries

Years, selected Asian countries, current numbers on top of bars



Source: UN Population Division (World Population Prospects, 2010 Revision), Crédit Suisse.

Despite the differences, increasing longevity is common to all Asian countries. The old saying that "a man rarely lives to 70" is now outdated in the PRC as an average new-born baby can now expect to live 73 years, and a 60-year old Chinese person can, on average, expect to live a further 19 years.

3.3 The Demographic Transition

The Demographic Transition model[4] is a model of population change attributed to Warren Thompson. It represents the transition from high birth and death rates to low birth and death rates as a country develops from a pre-industrial to an industrialized one.

Table 5: Demographic Transition Theory and its Application to Selected Countries

Stages and current examples

Stage 1	Stage 2	Stage 3	Stage 4	Possible Stage 5
High & fluctuating death rates	Falling death rates*	Falling death rates	Low birth rates	Very low birth rates
High & fluctuating birth rates	High birth rates	Falling birth rates**	Low death rates	Death rates higher than birth rates
Stationary population numbers	Large increase in population	Stable population growth	Stable population	Declining population/ Ageing
	India, Indonesia, Malaysia, Viet Nam, Venezuela, Mexico	Brazil, PRC, Thailand, US, UK, France, Chile	Italy, Russia, Republic of Korea	Japan, Germany

*Reasons: improvements in food supply, sanitation, technology, basic healthcare and education.

**Reasons: contraception, increases in wages, urbanization, reduction in subsistence agriculture, increase in the status and education of women, reduction in the value of children's work.

Source: Crédit Suisse; Caldwell 2006.

Stages of the demographic transition theory are described in Table 5. According to this framework, Asian countries are in different stages of demographic transition. India, Malaysia, Indonesia and Viet Nam, the younger Asian countries, are in stage 2 of falling death rates, high

[4] Bloom, Canning, and Sevilla 2001.

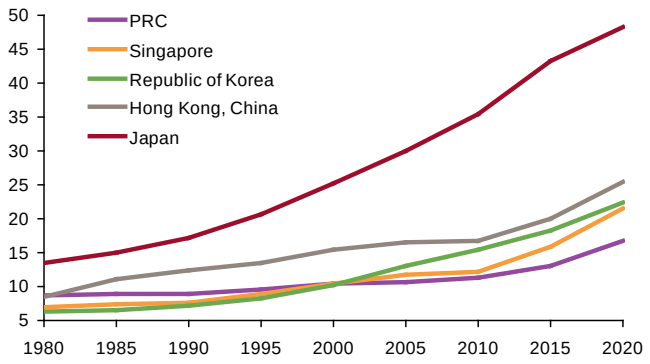
birth rates and increases in population. The PRC is in stage 3 of falling death rates and birth rates, while the Republic of Korea is in stage 4 of low birth rates and death rates. Japan is experiencing a stage where birth rates have become so low that they are lower than death rates leading to a declining and aged population. The fact that Asian countries are in different stages of demographic transition has led to very different patterns of population growth, age structure and life expectancy in these countries.

3.4 Aging Asia

Population aging has been a significant issue for Japan, with its low fertility rate, high life expectancy and increasingly high share of the elderly. Japan's old-age dependency ratio (the number of people aged 65+ per 100 people aged 15–64 years) increased from 13.4 (1980) to 35.5 (2010) and is expected to reach 48.2 (2020), as shown in Table 6. High old age dependency ratios are a major factor causing fiscal sustainability pressures in older European countries and in Japan due to very fast growing pension expenditure. A few other Asian countries, the Republic of Korea, Singapore and the PRC, are also experiencing a fast pace of aging reflected in rising old age dependency ratios. The old age dependency ratio of the Republic of Korea rose at the highest rate after Japan, from 6.2 in 1980 to 15.4 in 2010.

Table 6: Old-age Dependency Ratio: older Asian countries

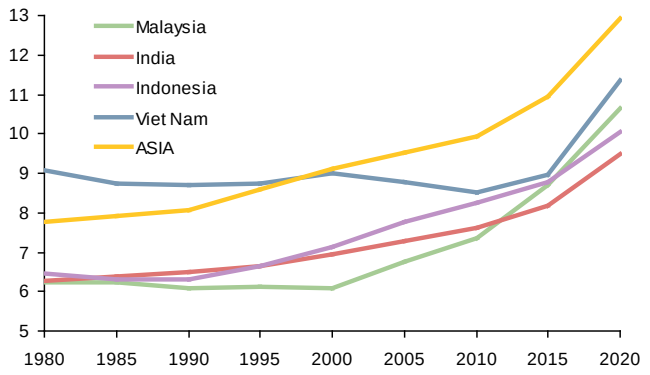
People aged 65+ per 100 people aged 15–64



Source: UN Population Division (World Population Prospects, 2010 Revision); Crédit Suisse.

Table 7: Old-age Dependency Ratio: younger Asian countries

People aged 65+ per 100 people aged 15–64



Source: UN Population Division (World Population Prospects, 2010 Revision); Crédit Suisse.

By contrast, countries such as Malaysia, India, Indonesia and Viet Nam are relatively young with lower but rising old age dependency ratios (Table 7). All these countries have an old age dependency ratio lower than that of Asia as a whole (9.9 in 2010). Malaysia has the lowest old age dependency ratio of 7.4 in 2010.

As Asia ages, its oldest-old population is expected to grow rapidly. The population aged 80+ is projected to increase from 47.2 million (45% of world total) in 2010 to 69.7 million (49% of world total) in 2020. Unsurprisingly, there are more women than men among this group (1.5 women per man), as women generally live longer. Within Asia, Japan has the highest proportion of its population in the 80+ age group, which grew from 2.3% in 1990 to 6.3% in 2010, and is expected to reach 9.2% by 2020. The proportion of the oldest-old is also growing rapidly in Hong Kong, China; Singapore; and the Republic of Korea. Currently, India, Indonesia, and Malaysia have less than 1% of their population in the 80+ age group.

