A Literature Survey on Ageing, Earnings and Productivity

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Abstract

The demographic changes projected by the Organization for Economic Cooperation and Development (OECD) for the following five decades indicate that there will be an older and smaller labor force. This may have pervasive effects on individual productivity, on factor and product markets and even on public finances.

This paper examines the relationships between age, earnings and productivity associated with an ageing population. In particular, the decline in cognitive abilities with age potentially plays an important role in determining individual's job performance under an economic environment of rapid technological changes. A number of economists utilize two main classes of models in most empirical studies: the dynamic multi-region macroeconomic models and overlapping-generations (OLG) models in a closed-economy. However, due to the limitations of the data sets and measurement approaches, they have not come to a coherent conclusion regarding the decline in job performance for older workers. Three major directions that may deserve future research considerations are proposed: the analysis of general equilibrium results, the direct impact of demographic developments on individual saving decisions and the interaction between resource scarcity and technological change. On the policy side, both employers and governments should take actions in response to the shift in labor supply. Employers may need to consider older workers as a pool for rehiring. Also, broader issues such as increasing productivity growth, diversifying the retirement income sources, attracting younger immigrants and delaying retirement age are discussed from a policy point of view.

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I. Introduction

One of the major structural changes facing the Organization for Economic Cooperation and Development (OECD) economies is the adjustment to an older and slower growing population. Ageing and lower fertility rates will result in a smaller proportion of the population being in the working age, especially after 2010. Such demographic shift will inevitably cause significant impact on both micro and macro aspects of the nationwide economy. How will the individual's productivity evolve with age? What will employers do in response to such an older and smaller labor force? What is the role of the government in adjusting the policies to maintain higher economic growth?

On the basis of a broad literature reviews, this paper will focus on the linkage between ageing population and individual productivity and the corresponding economic impacts, and then will try to find out the solutions to the above questions accordingly. We first project in section II the demographic trends in OECD areas for the following five decades and analyze the economic impact resulting from such changes. Aware of the important role of cognitive abilities in determining job performance, we pay more attention in section III to the age-productivity and age-earning profiles from the point of view of experience and schooling in particular. A number of modeling approaches are then discussed in section IV and some future research directions are proposed as a result. The measurements of the age-productivity profile are examined in details in section V so as to figure out the empirical difficulties in this field. The following two sections, VI and VII, suggest relevant labor force adjustments that should be taken into account by employers and governments respectively. Section VIII is the summary and conclusion.

II. Demographic Changes of Population and Economic Impacts of Ageing Population

i. The Demographic Changes of Population in OECD Countries

Demographic projections by United Nations (1998) suggest very modest growth or declines in the total population of the OECD area. The overall population will increase by about 100 million to reach 1.2 billion with a slower annual growth rate of only 0.1 percent. The population level will even start to fall in some countries. For example, the total population in European Union (EU) and Japan is expected to decline from around 2030. Italy, however, is most notable, where population levels will start to fall at some point during the first half of this century (Table 1).[1] The United States and Canada are expected to keep positive population growth rate, mainly due to immigration. Nevertheless, the projected rate is considerably lower than the pace of 1 percent recorded over the past 25 years. Over the same time horizon, however, growth in the number of elderly people - 65 years of age and over - will be eleven times faster, increasing by 152 million from year 1998 to reach almost 300 million by 2050 (Table 2). Virtually all OECD countries, albeit to various degrees and at different stages, will face ageing-population challenges. In the EU countries, the elderly population will increase by about 1.5 percent annually on average until 2030 (compared to 1.2 percent in the past 25 years), before slowing down over the subsequent 20 years. In Japan, the ageing process is more advanced, where it has already experienced a rapid increase in the share of elderly population during the past 25 years. The pace will start to slow down from 2010 and onwards. The tendency of population growth in Canada slows down since 1960 and will keep constant around 2040. In the United States, however, the pace will be about 1 percent faster than

[1] UN projections (1998) are based on assumptions on fertility, net immigration and mortality rates. Fertility rates are typically assumed to gradually reach the population replacement rate, which would imply a constant population. In most OECD countries net immigration rates are assumed to be zero, but in a few (Australia, Canada, Germany, New Zealand, Sweden and the United States) net immigration rates range between around 1 per 1,000 in Sweden and 4 per 1,000 in Canada. Mexico is the only OECD country with a negative net immigration rate of about -1.5 per 1,000.

other OECD countries, but approximately at the same rate as that in the past 25 years. In general, the growth of the elderly population in most OECD countries is expected to slow down after 2025 and will stabilize by the middle of this century.

The expected evolution of the age structure of a society depends on demographic conjectures about future fertility rates and life expectancy, as well as the level and age structure of immigration flows. Hence, such an increasing pace in the population of elderly people is not only due to the post-war baby boomers moving through the age structure, but also to individuals' lengthening lifetime and falling fertility rates. Recent projections for OECD countries[2] over the next 50 years show an average increase in life expectancy of about 4.5 years to 82 years. In particular, the fertility rates in most OECD countries appear to recover somewhat, but they are at only 1.7 children per woman on average, which is well below the standard - 2.1 children required to maintain a constant population[3] (Table 3). In addition, trends towards better nutrition, improved public health, higher education level, less physically strenuous jobs and advances in health care have contributed to a higher life expectancy for the current generation of elderly people and with fewer disabilities (Table 4). Furthermore, Table 3 also suggests relatively high immigration flows in Australia and Canada until 2050, albeit the percentage of immigrants with respect to total population will still decline. Likewise, immigrants are not sufficient to help moderate ageing pressures. Mérette (2002) mentions that there will not be a significant dent of the projected elderly proportion in the total population, unless there is a huge increase in the gross immigration quota, 500,000 per year rather than the

[2] These demographic projections are based on the middle variant of Eurostat population projections in the case of European Unions (EU) and national projections for the remaining countries. See OECD 2001.

[3] This average excludes some OECD countries with relatively high fertility rates, most importantly Mexico and Turkey, as well as a few other countries (Greece, Iceland, Ireland Luxembourg, Slovak Republic and Switzerland), which have also not been included as part of the projection.

current level of around 200, 000.[4] Obviously, such a huge increase is unlikely, the rather that under the stiffer competition among ageing societies in seeking for immigrants.

As a consequence of these demographic trends, projections to 2050 show declining working-age population and rising numbers of retired people. The labor force will become older and smaller. There will be an increase in the median age of the population by almost 10 years to 44 and a decline in the overall growth of the working-age population (individuals aged between 20 to 64) by 38 million. Moreover, the elderly dependency ratio, defined as the ratio of the elderly (individuals aged 65 and over) relative to the working-age population, is expected to double, particularly in the years after 2010, to almost 50 percent by 2050 from 22 percent at present (See Figure 1).[5] The expected rise in the dependency ratio of all OECD countries is attributed largely to both increases in the elderly of population over 65 years old and declines, given lowered fertility rates, in the working-age population. Figure 2 shows that among the G-7 countries[6], considerably sharper increases in the dependency ratio are expected at the end of the period, and even suggests further pressures beyond 2050 as well. For instance, the ratio in Italy is expected to continue rising sharply and finally reach a peak above 65 percent around 2050. For Japan, the dependency ratio has already doubled over the past 25 years to 20 percent and is expected to almost triple to reach 55 percent by the middle of next century. Germany and France are likely to keep fairly steady ratios over the next 10 years, with a quick rise afterwards before stabilizing at 40 percent or so in 2050. A reduction in

[4] Refer to Billings, Lawlis and Roth (1998) for details.

[5] The combination of increased life expectancy and low fertility will lead to substantial changes in the demographic profile of OECD countries. As the number of elderly people (65 years and above) is expected to increase substantially to reach over a quarter of the OECD population, the proportion of the very old (80 years and above) could almost triple by 2050 to reach 9 percent. Over the same period the proportion of children and those in their prime age (20 to 54) will shrink in each of the main OECD regions. Also of note is the rise in the share of elderly workers (55 to 64 years), which is a group where attachment to the labor force is currently very low (Figure 3).