Longevity risk is particularly relevant for the oldest-old. Data from the US shows that annual health expenditure for the 85+ age group is much higher than that for the 65–74 age cohort. Each additional year lived beyond 85 leads to a disproportionate increase in health and long-term care expenditure relative to those for the 65–74 population.

4. FACTORS INFLUENCING LONGEVITY

Economic historian and Nobel laureate Robert Fogel[5] studied developments in the remarkable physiology of aging over the life-cycles of three cohorts:

(i.) the Civil War cohort born between 1838–1845. They had short lives with common disabilities at young ages, were prone to malnutrition and exposed to severe diseases;

(ii.) the World War II cohort born between 1920 and 1930. Few of them died in infancy and most lived past age 60 without severe chronic diseases; and

(iii.) the cohort born between 1980 and 1990. They have a 50-50 chance of living to age 100.

He found that the average age at onset of disabilities has continued to rise, so members of later cohorts can expect to remain healthy to an older age.

Heterogeneity of longevity not only exists between different cohorts, but also within the same cohort. Socio-economic status (education, occupation, and income level), gender, marital status, nutrition, living environment (climate, pollution, sanitation, and population density), diet, lifestyle and physiological factors can all lead to differences in individual life expectancy. For example, adopting a healthy life style early can help to prevent or postpone disability in older age. A *National Geographic* special featured centenarians in Okinawa and Sardinia. They were characterized as having good nutrition, taking sufficient exercise, having interests, non-smoking, and being part of a social network. A Credit Suisse research report on global obesity found that the poorest black states in the US had the highest obesity rates and, by extension, they also had among the lowest life expectancies of all developed countries.

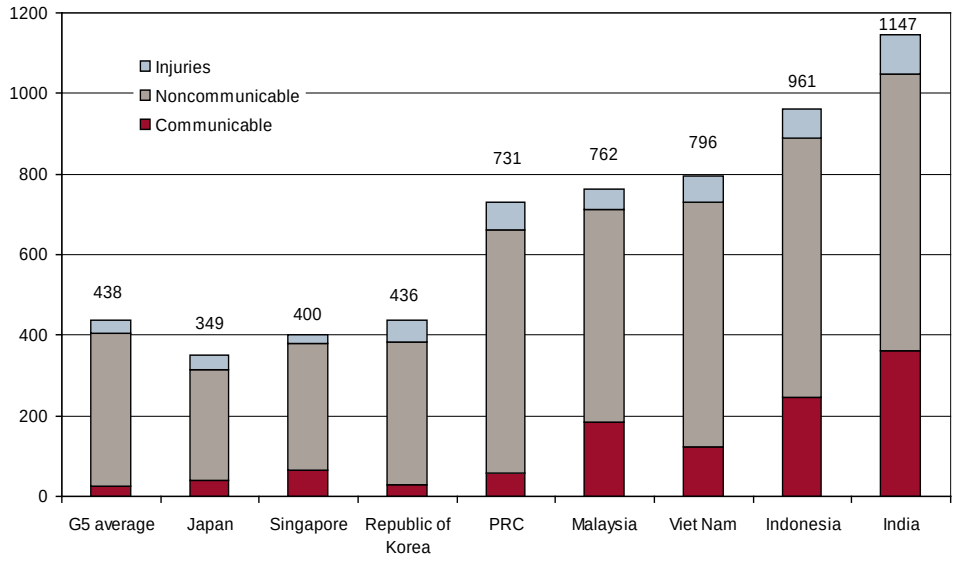
4.1 Mortality Rate and Causes of Death

The age-standardized mortality rates by cause (Table 8) remove the effect of variation in age structure. The poorer health conditions in India and Indonesia are reflected in their higher total mortality rates, about three times that of Japan.

[5] Fogel 2005.

Table 8: Age-standardized Mortality Rate by Cause

Deaths per 100,000 population, 2008



Source: World Health Organization (WHO) Global Health Observatory Database.

Communicable diseases such as tuberculosis and respiratory diseases are an important cause of death in younger and less developed Asian countries such as India, Indonesia, Viet Nam, and Malaysia. Further improvements in health and sanitation can prevent deaths due to infectious diseases especially among young people and thereby further prolong life spans in these countries. In the older and better developed countries such as Japan, the Republic of Korea, and Singapore, advances in the treatment of chronic diseases can play a major role in reducing mortality.

4.2 Diseases for the Old

According to the WHO's Global Burden of Diseases, the top causes of death among the elderly are very similar across the Asian countries. Cerebrovascular disease, chronic obstructive pulmonary disease, ischemic heart disease, trachea, bronchus, lung cancers, stomach cancer, hypertensive heart disease, liver cancer, lower respiratory infections, tuberculosis, diabetes mellitus, nephritis and nephrosis, and colon and rectum cancers are among the top killers for those aged 60 and above. Causes of death for this age group in Asia are also similar to those in western developed countries, except that Alzheimer's and other dementias, prostate cancer and breast cancer cause more deaths among the old in developed countries.

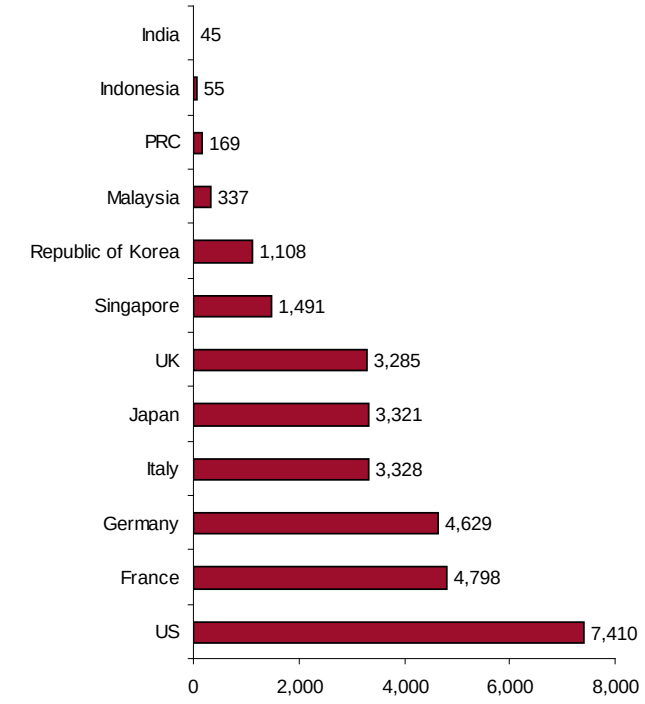
4.3 Health Expenditures in Selected Countries

To some extent, lower levels of per capita health expenditure in India and Indonesia explain lower life expectancy in those countries. The per capita health expenditure in these two countries is only one third of the corresponding level in the PRC (Table 9), a country that relatively underspends on health care. Japan has lower per capita health expenditure than all the other five major developed countries I have examined but longer life expectancy, suggesting the efficiency of its health care system. The US has a disproportionately high expenditure level on health care in relation to the health outcomes of its population, and thus it is not a good

example for efficient health care that might be emulated by Asian countries. The majority of the health expenditure in Singapore, India, Malaysia, and the PRC is borne privately. The Japanese government spends the highest share of gross domestic product (GDP) on health among the selected Asian countries, while governments in India and Indonesia spend the lowest share (Table 10).

Table 9: Health Expenditure per Capita

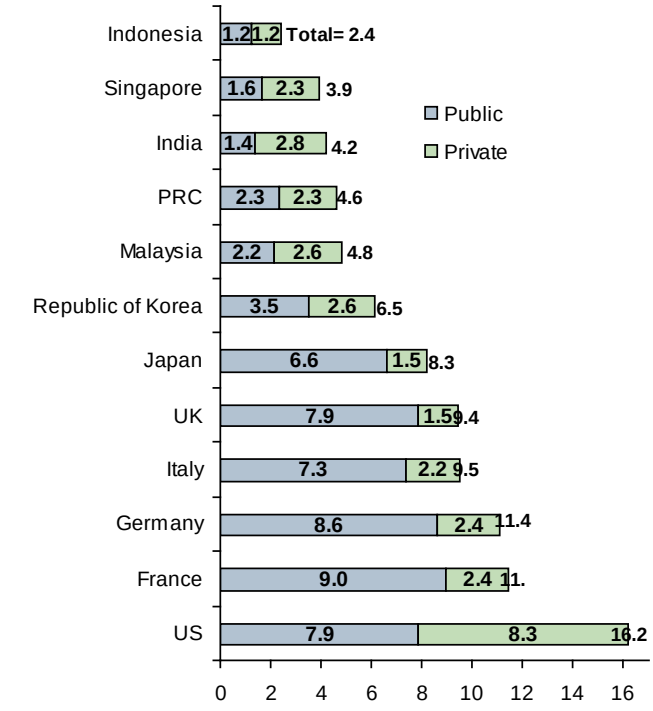
US$, 2009



Source: WHO Global Health Observatory Database.

Table 10: Public and Private Health Expenditure

% of GDP, 2009



Source: WHO Global Health Observatory Database.

5. LONGEVITY MODELS

Rapid and unexpected increases in life expectancy have provided an impetus to study and improve mortality forecast models. Small differences in longevity estimates and tables tend to drive big changes in the funding ratios (assets relative to liabilities) of pension funds and the profitability of insurance companies. Longevity risk models have not performed very well due to the fact that human life spans in aggregate as well as specifically are affected by a multitude of factors that are difficult to model in general, but, more importantly, have not been accounted for properly in modeling and updating longevity expectations. Experts have disparate beliefs about future changes in life spans; whether biological limits to life exist and whether medical advancements should be taken into account while forecasting mortality. This makes modeling future mortality even more difficult.

There are three common approaches to forecasting mortality[6] which are discussed below:

- **Expectation:** this is based on the subjective opinions of experts. It is not generally a good basis for mortality forecasting as expert expectations are invariably conservative.
- **Explanation**: these are structural or epidemiological models of mortality derived from certain causes of death with known determinants. Decomposition by cause of death poses problems and is subject to data difficulties. However it can give a better understanding of the factors behind overall changes in mortality.
- **Extrapolation**: most developments in mortality forecasting have been in extrapolative forecasting. This approach makes use of the regularity found in age patterns and trends over time. It calculates estimates of future mortality using current mortality rates and an estimate of the rate of change in future mortality—which is itself based on changes observed in the past. This observed trend in mortality changes is assumed to continue over the forecast horizon. The extrapolative models can be either deterministic or stochastic. Deterministic models do not calculate forecast probabilities as they directly extend past trends. Stochastic models attach probabilities to each forecast value. Since longevity has become uncertain, it is better to use the stochastic approach to calculate probability distributions rather than point estimates, in our opinion.

Within the **extrapolative approach**, models have been developed which incorporate zero, one, two or three underlying factors.

- **Zero-factor models** of aggregate measures, notably life expectancy, provide no information about changes in the age pattern.
- The **one-factor models** are also inadequate. Though they have the advantage of smoothness across age, they present serious problems for forecasting.
- **Two-factor models** incorporate time which, being fundamental to forecasting, is a major advantage. Methods using two-factor models (age-period or age-cohort) have been most successful. In Lee Carter models, a log linear trend for age-specific mortality rates is assumed for the time-dependent component. The equation describing the Lee Carter model is given below:

$$\ln m_{x,t} = a_x + b_x k_t + \varepsilon(x,t)$$

  $m_{x;t}$: Central mortality rate at age x in year t;
  a_x : Average log-mortality at age x over time;
  b_x : Response at age x to change in the overall level of mortality over time;
  k_t : Overall mortality level in year t (this time-varying component is our interest);
  $\varepsilon_{x,t}$: Residual.