[6] G-7 countries include Canada, Italy, United States, Japan, France, Germany and United Kingdom.

the number of other dependants, like fewer children, and the expected continuation of the upward trend in labor force participation may partially offset the burden on the working-age population, but it will not be sufficient to avert pressure on budgetary positions and output in the coming decades.[7]

Another significant fact is that a number of older workers (those aged between 55 and 64) have withdrawn permanently from the labor force at earlier and earlier ages over the past two decades in almost all OECD countries, especially in the high unemployment countries. In 1960 the average retirement age in the OECD area was around 65 years for both males and females. By 1995, males on average retired at 62 years old and females at 60.[8] The decline in retirement age starts from a low level and has been notable among most of the major continental European economies (Figure 4). Combined with the difficulties older workers experience keeping old jobs or finding new ones, both factors result in a drop in the employment rate of this group throughout many OECD countries (Table 5). Today less than half of the older workers in the OECD area are employed and in a number of countries the figure is less than a third. In some countries, such as France, the Netherlands and Spain, the employment rate has decreased to less than 35 percent and to about 25 percent or below in Italy and Belgium, while in others - United States, Japan, Korea, Norway and Sweden-, it is well above 50 percent and has remained broadly steady over the past 15 years.

ii. The Economic Impacts of Ageing Populations

Given current social security arrangements and policies, the transition towards an older and smaller

[7] In some countries a major problem is also given by very high inactivity rates amongst women of all cohorts. In Greece, Italy and Spain, for example, the female employment rate of prime age (25-54) women was still in 1998 about or below 50 percent of the rate for males (that compares with rates of about two thirds or more in most of the other OECD countries)

[8] The standard age of entitlement to a public pension for females in about half the OECD countries is lower by about 5 years than the age for males, even though it could be argued that there is no strong reason for this now.

labor force will have pervasive effects on productivity, on factor and product markets and on public finances. A considerable amount of empirical research has been produced in recent years attempting to estimate the economic consequences of ageing populations and needed policy changes. As a coin has two sides, economists mainly develop two opposite opinions toward such demographic changes. Some of them pessimistically believe that the ageing population, in most industrialized countries, may bring about serious fiscal and welfare problems and the economic growth will suffer. They set forth their contention from two aspects. From a macroeconomic point of view, facing to the sizable pressures caused by baby-boomers' earlier retirement and lengthening lifespan, the governments have no choice but fiscal adjustments, like raising taxes and accumulating public debt, which will directly cause a shortfall in public and private savings, significantly increase world interest rates, widen budget deficits, exacerbate the friction cross nations on trade and foreign investment policies, strain national monetary policies and exchange-rate regimes and finally lead to a slowdown in the growth of national standard of living (GDP per capita). The evidence provided by Hviding and Mérette (1998) suggests that real per capita GDP could be between 10 and 30 percent lower in 2050 relative to a scenario with no ageing. Based on observations of seven OECD countries, they estimate a decrease in real per capita GDP growth of 0.4 percentage points per year on average and the GDP in Canada will decline by 20 percent over the next 5 decades.

Furthermore, from the microeconomic point of view, the distribution of goods and welfare between retirees and workers as well as between current and future generations will be affected. The World Bank in 1994 prognosticated that a "looming" age crisis threatened both the elder and their offspring. Peterson (1999) asserts that such an ageing crisis intensifies intergenerational conflicts. The older generation encounters budget and health predicament because both public pension

programs and public health system are not sustainable in a fast ageing society. As for the current young cohorts, on the other hand, they have to afford heavier tax and family burden in order to support the same number of children and the rising proportion of elderly people. Thus, for a given levels of output and saving per worker, a larger number of dependents imply a lower level of consumption per capita. Inevitably, the living standards of the working-age population will deteriorate.

Some other economists, in contrast, offer a more optimistic view of these important demographic changes and propose that qualifying population ageing as an impending crisis is overstated without taking ageing benefits into account. Ageing population will not weaken economic growth to the extent forecast by the pessimistic predictions and could, in virtually, usher in gains for younger generations. Mérette (2002) puts forwards two mechanisms, - higher human capital investment and rising participation rates of older workers -, and regards them as potent means to mitigate the negative consequences of population ageing on nationwide economics. Nowadays with the globalization of markets and technological change, most industrialized countries, especially those under transition process from resource-based to knowledge-based economies, recognize the importance of human capital as an engine of economic growth. This will further trigger their incentives to invest more on education of younger cohorts in order to get higher yields contributing to future economic growth. It is conceivable that in the future, older workers will become better educated and have the capabilities to work for a longer period than currently. As a result, Mérette concludes that growth in both effective workforce and national economy may not drop much with population ageing over the next 5 decades. His conclusion is not without empirical evidence. Fougère and Mérette (2000a) examine the impact of the two mechanisms as well as the tax

smoothing effects of private pension plans. In the case of Canada, a fast ageing society, their results are consistent with his optimistic contention. Under the circumstance of no mechanism being adopted, all cohorts will undergo a loss in welfare. When both mechanisms are in full use, the young and future generations are better off [9] but those born before 1965 are worse off.

III. Ageing, Earnings and Productivity

i. The Relationship Between Ageing and Productivity

Labor force is heterogeneous and evolving over time. Employers may be conscious of the current productivity based on the handy track record of employees within organization; however, they have no idea about the prospective productivity profile when the employees age. Labor force ageing can cause variations on individuals' physical abilities, cognitive abilities, education and so on. All these differences, in turn, lead to different productive capacities across age groups of the working population. Naturally, the studies of age-productivity profile have crucial implications if the industrialized countries want to maintain economic growth and living standards even if the labor force is ageing more rapidly.

Quite a few economists have studied the links between an ageing labor force and productivity on various kinds of occupations. For example, Oster and Hamermesh (1998) present a case study of economists and conclude that economists' publications diminish with age, especially in leading journals, at a rate as rapid as in the physical sciences. Bayer and Dutton (1977) and Bratsberg et al.

[9] The adoption of both mechanisms can raise the welfare of individuals born 1995 by up to 5 percent and those born in 2010 by 7.5 percent.

(2003) present similar results on older researchers. We can also find evidence from Fair (1994) for athletes, Galenson and Weinberg (2000) for modern American painters, Bhattachaya and Smyth (2001) for judges and Diamond (1986) for mathematicians and scientists. All these age-productivity profiles suggest that age-variation can affect an individual's productivity throughout his or her lifetime, and that productivity declines as a worker gets close to retirement age. A study from the U.S. Department of Labor (1957) compares output between cohorts of different ages on the basis of a broad selection of industries. Job performance increases until the age of 35, before steadily declining thereafter. However, the slope of the decline is not steep and it is heterogeneous between industries: productivity declined by only 14 percent in the men's footwear industry, and 17 percent in the household furniture industry. Guillemette (2003) estimates the demographic changes of 39 Canadian business sectors and finds that people in their sixties tend to be less productive, albeit insignificantly. Along the same line, Tang and MacLeod (2004), based on a panel dada of Canadian Provinces, draw a conclusion that labor force ageing has incurred a negative impact on productivity growth in Canada since 1996[10] and workers aged 55 and over tend to be less productive than others.

ii. Ageing, Cognitive Abilities and Productivity

Among the causal factors that affect job performance,[11] cognitive abilities play an increasingly important role in modern technological economy, whereas physical abilities begin to quit the dominant stage nowadays. Cognitive abilities refer to the broad aspects of intellectual functioning,

[10] The impact will be a reduction of productivity growth by 0.2-0.3 percentage points per year, with Newfoundland being hit the hardest by 0.4-0.5 percentage points.

[11] An individual's productivity can be influenced by several causal factors, including physical abilities, cognitive abilities, and education and job experience. Combined with firm characteristics, they determine the job performance. (See Figure 5)

such as reasoning, spatial orientation, numerical capabilities, verbal abilities and problem solving. The most commonly used measurement of cognitive abilities is the intelligence quotient (IQ) score.

According to the different behaviors responding to ageing, we can divide cognitive abilities into two categories (Figure 6). One is called fluid abilities, which concerns the performance and speed of solving tasks related to new materials, such as perceptual speed and reasoning. The other is named crystallized abilities, which measures those abilities that can improve with accumulated knowledge, including verbal meaning and word fluency. Each of the two categories tends to follow relatively independent slopes over the life cycle (Schaie 1994). The fluid abilities are strongly reduced at older ages, whereas crystallized abilities still maintain at a relatively high functional level until a late age in life (Horn and Cattell 1966, 1967). Some empirical papers based on the studies of psychometric test results can help account for this perspective. The result from Blum et al. (1970) turns out that, in a test-retest study[12] of twins, vocabulary size does not differ with age, but there is a general reduction in other cognitive abilities. Along the same line, Schwartzman et al. (1987) study the specific test results[13] of male workers between different age groups, young and old. They find that verbal abilities remain almost stable, but reasoning and speed abilities decline with age.