  However the shortcoming of the Lee-Carter model has been that it assumes that the ratio of the rates of mortality change at different ages remains constant over time whereas evidence of substantial age-time interaction has been found.

- **Regression-based (GLM) methods**, including dynamic parameterizations, have been less successful in forecasting because non-linearities in time can lead to implausible forecast trends.
- **Three-factor methods** are more recent: the Lee-Carter age-period-cohort model appears promising. The Renshaw-Haberman model was the first to incorporate a cohort effect parameter to model variations in mortality among individuals from different cohorts. Cohort models involve heavy data demands.

[6] Booth and Tickle 2008.

The models described above generally model mortality rates for the underlying national population. However insurers and pension funds are interested in the mortality rates of specific individuals. Salhi & Loisel (2010)[7] propose a model that looks at the links between insured specific mortality and national population mortality by looking at the long-run relationship of the behaviour of the two mortality series. For a complete analysis of this specific basis risk, one needs to take into account individual characteristics such as income, education, professional status etc.

Caution is needed when applying these models. There is a trade-off between goodness of fit and forecasting accuracy. There are limitations in time series methods and their application to long forecasting periods. There is a lack of appropriate data sources for particular applications and modelling error as not all sources of uncertainty can be quantified, making it essential to investigate more than one modelling framework. Beyond models, there is a need to have a real understanding of the causal factors underlying longevity, the ageing process, and the characteristics governing different populations.

6. HOW TO MANAGE LONGEVITY RISK

Longevity risk is the risk that future outcomes in mortality and life expectancy will turn out different to expectations. Longevity risk manifests as either an idiosyncratic or a specific risk unique to each individual or aggregate risk which is due to uncertainty about overall rates of population mortality increase. Specific longevity risk can be diversified by pooling, however aggregate longevity risk cannot be diversified away.

Individuals, annuity providers, corporate pension funds and governments alike are all carriers of longevity risk. Individuals risk outliving their assets post-retirement; life insurance providers risk not meeting their actuarial assumptions; and corporate pension plans and state and federal governments risk promising overly-generous benefits that they cannot afford.

A number of risks have materialized in the Western world. Many defined benefit pension plans have increasingly large liabilities outstripping assets, constraining corporate operational performance. Lane, Clark & Peacock[8] estimated that aggregate FTSE 100 UK International Accounting Standard 19 pension deficit was GBP£19 billion (end June 2011). Governments need to finance pension and other promises to the elderly by issuing more debt, causing concern for fiscal sustainability. According to the European Commission[9], pension expenditure for the EU's 27 member states is projected to increase from 10.2% of GDP (2007) to 11.9% (2030) and 12.6% (2060).

Those challenged by uncertain longevity have reacted by mitigating, transferring or sharing risk among a larger group. The responses from pension plans include a shift from offering defined benefits (DB) to defined contributions (DC) (In Table 11, note that DC shares have increased in almost all countries especially in the UK) and from being unfunded to funded, implementation of asset management strategies that better match liabilities, and utilization of longevity-linked instruments to remove longevity risk off the balance sheets of existing DB plans.

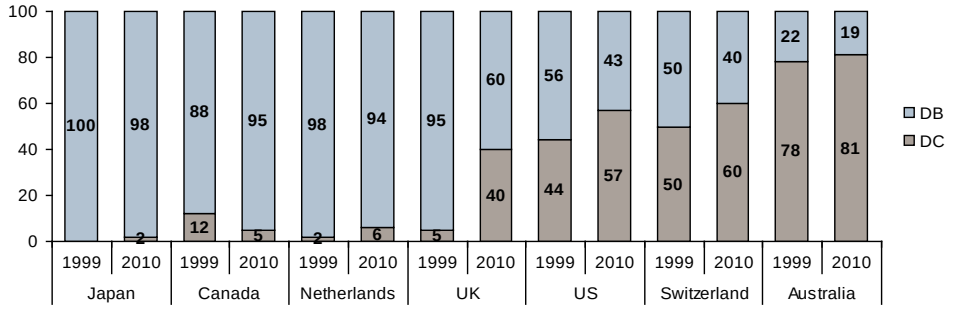
[7] Barrieu et al. 2010.

[8] Lane, Clark & Peacock 2011.

[9] European Commission and Economic Policy Committee 2009.

Table 11: DB/DC Split of Pension Assets

%



Source: Towers Watson. 2011. Global Pension Asset Study.

Governments have also responded by reforming pension systems to encourage people to work longer and save more for retirement. There has been a growth in the volume and contract types of annuity products offered by insurers and the growth of the reinsurance market that allows insurers themselves to further transfer longevity risk. There is, however, still a lack of financial instruments to hedge against longevity risk. Lane, Clark & Peacock report that the total value of private sector DB liabilities is over GBP£1,000 billion and the current appetite from insurers is sufficient to write no more than GBP£10 billion of buy-out and buy-in business each year before prices begin to rise. Investors taking longevity risk can earn a risk premium and diversify.

6.1 Annuities

Individual retirees face the risk of outliving their resources if they spend aggressively, or under-consuming their wealth if they spend conservatively. The primary appeal of annuities is that they offer an effective solution to wealth allocation and consumption decisions for retirees—"the opportunity to insure against the risk of outliving their assets by exchanging assets for a lifelong stream of guaranteed income"[10]. Broadly, there are three sources of annuities for retirees: social security, employer-sponsored DB plans, and actual annuity contracts. However, with the sustainability of social security systems in doubt in many Western countries and the closure of many employer-sponsored DB plans, actual annuity contracts are emerging as an increasingly important way for individuals to manage longevity risk.