The age-related productivity decline is increasingly attributed to the reductions in cognitive abilities with age. The age-induced declines of cognitive abilities are prevalent among human beings no matter the nationality or sex (Park et al., 1999; Maitland et al. 2000). Schmidt and Hunter (1998)

[12] In this paper, the author examines the rate of change on selective tests of intelligence among twins on the basis of a twenty-year longitudinal data set.

[13] It refers to the psychometric test results of young and older men.

provide a meta-analysis examining how individual characteristics relate to job performance such education, work experience, and general cognitive abilities and come to the conclusion that mental ability test scores are the best predictors of individual job performance. A large body of evidence indicates that cognitive abilities decline from earlier adulthood. Verhaegen and Salthouse (1997) estimate linear and nonlinear age effects and structural models to investigate the age-cognition relations on the basis of 91 studies. The meta-analyses show that cognitive abilities reasoning, speed and episodic memory declines significantly before 50 years old and more thereafter. The peak values of most abilities are reached in the 20s and early 30s (Avolio and Waldman 1994, Figure 7). Furthermore, Murnane et al (1995) do further research on the growing importance of cognitive skills in the determination of earnings. They examine the independent variables including the numbers of sibling, race, work experience, parental education and whether the individuals were full-time employed or raised in a single parent household and find an increasingly strong correlations between test scores and wages: math score predicts wages better in the 1980s than in the 1970s, and test scores was stronger six years after graduation than two years after graduation. Other evidence showing the importance of intellectual abilities in determining earning levels include Juhn et al. (1993), Grogger and Eide (1993), and Murnane et al. (2000).

Experience, Job Performance and Earnings

As cognitive abilities are pivotal determinant factors of job performances, jobs can also be correspondingly distinguished according to whether reduced cognitive performance and/or long experience affects job performance (Warr 1994). The age-productivity profile tells us that productivity usually decreases as the workers gets older and the cognitive abilities decline. However,

not everything is absolute in the world and without exceptions. The decreased cognitive abilities of older workers can lead to lower productivity, unless their longer experience and higher levels of professional knowledge outweigh the decline in cognitive abilities. For example, the relative demand for work tasks that involve certain cognitive abilities have shifted asymmetrically over recent decades. The demand for interactive skills, which are abilities that are relatively stable over the life cycle, has increased more than the demand for mathematical aptitude, which declines substantially by age (Autor et al. 2003). Thus, the longer the elderly work, the more professional knowledge they acquire, which outweighs the age-related declines in learning abilities. This suggests that older workers are getting relatively more productive over time. Any decrease in the labor market value of long experience is likely to have an even stronger importance on the relative performance of older and younger worker.

Nevertheless, job experience cannot contribute to productivity improvements throughout the entire life span. Experience increases individual productivity up to a given duration, and thereafter, cognitive declines outweigh experience contribution, which can decrease job performance. Ilmakunnas et al. (1999) construct a matched worker-plant data from Finnish manufacturing and estimate productivity and wage profiles according to age and seniority. One of their conclusions is that skills are not firm specific. At low seniority, productivity increases fast, but starts to decline early. The job duration can improve job performance for up to 3.8 years[14] (See Figure 8).

[14] The authors construct a model for total factor productivity (TFP) levels and include some explanatory variable in terms of logarithms for the plant's labor characteristics, such as the average age of the employees (AVAGE), the average seniority (SEN), and the average years spent in schooling by the employees (EDUY) and squares of these variables. Since the square of EDUY is not significant in the TFP equations, the authors discard it. When all the worker characteristics are controlled, the result shows that productivity initially grow fast with experience in the plant until it reaches its peak at 2.5 years, and then declines slowly over time. When variables of plant generation included (GENA-GENF), the seniority productivity profile shifts up. It peaks slightly later, at 3.8 years, and declines more slowly. The coefficient of the plant generation variables indicates that new vintages have higher productivity.

There is abundant evidence that age-earning profiles are not exactly related to age-productivity profiles, but continue to grow with labor market experience over most of a normal work life (Ilmakunnas et al., 1999). Medoff and Abraham (1980, 1981) provide direct evidence concerning the relationship between experience and performance among managerial and professional employees doing similar work in two major U.S. corporations. Their results show that within grade levels[15], there is a strong positive association between experience and relative earnings, whereas there is either no association or a negative association between experience and relative rated performance. The above results support the hypothesis that human capital is not firm specific, and seniority related wages are used for incentive reasons.

However, there are still other potential explanations of the link between experience and earnings in which productivity growth plays a very minor role. Mincer (1974, Page 80) recognizes the possibility that the positive association between experience and earnings might only "reflect the prevalence of institutional arrangements such seniority provisions in employment practices." He then makes the observation that sets the stage for his study: "Such practices, however, do not contradict the productivity-augmenting hypothesis, unless it can be shown that growth of earnings under seniority provisions is largely independent of productivity growth."

In summary, the human capital interpretation of the experience-earnings profile is distinguished from other interpretation by the prediction that earnings growth reflects productivity growth. In the human capital model, productivity growth does not necessarily produce earnings growth. If a

[15] Medoff and Abraham address that, for compensation purpose, companies assess the relative importance and difficulty of their myriad positions and group them in light of theses assessments into grade levels. For the two companies under analysis in this paper, this grading is based on a position description filled out and kept current by the supervisor of this job with the concurrence of higher-level supervisors, if necessary. Therefore, the jobs held by sample members from Company A fall into nineteen grade levels, whereas twelve for Company B. Moreover, in light of the way in which jobs are classified into grade levels, the authors also assume that positions within a grade level are of equal importance and difficulty.

worker's productivity were enhanced by firm-specific on-the-job training program financed solely by the firm, the earnings profile would be flat. However, if growth in earnings is observed, according to the model, either general or specific training (financed partially by the worker) and thus growth in productivity must have occurred.

Schooling, Job Performance and Earnings

Conventional estimates for a large number of countries generally indicate that the social returns to schooling are positive, significant and competitive with returns to investment in physical capital. Such estimates are good guides for policy resource allocation. However, the interpretation of the positive relationship between the schooling and the earnings of workers has been questioned. That is, whether as the conventional estimated assume, the coefficient of the schooling variable in the earnings function measures the effect on the productivity of workers' human capital acquired in school. Education has been hypothesized in part, or instead, to represent screening for native ability and motivation, or credentialism. As a consequence, conventional measures of the social benefit of education are substantially upward biased.

In response to this, Boissiere et al. (1985) include two new variables - measures of the worker's cognitive skills and of his reasoning ability - which are not previously found in studies of developing countries and only rarely found in the studies of the education-earnings relationship in developed countries, in order to test why workers with secondary education earn more.[16] Based on two rigorously comparable micro data sets from Kenya and Tanzania, their econometric results

[16] The usual variables in earnings function estimates of the benefits of schooling are individual earnings, years of schooling, and years of working experience.

illustrate that the contribution of years of schooling is larger than other variables, reflecting the size of its coefficient and the tendency for the proportion with secondary education to rise with earnings quintile. The direct returns to reasoning ability in the labor market are small, those to years of schooling are moderate, and those to literacy and numeracy - dimensions of human capital - are large. In a word, the direct returns to years of schooling could reflect credentialism or screening or human capital acquired at school or at home. The main effects of length of schooling and reasoning ability on earnings are indirect, operating through the development of cognitive skills. Earning differences by educational level tend to rise with age.

As for the OECD countries, the cohort of old workers (aged 45 to 64 years) in 2015 tends to be better educated than their counterparts in 1995 (Table 6).[17] The proportion of those less educated (i.e., who did not complete upper secondary schooling) will significantly decrease by over one-third by 2015.[18] This seems to be good to old workers, especially for men, since rising educational attainment could ease the absorption of a larger cohort of old workers. Recent decades have witnessed a strong increase of labor demand for more-educated workers and a concomitant deterioration in the employing opportunities for less-educated workers (OECD, 1997a, Chapter 4). Poorly educated youths, particularly men, appear to have been most disadvantaged. Moreover, old workers have also been negatively affected. Old workers who are displaced from production jobs, a group with low educational attainment on average, are at a high risk of remaining unemployed for a longer period of time and typically experience a good deal of income losses if they do become re-employed (Carrington and Zaman, 1994; Fallick, 1996). However, a word of caution is in order.