An annuity is a contract offered by insurers guaranteeing a steady stream of payments for either a fixed term or the lifetime of the annuity owner in exchange for an initial premium charge. Its history can be dated back to ancient Rome when speculators who dealt with marine and other lines of insurance offered contracts promising payments for a fixed term in return for an up-front charge. Today, annuities have evolved into a multitude of forms: the payouts can commence immediately or be deferred to a later time, the payments can be fixed or vary with certain underlying factors such as inflation, and the policy can cover a single life or multiples of lives, or have an embedded bequest option that allows payments to continue after the annuitant's death to a beneficiary. Annuity contracts can also be purchased by pension funds for their members, as is the case with group annuities. Group annuities were initially associated with DB plans to manage longevity risk and cash flows for plan sponsors and were recently used in DC plans to

[10] Brown et al. 2001.

mitigate longevity risk for individuals. The annuity market grew very fast in the US from the 1980s until the recent financial crisis.

However, the annuity market remains small relative to the magnitude of risk that individuals are exposed to. Several impediments have led to this under-annuitization. First, for annuity providers, the pricing of such products can be an onerous task. They are exposed to substantial mispricing risk, especially without appropriate financial instruments to further hedge longevity risk. Second, the annuity market suffers from asymmetric information, as those exposed to higher risk will be more willing to seek annuities, but insurers will not be able to distinguish between high-risk and low-risk types. The extent of adverse selection adds to the cost of annuities, making them unattractive to low-risk individuals. The consequence of the recent European ruling against gender discrimination for EU insurers has yet to be seen. Third, the demand for annuities is further tamed by retirees' bequest motives, the reluctance to lose discretionary control, etc.

6.2 Longevity-linked Instruments

Longevity indices and longevity bonds provide hedging tools of aggregate longevity risk of the overall population at an institutional level.

6.2.1 Longevity Indices

A longevity index indicates the probability of life expectancy for individuals of a certain age to increase by a certain number of years over a period of time. Longevity indices not only provide a hedging tool for pension plans, insurers and re-insurers to transfer their longevity risk to other participants in the capital market, but also improve the understanding, visibility and transparency of longevity risk.

A longevity index needs to be based on credible national data to be accepted as a transparent common reference. Therefore, governments and national statistical institutions in particular, can play an important role in promoting the development of longevity-indexed products by developing a standardized index for longevity risk to be used as a benchmark in markets for longevity bonds and annuities. The market for longevity indices is still at an embryonic stage.. Existing indices are shown in Table 12. The JP Morgan LifeMetrics[11] Index incorporates historical and current statistics on mortality rates and life expectancy, across genders, ages and nationalities.

[11] LifeMetrics Press Release 2007.

Table 12: Longevity Indices

	Time launched	Population	Index group
Credit Suisse Longevity Index	2005	US	Overall, gender and age-specific sub-indices
JP Morgan LifeMetrics Index	2007	US, England & Wales, the Netherlands, and Germany	Overall, gender and age-specific sub-indices
Deutsche Börse Xpect Age and Cohort Indices	2008	Germany, the Netherlands, and England & Wales	Overall, gender and age-specific sub-indices

Source: the BLOOMBERG PROFESSIONAL™ service, company websites.

6.2.2 Longevity Bonds

Longevity bonds, also known as survivor bonds, generally pay a coupon that is linked to the survivor rates of a selected birth cohort. If a higher than expected proportion of this cohort survives, the coupon rate would increase, offsetting some of the provider's cost and hedging aggregate longevity risk. Longevity bond issuance has so far been very limited. The most obvious reason is that very few market participants would gain from an unexpected rise in life expectancy[12]. Pharmaceutical companies have been suggested as potential candidates, but the supply capacity of such companies is likely to fall short of potential demand. Some suggest that governments are in fact better positioned to issue such longevity bonds even though they are already exposed to longevity risk through social security provision. Governments can use fiscal tools to share the risk across generations and have the option to increase official retirement age. Also the development of longevity bonds will improve the efficiency of annuity markets and in turn reduce the need for governments to provide means-tested old age entitlements[13].

The first attempt at longevity bond issuance was unsuccessful. In 2005, the European Investment Bank issued a GBP£540 million longevity bond. The deal was structured by BNP Paribas and re-insured by Partner Re. The coupons were linked to the survivorship of a cohort of males aged 65 in 2003 in England and Wales and should have been of great interest to UK pension schemes and life insurers. However, it failed to attract sufficient demand and was withdrawn. The failure has been attributed to lack of understanding of longevity risk and the product's utility among pension funds as well as problems with the design of the issue, etc.[14] In 2010, Swiss Re successfully launched a series of eight-year longevity-based insurance-linked securities notes worth $50 million.

[12] Antolin 2008.

[13] Blake, Boardman, and Cairns 2010.

[14] Antolin and Blommestein 2007.

6.3 De-risking DB

The DB legacy has captured the attention and efforts of pension plan sponsors as they have realized the amount of risk they have taken on: longevity risk being the key but not the only risk. The risks that pension schemes are exposed to are:

- Market risk: uncertain asset returns, interest rate, inflation risk;
- Demographic risk: longevity risk and risks associated with member choice.

Longevity affects the liabilities of DB pension plans through their lifetime annuity payments, as unexpected increases in mortality and life expectancy increase the length of the payment period. Recent capital market developments have offered a few solutions for DB plans to off-load these risks, including pension buy-outs, pension buy-ins and longevity hedges[15]. Pension buy-outs and pension buy-ins are also called bulk annuities.