[17] Educational attainment is not projected to 2030, because the cohorts who will constitute the older work force that have not yet completed their initial education. Further increases in educational attainment are expected to occur between 2015 and 2030.

[18] The unweighted average for OECD member countries falls from 44.1 percent to 26.9 percent. (Table 6)

A "prediction" that the rapid increase in the educational levels of older workers is likely to expand their employment opportunities is potentially subject to a fallacy of composition (OECD, 1998). For a given cohort, more educated workers fare better on average than less educated ones. If this is due to so called "screening" by employers, then it need not follow that an upwards shift in the amount of schooling received by a cohort will result in improved employment prospects for the cohort as a whole. Moreover, if the education level of a cohort improves, the return to education may then decline.

iii. Age, Training and Productivity

Table 7 presents the participation rates in professional and career-upgrading training from International Adult Literacy Survey (IALS, 1994-1995). The figures in unweighted average show that the participation rate of the oldest cohort – aged 55 to 64 years- significantly decreases to 15.4 percent, albeit the proportion for older workers - aged 45 to 54 years – and the younger workers - aged 25 to 44 years – are 21.1 percent and 22.8 percent respectively.[19] The data indicate that the training rates does decline beyond age 54, when impending retirements will cause the five-year retention rates to start to fall. OECD (1997a) calculates five-year retention rates to measure the percentage of workers of different ages who will still be with their current employer five years later. The data from OECD (1997a) suggest that the retention rate for workers aged 45 years and older is higher than that for younger workers. The retention rates remain relatively high and comparable with those of prime-age workers through about age 50-54 years. Beyond the age of 55, the probability of an older worker remaining a further five years with the same employer declines

[19] The rate for the oldest cohorts is close to the rate for the youngest cohorts, aged 15 to 24 years, which is 15.2 percent.

substantially. Apparently, the pending retirement of these workers significantly shortens the amortisation period and may discourage further skill training. Another data profile from business enterprises in the United States exhibits a similar age profile for participation in training and suggests that annual hours devoted to training actually peak around age 50 (Lynch, 1997).

Virtually, the issue of training is twofold. First of all, the most critical issue on training old worker is the lack of access (American Association of Retired Persons (AARP), 1995; Barth, McNaught, and Rizzi 1994; Carnevale and Stone 1994; Hall and Mirvis 1993). Employers get used to concentrate on training younger cohorts because they expect greater economic returns from younger workers than from older cohorts. Evidently, older workers are not treated comparably to younger workers in gaining opportunities to training. Hall and Mirvis (1993) suggest that employers are investing in under-prepared labor force entrants at the expense of older workers. Nearly 34 percent of the managers in Barth, McNaught, and Rizzi's study (1993) report that their companies spend very little money on training older workers, compared to only 21 percent who spend very little on training workers under age 35. Moreover, less-educated older workers are even less likely to receive training than more educated workers (OECD and Statistics Canada, 1995). These individuals may become increasingly vulnerable to skill obsolescence, especially when pension reforms tend to delay the desired age of retirement. Therefore, it is no doubt that low training will lead to low earnings or employability problems among older workers and, hence, raise equity concerns. For instance, many low-educated older workers who have little skill training in previous work history may have to adapt to newly changed job requirements or search for new jobs, although they are ill prepared to do so.

The other part is concerned with older workers' ability to learn new skills. No basis exists for the stereotypes surrounding the ability of older adults to learn new skills (Rothstein and Ratte 1990). "When companies tailor programs to the age, knowledge, and experience of older workers, training proves just as effective as and no more expensive than it does for younger workers" (Carnevale and Stone, 1994). Rybash et al. (1986) argue that senior employees can remain highly productive within a field that they know well and where long experience is beneficial. Tacit knowledge, procedural knowledge used to solve daily problems, is a good case of age-robust ability. That's the reason why we can find many older managers who perform as well as younger ones (Colonia-Willner, 1998). McNaught (1994) also cites an example of Days Inn that has used older workers successfully. Days Inn employs older workers as reservations agents. Compared to younger workers, older workers fare very well: their training takes no longer, they have lower turnover rates, and they are more likely to complete a call with a successful reservation. Given the appropriate opportunity, older workers are quite capable of learning new skills and achieving high productivity.

Consequently, the adaptation of training practice is remarkable when workforce is ageing. First, training helps to minimize any adverse effects of ageing on overall productivity. Although the decline in cognitive abilities is inevitable, scientific studies suggest that targeted training programs can effectively soften or halt age-specific reduction. Schaie and Willis (1986a, 1986b) find that training the elderly can stabilize or even reverse age-induced declines in spatial orientation and inductive reasoning. Ball et al. (2002), along the same line, draw a conclusion that older employees receiving trainings such as exercising speed, reasoning and memory abilities tend to perform better on their future jobs than those who do not. Secondly, training is also useful to accommodate any preference of older workers to delay retirement. The firms' training investments reflect their

expectations about their desired age of retirement. Since pension reforms are designed as an important complement to encourage later retirement, firms need to pay attention to such a shift and adapt training practices earlier. Government also plays a vital role in such a reform. Policies engaged in increasing the perceived payback period for investments in older workers are able to raise the age threshold beyond which training rates start to fall in anticipation of retirement.

IV. Modeling Approaches and Future Research Proposals

Researchers have recently utilized a number of general equilibrium exercises to examine the economic implications of ageing populations. Among them, two kinds of modeling approaches have been used quite often. The first one is the application of dynamic multi-region macroeconomic models, which allow for trade and capital flows among different economic regions. The other one is concerned with a closed-economy, i.e. overlapping-generations (OLG) models, which allow for decisions by different age groups.

Both approaches have made substantial improvements compared to the earlier research. These models are modified to start from initial conditions instead of a steady-state equilibrium as before. They also specify the demographic conditions, such as fertility rates and life expectancy. In addition, heterogeneous households are directly introduced into both classes of models in terms of productivity and age cohorts with an explicit modeling of the impact of technical change. Recent papers accomplished by Turner *et al.* (1998) with the Minilink model and by McMorrow and Roeger (1999) with the QUEST model, which were presented at the OECD and at the European Commission, belong to the first approach, while other studies, such as Miles (1999) for the United

Kingdom and Europe and Kotlikoff et al. (2001) for the United States, represent the second approach.

Both the dynamic macro and OLG approaches have some features in common. They are all general equilibrium in nature and are solved for long durations. In these models, ageing affects household decisions through the life-cycle hypothesis, under which individuals save during their working life and consume their accumulated assets after retirement. Furthermore, both approaches adopt neoclassical production function and regard technical changes as an exogenous condition. They consider not only the increasing pensions and health care expenditures that are affected by longer life expectancy in a given population, but also possible the reductions in education expenditures that are related to low fertility rates. However, this feature is somehow questionable and may need further modification. Fougère and Mérette (1999) propose an explicit modeling of endogenous growth features in an OLG framework. Finally, all models are solved under an explicit government budget constraint. With the exception of Turner *et al.* (1998) which allow for some increase in both public debt and taxes, the other three models imply that ageing results in increases only in payroll tax rates and revenues, which restrict the household and business decisions. As long as the ageing shocks are imposed, the final outcomes of both approaches reflect the establishment of a general equilibrium.

In addition to the common features, the two kinds of models have some distinctions as well. First of all, the sources of variables are different, which may lead to disparate disadvantages. The dynamic macro models depend on econometric estimates of household and business decision rules derived from time series of aggregate macroeconomic variables. With fully forward-looking and

time-consistent expectations, the specifications of behavioral equations are in line with dynamic optimization. Inevitably, such estimates may suffer from aggregation problems. In contrast, OLG models rely on detailed microeconomic information, especially on households. Most of the variants are obtained from external sources and adjusted through calibrations. The models are aimed at solutions for single economies under a hypothesis that allows the variations of relative prices to equilibrate goods and factor markets. Hence, the models require strong assumptions to be solved. Moreover, the results are very sensitive to the uncertain diversifications in parameters. Given the large amount of variables and wide margins of uncertainty, sensitivity tests are typically difficult to conduct. Therefore, the overall reliability of this approach is sometimes trustless. Secondly, the ways to deal with the economic effect of population ageing for each approach are different. As we discussed above, population ageing can influence an economy through higher longevity or reduced fertility, which are explicitly taken into account by the OLG models. The macroeconomic models, however, introduce these shocks in an *ad hoc* way, where they use the estimated consumption functions on the basis of separate evidence concerning the impact of the dependency-ratios on saving.[20]

On the basis of the above analyses, a number of issues may deserve future study. First, the general equilibrium results of show that the relative price affects on labor and capital vary across the modeling exercises. For example, Kotlikoff *et al* (2001) obtain a very large increase in tax rates and the striking consequent effects on capital intensity for the United States, which is, nevertheless, much smaller than that for Japan and Europe. Hence, they suggest that the role of particular parameters played in the model specification should be carefully assessed and that differences in the

[20] The standard of living is approximated by GDP per capita, except in Turner et al. (1998) who consider GNP per capita corrected for changes in the terms of trade.

way that technical change affects household productivity in the various models, within and across generations, also should be highlighted.

Second, the direct impact of demographic developments on individual saving decisions should be thoroughly evaluated, since it is the vital and still controversial channel through which ageing might affect an economy. The selection of the data set is crucial in this research. We may prefer more and better household data, possibly panel data, so as to inspect the validity of variants belonging to the life-cycle model. Aggregate time-series results are generally supportive. But cross-section evidence is rather less favorable, since cross-section studies seem to face quite a few difficult measurement problems. On balance, recent evidence tends to be more supportive of the life-cycle hypothesis, even though not in its simplest stripped-down version.

Third, the interaction between resource scarcity and technological change may need further examination. The possible effect that demographic changes may have on labor and total factor productivity is a noteworthy issue. The scarcity of labor supply due to fertility rates reduction will induce a reallocation from physical to human capital investment. In an endogenous growth framework, such shifts may lead to positive effects on economic growth, which might partly offset the mechanical impact of ageing on productivity. Thus, the overall final effect of ageing on growth might still be positive according to some specifications. Fougère and Mérette (1999) present supportive evidence to this issue, based on a previous OLG modeling approach by Hviding and Mérette (1998) for seven OECD countries. Once a human capital sector is introduced to incorporate the main features of an endogenous growth specification, a substantial attenuation of the reduction in growth due to ageing populations and fiscal imbalances is obtained. Although this result is

dependent on the specification and the parameters chosen by the authors on the basis of a calibration exercise, given the strikingly different implications of this result for policies, further empirical work is needed to evaluate its importance.

V. Empirical Difficulties in Measuring the Age-Productivity Profile

Disney (1996) reviews the literature on the links between an ageing labor force and productivity. He concludes that the relationship is still unclear, and that to some extent, it is an empirical question.

According to Czaia (1995), "the relationship between age and job performance is complex and far from understood", because much of the available data are unreliable. The data sets examining the impacts of age and mental functioning are cross-sectional data and longitudinal data sets. Cross-sectional data present the current abilities of observed cohorts, while longitudinal data follow the ability levels of one or more cohorts over the years. The problem with cross sectional samples is that they do not take into account that seniority leads to occupational shifts. Good employees get promotions, whereas inefficient workers are more likely to be demoted or even lose their jobs. The ability levels can vary between cohorts, which can bias age-productivity estimates based on within-occupation measurements. For example, when analyzing primary mental ability test results for 1924, 1945, 1952 and 1959, Willis and Schaie (1998) find that reasoning and verbal memory increase with age, while the performance of vocabulary and numerical ability decline, which is obviously inconsistent with the argument we discuss in section III. Rodgers (1999) explains that such an odd result may be attributed to methodological errors related to the problem with cross-sectional data just discussed. In addition, a higher educational attainment may also lead to a

rise of mental ability level. Hence, individuals from more recent cohorts will be better prepared and more motivated when taking these tests. As far as longitudinal studies are concerned, they may suffer from non-random attrition as well. In the case of the Seattle Longitudinal Study, there are two sources that may bring about an upward bias in the results. The first is the loss of respondents. Schaie (1994) points out that nearly more than half of the original sample was lost by the time of third wave, so the remaining sample is more likely to be positively selected. The second is observed individuals' experience from test practices. The subsequent cohorts perform better than those in previous wave because they practice more in such tests. Therefore, Willis and Baltes (1980) conclude that ability decrements found in longitudinal data will substantially underestimate the true cognitive declines.

In addition to the empirical bias originated from data sets, the measurements of age-productivity profile also have their disadvantages. A general problem with estimates of age-productivity profile is that older employees who could remain in the workforce are likely to be positively selected and usually have a higher productivity compared with those who leave the workforce earlier. This may cause an upward biased result too. Based on employment structure, studies estimating the influence of age on individual job performances use different indices. The most popular measurements include supervisor's rating, work-samples, employer-employee matched data sets and age-earnings profile. The above four measures are discussed in turn.

First of all, empirical evidence based on supervisor's rating is unlikely to indicate a clear systematic relationship between age and productivity. As we mentioned in section II, Medoff and Abraham (1980, 1981) conclude that, for white-collar employees in large American corporations, seniority is

either unrelated or negatively related to performance evaluations. Based on the meta-analysis of 18 supervisor assessment samples, Waldman and Avolio (1986) get an insignificant negative impact of age on job performance; thus they propose that age is not a crucial factor in influencing productivity differentials. Remery et al. (2003) do the similar research on a survey of 1007 Dutch business leaders and personnel managers. In spite of the fact that older workers have the highest job knowledge in the observed workplaces, the employers are more likely to consider older worker as less productive in the case of the larger proportion of older employees relative to younger workers in work force. Therefore, the studies that rely on supervisor's ratings of performance may be questionable, if the rater has negative attitudes about older workers (Siegel, 1993; Hassell and Perrewe, 1995). Further, although supervisor's evaluations do on average show little or no relationship between the assessment score and the age of the employee, managers sometimes tend to inflate opinions of older employees since they wish to reward older staffs for their loyalty and past achievements, which will bring about a biased result (Salthouse and Maurer, 1996).

Compared to supervisor's rating, the following two approaches, work-sample tests and employer-employee datasets, are more objective. In general, studies using the two measurements suggest that productivity tends to follow an inverted U-shaped profile, where individuals in their 30s and 40s have the highest productivity levels, productivity then turning to a decline after 50 years of age. The argument is supported by evidence from Kutscher and Walker (1960) and Hellerstein et al. (1995, 1999). However, identification and selection can still constitute a problem in both approaches. Work-samples measure the quantity and quality of the workers' output. Although the task-quality/speed tests appear to be objective, they do not exactly reflect the true productivity profile. The workers observed are likely to be selected in terms of age groups and

occupations. Salthouse and Maurer (1996) further indicate that older workers are unable to sustain a high work speed for a long period. Thus, the time limit in such samples may show age-biased results as well.

Employer-employee matched data sets are more advantageous than the above two measurements, which are less subjective than supervisors' ratings and have fewer sample selection problems than work-samples tests. In this data set, individual productivity is measured as the worker's marginal impact on the firm's value-added. However, how to isolate the effect of employee's age from all other factors which affect the firm's value-added is particularly problematic for researchers. For instance, firm's success will increase the number of new employees and lead to a younger age-structure. Andersson et al. (2002) adopt lagged measures of employees' age so as to correct the biased result in their employer-employee data sets. Their analyses are consistent with previous findings that older workers with primary and secondary education are less productive than younger cohort, while tertiary non-technical older workers are more productive than younger counterparts.

Age-earning profiles are a fourth approach to measure age-productivity profiles. In this case, earnings are used as a proxy of current productivity. The age-earnings profile is characterized by a relatively steep increase in wage levels from the entrance age to labor market until the peak is reached about 50 years old and thereafter followed by a mild reduction in earnings during the last years before retirement. A wage analysis from OECD (1998) illustrates that 17 out of the 19 countries observed, gross wages peak for the 45-54 year old age group. The 25-29-year-olds earn on average 0.72 of what the 45-54-year-olds earn, while the 55-64-year-olds earn 0.91 of what the

44-54-year-olds do.[21] As we discussed in section II, age-difference in earnings grows with educational level (OECD, 1998). For employees with less than an upper secondary education, 25-29-year-olds earn 0.81 percent of the 45-54-year-olds's wages. But for those with a university education, the gap is widening, among which 25-29-year-olds are only paid 0.53 times of the 45-54-year-olds's salaries. Moreover, some researchers may use labor market participation rates to reflect age-differences in work performance, since low employment rates imply decrease productivity. One study from OECD (1998) shows that in 1995, 54.3 percent of the 55-64-year-olds participated in the labor force, compared to 89.8 percent for 35-44-year-olds in OECD countries. The unemployment rates of the 55-64-year-olds were 5.5 percent in 1996, which was lower than unemployment among younger cohorts. But the proportion of long term unemployed was higher among the older employees, and it has increased over time (Baumol and Wolff, 1996).