Pension Buy-outs

In a pension buy-out, the plan assets and liabilities are transferred from the plan sponsor to the insurer, enabling the sponsor to be fully discharged of liabilities and uncertainties of asset returns. Hence buyouts transfer all demographic and market risks. The insurance policies are written in the names of individual members, who then become completely disconnected to the scheme and receive payments from the insurer. A pension buy-out not only allows the scheme to get rid of longevity risk, but also the risk of uncertain asset returns and inflation. However, members will be exposed to counterparty risk from the insurer. Pension buy-outs can be fully or partially structured, covering all or a selected group of members. Full buyouts are usually followed by the wind up of the pension scheme. Pension buy-outs are relatively small in the current state of the insurance market and are more attractive to smaller plans looking to eliminate otherwise disproportionally high running costs.

Pension Buy-ins

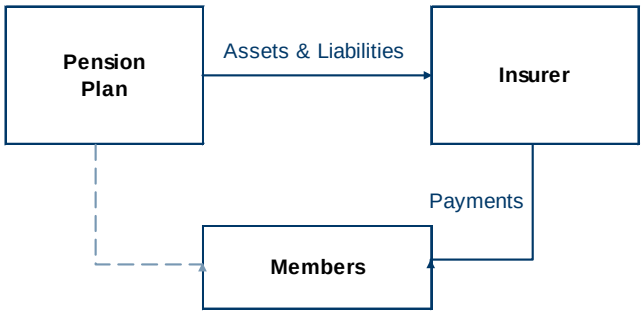
Pension buy-ins are an investment for pension schemes and are similar to pension buy-outs, allowing the pension plan to transfer longevity risk, inflation risk, and the risk of uncertain asset return. The key difference between pension buy-outs and pension buy-ins is that, in a pension buy-in, the insurance policy is written in the name of the pension trustee and the liabilities remain in the pension scheme. Liabilities are insured but the pension plan is still directly liable to its members. Assets are transferred from the pension plan to the insurer but are normally used as collateral against the insurance policy to reduce counterparty risk. See Table 13 for a comparison of the structures of buy-outs and buy-ins.

Buy-in and buy-out volumes in 2009 were GBP£3.7 billion, lower than in 2008 (GBP£7.9 billion). The financial crisis may have led to reduced demand from pension schemes for buy-ins and buy-outs as well as reduced capacity from insurers.

[15] Lane, Clark & Peacock 2010.

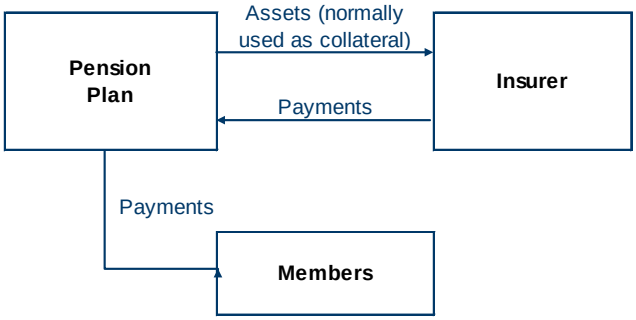
Table 13: Pension Buy-outs and Buy-ins

Pension Buy-out



Insurance Policy	Written in the names of individual members
Pension Plan	Fully discharged of assets and liabilities Disposed of longevity risk, inflation risk, and risk of uncertain asset returns
Members	Completely disconnected to the pension plan Receive payments from the insurer
Insurer	Take over assets (with premium) and liabilities Pay members

Pension Buy-in



Insurance Policy	Written in the name of the pension trustee
Pension Plan	Assets transferred. Liabilities remain but insured Transfer longevity risk, inflation risk, and risk of uncertain asset returns
Members	Remain with the scheme Receive payments from the pension plan
Insurer	Take over assets (with premium) Insure pension plan's liabilities

Source: Lane, Clark & Peacock 2010.

Longevity Hedges

A longevity hedge is normally executed through a longevity swap, where the pension plan pays a series of fixed payments (fixed leg) and receives a series of floating payments linked to the actual lifetimes of its members (floating leg). Unlike a pension buy-out or buy-in, a longevity hedge only allows the pension plan to transfer longevity risk, while other sources of risk remain and are managed separately. There are no transfer of assets, allowing the plan sponsor to retain investment control and exposure to asset returns. In a longevity hedge risks are hedged with an investment bank or a (re) insurer.

Longevity hedges are two types: a **bespoke longevity hedge** which transfers the longevity risk of members covered, and an **index-based hedge** of aggregate longevity risk. In a bespoke hedge, the leg of floating payments is linked to the actual lifetimes of the specific members covered, and thus allows the plan sponsor to fully dispose of longevity risk. However, bespoke hedges are only viable for relatively large schemes, as a large group of members is needed to efficiently price the hedge. An index-based hedge, on the other hand, provides protection against unexpected increases in longevity of a general population, and the scheme is left holding the specific longevity risk of its members. The advantages of index-base hedges are that they are available regardless of scheme size, are easy to price, have standardized characteristics and can be traded between institutions if a secondary market were to be developed. A GBP£3 billion longevity swap by BMW's UK pension scheme with Abbey Life took place in February 2010: the largest longevity trade to date.

q-forwards are instruments introduced by JP Morgan, which are based on an index which draws upon either death probability or survivor rates. In this contract, the q-forward seller (i.e., the pension fund) will be paid by the counterpart of the forward if mortality falls by more than expected. It is essentially a single-period longevity swap.

I provide a very brief summary[16] of some of the pros and cons of these de-risking solutions and how they might change with the advent of Solvency II based regulation.