One thing worth noticing is that despite the decline of individual's productivity in his later age, the increases in earnings are almost stable throughout a worker's life, which creates a discrepancy between productivity and wages. Younger workers are more productive but underpaid, whereas older workers are paid above their marginal productivity. Firms gain from having a delayed payment contract as long as most workers are paid below their marginal productivity. It is evident that firms benefit more from hiring younger workers while lose profit from hiring the elderly. When labor force is aging, the firms' profit will inevitably decrease and eventually turn negative. Consequently, population aging can challenge the financing of such systems, and increase firms' incentives to either decrease older individuals' wage or to lay them off (Lazear, 1979, 1988).

[21] These percentages represent unweighted averages for the countries in the study.

VI. Labor Force Adjustments of Employers Corresponding to Older Workforce

The demographic changes shown in section two indicate that the labor force is getting older in ages and smaller in proportion of population. The shifts in labor force will affect both the supply- and demand-side of the labor market. In this section, we first examine the situations of old employees facing technological changes. Empirical evidence is then discussed in order to assess whether older job seekers are disadvantaged in competing for jobs. Finally, attentions turns to whether firms benefit from rehiring the older workers in the case of a smaller-size labor force.

i. Technological Change and Older Workers

The labor market is replete with imperfect and asymmetric information. Workers and jobs are naturally heterogeneous, and the quality of their interaction when paired is notoriously difficult to forecast. The emergences of electronic commerce specifically, and the Internet more generally, promise to open new channels for improved worker-firm communications. What are the consequences of this? The introduction of new technology increases the demand for highly educated workers as well as individuals who are more able learners. Second, Internet will change the way of employer-employee matches. Various kinds of new methods turn out to help workers and firms search for one another more conveniently, such as internet job boards, which are websites offering searchable databases of job listings and resumes; corporate websites permitting on-line job applications; and employer-initiated employee searches that target promising candidates via their on-line credentials. These new ways greatly reduce the cost of job search, which, according to labor market search theory, will raise productivity and increase the probability for older workers rehired.

Finally, labor services may be increasingly delivered via Internet rather than on-site. When the work product is primarily information, improvements in communications technology enable firms to transmit the work to the workers without the actual work done by employees (Autor, 2001).

Economic theory implies that these developments will undoubtedly produce social benefits. But these gains are unlikely to be uniformly enjoyed, and the process of realizing them will generate novel problems. For example, Bartel and Sicherman (1993) argue that older workers' risk of being excluded from the labor market rises with the rate of technological change, which is consistent with the findings of Ahituv and Zeira (2000), who investigate industry sectors differences, and Clark et al. (1999), who examine cross-country evidence. The elderly learn at a slower pace than younger individuals when what they learn is qualitatively different from what they have already mastered. Technology changes are in this case. According to human capital theory, technological changes will affect the retirement decisions of older workers in two aspects. Workers in industries undergoing high rates of technological change will have longer working careers, if there is a net positive correlation between technological change and on-the-job training. Meanwhile, an unexcepted change produces an increase in the depreciation rate, leading to a revised rate of investment in human capital. Hence, it will induce older workers to retire sooner because the required amount of retraining will be an unattractive investment.

ii. Mobility of Older Workers

The work-force ageing creates an increased need for older workers to change jobs because more will be laid off. From Figure 9, we find that, for older workers of selected European countries who

left a job in the previous six months and were not currently re-employed, the year 1991 is a crucial turning point since the proportion of older workers laid-off and jobless significantly increases afterwards. Until 1995, layoff becomes the highest causal factors– 2.1 percent without a job-leading to older employees' unemployment.[22] Farber (1996) suggest that this reflects not only the recession of the early 1990s, but also a secular increase in job displacement for older workers. Layoff occurs when firms' downsizing needs cannot be met by voluntary attrition. However, older workers are unlikely to quit voluntarily, so the trend of ageing labor force may cause voluntary attrition to decrease. It is apparent that both involuntary job loss and voluntary attrition are vital causes of unemployment for older workers. The combination of steady unemployment rate, decreasing attrition and falling share of younger workers over the next few decades indicate a tendency towards rising layoffs. That is, employers will have more difficulties in protecting older employees from being laid off (Devine and Kiefer, 1991, Chapter 8; OECD, 1996 and 1997a, Chapter 5).

Older job seekers are disadvantaged in hiring when competing with younger counterparts. Table 8 shows that older workers account for a smaller share of new hires than total employment. Controlling for observable characteristics, multivariate analysis can provide a better indication for this. Employer preferences for younger job candidates is one of the reasons why older job losers experience long jobless spells and larger earnings losses once re-employed. Young workers are usually more educated, healthier and quicker to respond to technology changes than older workers (Tang and MacLeod, 2004). There are many other potential reasons for this finding. For example, higher costs associated with hiring older workers - such as fixed hiring costs or a higher cost of

[22] The risk stemming from retirement is 1.2 percent, early retirement for economic reasons is 0.8 percent, and quits and illness are both 0.7 percent

providing non-wage benefits -, or age discrimination due to declining productivity with older workers. In a word, older workers' long-term unemployment is mainly attributed to current limited mobility.

As a consequence, the economic costs resulting from older workers limited mobility will increase, along with the rising numbers of jobless older workers. Although greater proactive training investments to maintain trainability probably could improve the mobility of older job changers, little is known about exactly what sort of training program could generate the highest returns; furthermore, market incentives may be inadequate to induce the desired response (OECD, 1998).

iii. Rehiring of Older Workers

With the ageing process going on in most industrialized countries, the problem of relative scarce labor force appears to be more and more severe. In addition to immigration flows and increased women participation, rehiring older workers can be an effective solution. Educational attainment is higher among current younger cohorts, which implies that future older workers will better educated than present ones. They will be capable to work over a longer horizon, to play more active roles in the labor markets and to postpone their retirement age. This could somewhat mitigate the pressure of labor scarcity.

Many firms prefer seniority-first criterion when rehiring. Namely, employers like rehiring those old workers who have more experience. The role of seniority in the process of labor force adjustment is complex. It provides constraints on the ability of the firm to adjust its labor force to changing

economic circumstances, which affects the relative number of permanent versus temporary layoffs, new hires versus rehires, and terminations and voluntary quits. Santiago (1987) utilizes quasi-experimental data in an attempt to determine the role of seniority in labor force adjustment within a single firm. The results suggest that worker-firm attachment depends partly on the accumulation of firm-specific human capital, while the probability of worker-firm separation is influenced by the depreciation of skills over the life cycle. Furthermore, the seniority-first criterion for rationing jobs is consistent with a Lazear-type deferred payments scheme as evidenced by the rising seniority-wage profile that accompanies worker-firm attachment. It is also evident that assessment of worker reliability based on the upward portion of the wage-productivity cum seniority locus is appropriate since it reduces subsequent turnover.

Actually, plenty of enterprises have already begun to rehire older workers in practice. McNaught (1994) cites three examples of such companies. Days Inn is one of the successful cases. It re-employs older workers as reservations agents. Compared to younger employees, older employees fare very well: their training does not take longer, they have lower turnover rates, and they are more likely to complete a call with a successful reservation. B & Q, a chain of English do-it-yourself stores, once encountered problems staffing its stores with entry-level workers. So it opened a new store staffed only with older workers. Not only has the store experienced increased work force stability[23] and improved customer relations, but it has been 18 times as profitable as other similar stores belonging to the chain. Travelers Insurance Company began by using retirees to staff the company hotline. When that endeavor proved successful, it organized a retiree job bank to facilitate placement of retirees on a part-time basis throughout the company. In 1989, the company realized a

[23] Compared to comparable stores, this store undergoes 6 times less employee turnover and 40% less absenteeism.

cost savings of over one million dollars by operating its own job bank, compared to hiring through temporary agencies.

VII. Policy Suggestions Responding to Ageing Populations

Associated with the demographic changes and fiscal pressures caused by ageing populations, the challenge to most OECD member countries is how to raise more funds to support more and more retirees. Several broad areas are targeted for reform in the OECD strategy, albeit none of them is perfect solution to the ageing difficulties (OECD, 2001).

i. Increasing productivity growth

Population ageing necessitates high productivity growth to maintain a good quality of life. As we discussed above, population ageing may produce positive effects on the potential economic growth for a country. A number of studies have been devoted to the factors shaping the growth process and the policies favoring better growth performance. OECD (2001a) suggests that the accumulation of physical and, especially, human capital, such as research and development, are crucial factors to economic growth. Also important are broad sets of policies extending to sound macroeconomic management, openness to market competition and international trade, a tax system encouraging work effort, and government expenditure programs emphasizing investment and capital accumulation. Appropriate conditions in financial markets and product market regulations contribute to fostering innovation and productivity enhancement as well.

However, whether higher productivity growth would significantly ease the future fiscal pressure of ageing populations in many countries is not certain. The impact depends not only on the extent to which the linkages between higher productivity and wages feed through to higher per capita pension payments, but also on the specific institutional arrangements governing pension systems. For instance, in countries where pensions are regularly indexed to some measure of earnings, faster productivity growth would have an insignificant impact on government pension spending relative to GDP. Austria, Denmark, Germany, the Netherlands, Portugal and Sweden are in this case. On the other hand, in countries where there is no direct link between pension benefits and the earnings, higher productivity growth would make a sizeable impact, such as in Finland, France, Italy, Luxembourg, Spain and the United Kingdom[24]. When there is no direct link, higher living standards as a consequence of increased productivity would generally lead to public pressures for increases in pension benefits. However, the budgetary impact in earnings related pension systems is only transitory, since higher productivity leads to an increase in the wages of current employees and, accordingly, their pension benefits in retirement

Generally, moderately higher growth would provide only a partial offset for most OECD countries. If productivity growth could be raised, the living standards would then be improved. Thus, a substantial increase in economic growth would have a significant impact on the economic costs of ageing. Meanwhile, with higher government revenues, there would be additional scope to modify pension benefit levels and contribution rates, helping to introduce the public pension reforms necessary to address the fiscal challenges that ageing populations pose.

[24] In these countries, pensions are only or mostly linked to price movements.

ii. Diversifying the sources of retirement income

The problem faced by most OECD countries is the fiscal pressure in funding more and more retirees caused by ageing. Therefore, the OECD strategy concerning the reform of the retirement income structure is to take account of all potential resources available to older people. A wider range of retirement income sources, including public and private pension payments, earnings and assets, are needed to help spread the burden across generations and lower the risk of future income loss.

One report presented at the Kiel Week Conference of OECD (2001) mentions that the so-called "3 pillar" approach would put in place a system where retirees would potentially have three sources of pension income: from a pay-as-you-go pension, from a compulsory fully funded pension plan and from a voluntary fully funded pension plan. In practice, the government has several ways to diversify retirement income provision. For those countries where pay-as-you go systems now dominate, they could facilitate the "3 pillar" system by increasing the size of advance-funded elements. For other countries where the public pension benefits are particularly high at present, it is necessary for them to either reduce the size of public pension benefits or try to establish a direct link between lifetime benefits and contributions[25]. They could even put the anti-poverty and income-replacement elements of public pensions into different programs. For example, Italy innovated the determinant method of pension benefits, which is now determined by the stock of contributions and made available from the age of 57 and onwards, with adjustments reflecting life expectancy and expected GDP growth rates. Other countries, such as Hungary, Poland and Sweden, have introduced or plan to introduce two-tier pension systems, that is, a pay-as-you-go tier and a

[25] This method would ultimately make those countries' pension systems broadly neutral.

fully funded compulsory tier.

Nevertheless, because of the intergenerational equity considerations, the current cohorts will worse off from this strategy because they have to pay the benefits twice: once for the current retirees and the other time for themselves.[26] At present, we are not able to find a satisfactory solution to this problem. Feldstein (1998) and Modgliani et al. (2001) suggest that we might have to envisage the effects of the substantial shift at low immediate costs and significant long-term gains. However in any case, financial structures and taxation systems still require a transitory duration to be modified. Disney (2000a, 2000b) sum up that the long-run solution seems to involve a strong funded element, whereas the transition costs have to be handled carefully and partial strategies need to take particular care as to their distributional consequences and potential for complexity.

iii. Attracting younger immigrants

The absorption of immigration is another complementary solution to the relative scarcity of labor force with ageing populations. The high fertility rates among immigrant women could help boost overall fertility rates and even long-term population growth. Moreover, increased immigration would have an immediate impact on the working-age population, assuming that the relatively young age structure of net immigration will apply also in the future.[27] For the EU as a whole, net migration has played a more important role in stimulating population growth over the past decade than domestic fertility. So do the United States and Japan. In some other OECD countries,

[26] See Chand and Yaeger (1996) for a detailed discussion of the fiscal costs associated to a shift from a pay-as-you-go to a fully funded pension system.

[27] The median age of new immigrants is on average about 30 years old, compared with 36 years for the overall OECD population.

nevertheless, the age profile of the foreign population is not too different from that of the native population, which suggests that the maintenance of past migration trends would be insufficient to offset ageing populations.

Even if large numbers of immigrants could be attracted to countries with ageing populations, immigration policy cannot easily be fine-tuned to achieve precise demographic objectives. For instance, it is easy to control the level of immigration, but policy has little or no control over emigration and hence net migration is difficult to influence. Furthermore, the existence of free circulation agreements, the persistent difficulty of tackling illegal immigration and humanitarian commitments limit the ability to control the overall demographic composition of immigration (Cobb-Clark for Australia, 2000; Duleep and Regets for Canada, 1992). In conclusion, although increased immigration can limit the adverse impact on living standards and government budgetary positions due to declining and ageing populations, it can hardly be the sole solution (United Nations, 2000; Tapinos, 2000).

iv. Lengthening working lives and raising employability

The OECD countries are facing a smaller and older labor force as projected in section II. In response to this shift, they need to endeavor to delay the employees' transition from productive activity to retirement, so that the number of pension beneficiaries would fall and output and tax revenues would be higher. Evidence indicates that a reduction of roughly 8 percent in the number of pension beneficiaries would be sufficient to neutralize the impact of ageing on the public debt to GDP ratio (OECD, 2001). Moreover, productive potential could be enhanced to the extent that

structural levels of unemployment can be lowered.

In Visco (2001a), some rough sensitivity calculations of age-related spending to labor market developments illustrate the potential for higher female and older worker labor force participation rates and lower structural unemployment to offset the pressures of ageing on output and fiscal positions. Such improvements would help ease the budgetary pressure on public pension funds and social security budgets in general and would also limit the extent of the slowdown in the growth of living standards. A few policies that may help make this into reality include increasing the length of the contribution period for full benefit and generally linking life-time benefits and contributions; removing pension earnings rules and other penalties for working later; increasing the average age of entitlement to full pension and the lower age limit for early retirement; phasing out programs that encourage access to invalidity or open-ended unemployment benefits for labor market reasons (OECD, 2000).

Futagami and Nakajima (2001), however, argue that an increase in retirement age might end up being counter-productive, because it would induce lower saving rates and lower endogenous growth. According to their model, rehiring the older workers would increase lifetime wages and pension benefits in the retirement years, which would lead to increased consumptions of households and lower saving rates. An increase in labor supply might be able to counter to these effects, but it is still insufficient to avoid an overall decrease in the aggregate saving rate. This will cause a reduction in wages and the delay in receiving pensions. For given tax rates and provided there is an increase in longevity, the budget constraint would not only determine a reduction in pension benefits, but also push up saving and growth rates. If pension benefits were kept unchanged, an

alternative would be a rise in tax rates, with negative consequences on growth. Visco (2001) suggests that the effects of delaying retirement age should be evaluated in comparison with this alternative, rather than for a given life span; the effects are very likely to be worse especially during the transition period. Similar result could be found in Kotlikoff et al. (2001).

VIII. Conclusions

As a result of declining fertility rates, increasing life expectancy and earlier retirement, the labor force in OECD member countries is becoming older and smaller. Given current social security arrangements and policies, the transition may have pervasive effects on productivity, on factor and product markets and on public finances. However, omission of likely positive factors may lead to overly pessimistic scenarios about the economic and fiscal consequences of ageing among some researchers. In particular, the higher educational attainment and rising participation rates of older and female workers make great contributions to the economic growth.