Advantages and drawbacks

	Advantages	Drawbacks
▪ Buy-outs	▪ Achieves full de-risking. ▪ From the scheme's perspective, the fact that the credit risk of default of insurer lies with the member and not the scheme is an advantage.	▪ Requires acceptance of the arrangement by affected plan members and pension fund to be fully funded on a buy-out basis. ▪ Requires to pass across ownership of its assets thus future upside potential is lost.
▪ Buy-ins	▪ Transfer market and longevity risks.	▪ Incomplete de-risking. Obligations of the insurer are typically not collateralized and a material credit exposure arises. ▪ Requires to pass across ownership of its assets thus future upside potential is lost. ▪ Under Solvency II, the capital requirement for insurance companies which offer buy-in solutions are expected to increase, leading to higher buy-in costs.
▪ Longevity swaps	▪ Independent of market risk but can still take advantage of market opportunities. ▪ Can be de-risked even in the absence of sufficient funding. ▪ Credit risk is mitigated through collateralization.	

Suisse.

6.4 Re-insurance

Insurers and banks can diversify away specific longevity risk by pooling annuitants and managing the foreseeable part of aggregate longevity risk and through charging an appropriate premium. However they are unable to deal with the unforeseeable part of aggregate longevity risk. Some life companies are losing money because annuitants are already living too long and annuity products were priced too cheap. Re-insurance offers insurers a tool to manage their exposure, and would help in enlarging the size of the insurance and longevity hedging market. The current capital in the insurance and reinsurance industry is far from adequate to combat longevity risk. According to Lane, Clark & Peacock[17], the appetite from six principal reinsurers was around GBP£20 billion in 2011, but was typically restricted to GBP£1 billion for individual transactions.

[16] McWilliam 2011.

[17] Lane, Clark & Peacock 2010.

6.5 Asset-Liability Management

Pension plans normally hold significant equity allocations, and their asset values thus fluctuate widely, mirroring the ups and downs of the equity market. The core of the problem is not the potential fall in asset values, but the fact that assets show little relation to liabilities. In recent years, asset-liability management, or liability-driven investment, has been increasingly adopted by the pension fund industry. This approach shifts from an asset-only focus to one that focuses on the relative riskiness of the assets and long-run liabilities. It involves modeling pension liabilities and cash flows based on factors such as membership composition, plan rules, inflation risk, interest risk, contribution risk of plan sponsors and longevity risk. Mortality and longevity risk is the biggest risk and is critical to liability modelling and valuation. Pension funds then implement asset allocation strategies accordingly, so that investments can match and outperform liability streams.

As pension liabilities generally have long durations, investments in long-dated bonds would provide better matching. As a consequence, there has been a reduction in allocation to equities and an increase in allocation to bonds among pension plans across many countries. Many of the aforementioned longevity-linked instruments such as longevity bonds would theoretically be ideal investments. However, the markets for these instruments are still virtually non-existent.

6.6 Risk-Sharing of DC Schemes

The switch from DB to DC has led to a full transfer of pension risk from employers to employees. The fast growth of DC schemes, mostly the traditional individual DC arrangements, has left millions of savers with difficult saving and investment decisions and exposed them to the risks of under-saving and potentially large investment losses.

The Dutch experience of collective DC schemes offers some remedies to allow risk-sharing at least among pension participants. Risk-sharing has been partially institutionalized in the first pillar statutory state pension schemes in many countries. Similar risk-sharing can be achieved in the supplementary pension system through collective arrangement, and is of particular relevance to members of DC plans.

The main distinction between collective and individual schemes is that the former pools members' investments together and allows risk to be shared between participants. For employers, the collective DC schemes are similar to conventional ones, as they would make fixed contributions and provide no guarantee toward future pension payouts. For employees, contributions would be paid into a collective fund managed by a trustee instead of individual savings accounts, thus reducing the impact of investment loss and potentially increasing the security of retirement income. In the book "Costs & Benefits of Collective Pension Systems (2007)"[18], the authors stated that "risk-sharing within and across generations improves the average result to the participants". In addition, consolidation of pension funds also improves cost efficiency due to economies of scale. The authors calculated that costs per participant to mandatory industry-wide pension funds are significantly lower than company pension funds and the costs of collective pension funds are lower than private schemes.

However, there are new problems associated with collective schemes. It transfers risks and value between current and future generations, male and female, and the sick and healthy, leading to unequal distribution of costs and benefits. It is also not geared to heterogeneous participants as most collective schemes impose identical contribution and indexation rules for all

[18] Steenbeek and Van Der Lecq 2007.

participants irrespective of age, risk aversion etc. Thus, collective DC schemes need to be appropriately designed so that there is no hidden re-distribution; schemes are close-ended and controllable; new entrants neither benefit nor suffer from existing surpluses or shortfalls; and intergenerational settlement is based on sound arguments. All of these needs require to be overseen by an independent supervisor.

6.7 Renegotiated Benefits

So far, debate has been restricted to discussing the transferring and sharing of longevity risk between stakeholders. Aggregate longevity risk has to be eventually assumed by someone, and its uncertainty has made the provision of longevity risk solutions for individuals and pension funds increasingly difficult. As longevity further increases and populations age, some of the old age promises are likely to be reneged and some renegotiated. The ultimate solution to prevent individuals from saving insufficiently for retirement and to prevent private and public pension plans from accumulating deficits is pension reforms. There is a need for reforms that encourage and allow people to work longer as they live longer, save more and depend less on employers and governments. All of these reforms can be more easily achieved in many Asian countries, where governments are starting to direct resources to pension systems as populations age.

7. LONGEVITY RISK SOLUTIONS FOR LOW AND MIDDLE INCOME ASIAN COUNTRIES

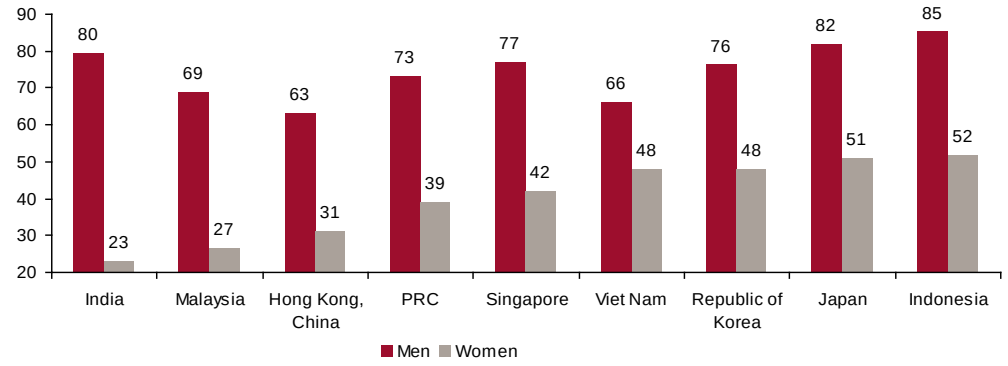
The above discussed solutions might work in the most advanced Asian markets like Japan and Hong Kong, China, but for the majority of Asia, which needs to deal with longevity risk, the practical and easier solution is education and the acknowledgement that retirement ages need to move with longevity. Multi-pillared retirement provision and risk-sharing are the more feasible and fair solutions. But as capital markets develop and become more sophisticated, Asian investors and governments should take into account the differences between western advanced countries and Asian countries, where populations are aging but are not as rich. In our opinion, savings in Asia should continue to be higher in combination with other progressive institutional developments on the pensions, insurance, reinsurance and annuity fronts.

The policy lesson that Asia can take from the more mature European countries and Japan is that retirement ages ought to be linked to life expectancy. In Japan, Republic of Korea, Mexico, Portugal, Turkey and the UK, the effective retirement age (male, female or both) is greater than the official retirement age. Many older people need to keep on working beyond normal retirement age as they find that their retirement income is insufficient.

Sustaining expenditures in old age can be affordable if individuals have enough savings, or if government budget balances are in good shape, or if intergenerational transfers are made. However, potential additional sources of income in old age are related to job opportunities for the elderly, society's attitudes towards flexible retirement, and health conditions. Table 14 illustrates male and female workplace participation rates for the 55–64 age group in Asian countries, and demonstrates a large male-female participation gap as women tend to retire much earlier than men.

Table 14: Labor Force Participation among older Workers

Participation rate for age group 55–64 (%)



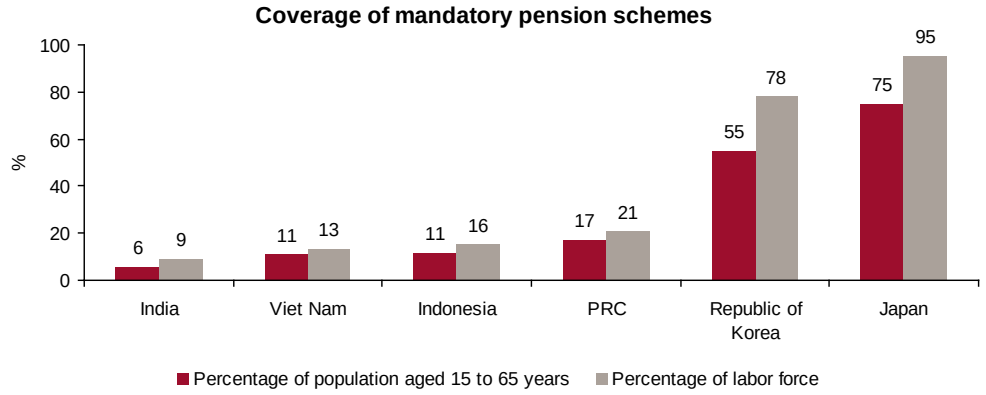
Source: International Labor Organization (LABORSTA); Crédit Suisse.

A lesson to all countries is that as women live longer, it is prudent to have fair opportunities for them to work to older ages. Otherwise they will be dependent on the state, their employer or spouse/family to defray their increased old-age expenditure throughout a long post-retirement life.

Most of the Asian countries with a younger population are yet to devise fully-fledged formal old-age support systems. Table 15 highlights the coverage of Asian pension systems. India, Viet Nam, Indonesia and the PRC have a long way to go in terms of expanding coverage of mandatory pension schemes. In fact, informal sources of old age support such as family support still play an important role in these countries. In Chinese and Indian culture, for example, supporting and caring for elderly parents is a long-cherished heritage. It forms part of Chinese law that adult children are held responsible for providing for aged parents, while aged parents without income sources and incapable of working, have the right to demand financial support from their children. From an economic perspective, this reciprocity between generations based on kinship is an informal insurance: self-made inter-generational risk-sharing. However, falling fertility rates and changing family structures in Asia have cast doubt on this tradition of family support that has worked for thousands of years. The now common 4-2-1 family structure to be found in the PRC means that many young couples are burdened with the responsibility of supporting four parents and one child. There is thus an imperative need to establish an institutional social support system for old age. In doing so, Asian countries should learn from the mistakes of the West and design an adequate, equitable and sustainable system that effectively tackles longevity risk.

Table 15: Coverage of Mandatory Pension Schemes

Percentage of population in working age group and labor force covered



Source: OECD. 2009. Pensions at a Glance Special Edition: Asia/ Pacific.

8. CONCLUSION

Recent demographic trends suggest that longevity has emerged as a key risk affecting individuals, pension plans, insurers and governments in both the developed and emerging world. In Western countries, despite capital market developments, the availability of solutions to tackle longevity risk remains limited. Further developments should focus on creating a set of instruments that are effective, economically affordable and transparently priced. Understanding, measuring and managing longevity risk is essential. Moreover, further reforms of pension systems are needed to address the root of the problem. For Asian countries, the experience of the West provides ample guidance in formulating their pension plans and promoting capital market developments to avoid the same predicament the West is now struggling with.

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