Generally speaking, though productivity decreases as an employee gets close to retirement age mainly because of declines in personal cognitive abilities, there are still exceptional cases. The duration of working experience and incremental education attainment help to maintain productivity stable or even to increase it, which is reflected in the age-productivity and age-earning profiles. Due to the limitations of data sets and estimation approaches, researchers have difficulties in coming to coherent conclusions. In any case, it may be wise to observe that more recent cohorts who will be better prepared and more motivated. Employer-employee matched data sets are more advantageous compared with supervisors' ratings and work-samples tests. We could also use earnings as proxy to

measure productivity.

Two classes of models, dynamic multi-region macroeconomic model and overlapping-generation model, are utilized to examine the economic implications of ageing populations. Each modeling approach has its advantages and disadvantages. We propose three directions for further study: the role played by particular parameter in the model specification and the effect of technical change on household productivity; the individual saving decisions under the fiscal pressure of ageing, and the interaction between resource scarcity and technological change.

Accordingly, both firms and government are aware of the challenges associated with ageing populations and have to take actions as soon as possible. With the rapid development of technology changes, older employees are not capable to catch up with the up-to-date skills required by some high-tech positions. The mobility of older workers is thus limited which leads to voluntary unemployment and involuntary joblessness as well. Firms, however, need to invest more in on-the-job training programs while rehiring older workers due to labor force scarcity. Several reform strategies are suggested correspondingly for OECD policy adjustments. Among these, two are briefly discussed in what follows: first, increasing productivity growth in order to support improvements in living standards and to ease future fiscal pressures; second, shifting towards more diversified retirement income sources, with a larger role for full funding of pension liabilities. In addition, two complementary approaches to modify public pension generosity and eligibility criteria, for instance by increasing the average number of years individuals spend active in labor force, are also briefly considered. Those are fostering policies promise to boost productivity performance and allowing for higher levels of immigration.

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Table 1: Total population growth[1]

Country	1960	1970	1980	1990	2000	2010	2020	2030	2040	2050
United States	1.7	1.2	0.9	1	0.9	0.7	0.6	0.5	0.3	0.2
Japan	1.2	1	1.1	0.6	0.3	0	-0.3	-0.5	-0.6	-0.6
Germany	0.6	0.7	0.1	0.1	0.4	0	-0.1	-0.2	-0.3	-0.4
France	0.9	1.1	0.6	0.5	0.4	0.3	0.1	0	-0.1	-0.2
Italy	0.6	0.7	0.5	0.1	0	-0.3	-0.5	-0.7	-0.8	-1
United Kingdom	0.3	0.6	0.1	0.2	0.2	0.1	0.1	0	-0.2	-0.3
Canada	2.7	1.8	1.4	1.2	1.1	0.9	0.8	0.6	0.4	0.4
Australia	2.3	2	1.5	1.5	1.1	0.9	0.8	0.6	0.4	0.4
Austria	0.2	0.6	0.1	0.2	0.6	0.2	-0.1	-0.3	-0.5	-0.7
Belgium	0.6	0.5	0.2	0.1	0.2	0	-0.1	-0.2	-0.4	-0.5
Czech Republic	0.7	0.3	0.5	0	-0.1	-0.2	-0.3	-0.5	-0.7	-0.9
Denmark	0.7	0.7	0.4	0	0.3	0.1	-0.1	-0.2	-0.4	-0.4
Finland	1	0.4	0.4	0.4	0.4	0.1	0.1	-0.1	-0.3	-0.3
Greece	1	0.5	0.9	0.6	0.4	-0.1	-0.4	-0.6	-0.7	-0.8
Hungary	0.7	0.3	0.4	-0.3	-0.3	-0.4	-0.5	-0.6	-0.7	-0.7
Iceland	2.1	1.5	1.1	1.1	1	0.8	0.6	0.4	0.2	0
Ireland	-0.5	0.4	1.4	0.3	0.6	0.7	0.7	0.4	0.3	0.2
Korea	2.1	2.5	1.8	1.2	0.9	0.6	0.4	0.2	0	-0.3
Luxembourg	0.6	0.8	0.7	0.5	1.2	0.6	0.2	-0.1	-0.3	-0.4
Mexico	2.9	3.2	2.9	2.1	1.7	1.3	1	0.8	0.5	0.3
Netherlands	1.3	1.3	0.8	0.6	0.5	0.1	-0.1	-0.2	-0.4	-0.6
New Zealand	2.2	1.7	1	0.8	1.4	0.9	0.8	0.6	0.5	0.4
Norway	0.9	0.8	0.5	0.4	0.5	0.4	0.3	0.1	0	-0.1
Poland	1.8	1	0.9	0.7	0.2	0.1	0	-0.2	-0.3	-0.4
Portugal	0.5	0.2	0.8	0.1	0	-0.1	-0.3	-0.4	-0.5	-0.7
Spain	0.8	1	1.1	0.5	0.1	-0.1	-0.4	-0.5	-0.7	-0.9
Sweden	0.6	0.7	0.3	0.3	0.4	0.1	0.1	-0.1	-0.2	-0.2
Switzerland	1.3	1.4	0.2	0.8	0.8	0.3	0	-0.2	-0.4	-0.6
Turkey	2.8	2.5	2.3	2.4	1.7	1.3	1	0.8	0.6	0.4
OECD Total	1.3	1.2	1	0.8	0.7	0.5	0.3	0.2	0	-0.1
Memorandum item: Total population, in millions										
OECD Total	774.3	872.5	962.2	1043.2	1117.7	1170.1	1207.7	1228.9	1231.9	1220.9

1. Average annual percent change over 10 years to date shown.

Source : United Nations Population division, *World Population Prospects:* The 1998 Revision.

Table 2: Elderly population growth in OECD countries

Population aged 65 and over

Country	1960	1970	1980	1990	2000	2010	2020	2030	2040	2050
United States	2.7	1.9	2.2	2	1	1.2	3	2.7	0.7	0.3
Japan	2.7	3.2	3.7	3.4	3.9	2.5	1.7	-0.1	0.5	-0.1
Germany	2.3	2.4	1.4	-0.3	1.3	1.9	0.7	1.7	0.6	-0.6
France	1.1	2.1	1.4	0.5	1.7	0.7	2.1	1.4	0.8	-0.1
Italy	1.9	2.3	2.4	1.6	1.8	1.1	0.9	1.2	0.9	-0.9
United Kingdom	1.2	1.6	1.7	0.6	0.4	0.7	1.6	1.5	0.6	-0.3
Canada	2.5	2.2	3.3	3	2.5	2	3.2	2.8	0.9	0.4
Australia	2.7	1.9	2.9	3	1.9	1.9	3.1	2.4	1.4	0.6
Austria	1.7	2.2	1	-0.1	0.4	1.3	1.4	2.3	1.1	-0.3
Belgium	1.4	1.7	0.9	0.6	1.2	0.5	1.7	1.7	0.4	-0.5
Czech Republic	1.3	3.6	1.4	-0.6	0.8	1.2	2.7	0.8	0.8	0.7
Denmark	2.2	2.2	2	0.8	0	1.2	1.8	1	0.5	-0.8
Finland	1.8	2.8	3.1	1.5	1.4	1.4	2.9	1.2	-0.2	-0.3
Greece	2.9	3.6	2.6	1	3.2	1.1	0.8	0.9	1	0.2
Hungary	2.8	2.8	1.9	-0.4	0.6	0.4	1.5	0.1	0.8	0.8
Iceland	2.4	2.6	2.2	1.9	1.8	1.4	3	2.8	1.3	0.6
Ireland	0	0.4	1	0.8	0.6	1.5	2.8	2.2	1.4	1.7
Korea	3	2.4	3.3	4	3.9	3.9	3.2	4.2	2.3	0.5
Luxembourg	1.6	2.3	1.5	0.4	1.9	1.5	1.9	1.9	0.9	-0.1
Mexico	3.3	2.4	1.7	2.5	3.6	3.7	4	4	3.9	2.4
Netherlands	2.8	2.5	2.1	1.7	1.3	1.5	2.7	2	0.8	-0.8
New Zealand	1.8	1.6	2.6	1.9	1.9	1.7	2.9	2.6	1.3	0.6
Norway	2.3	2.3	1.9	1.4	0	0.8	2.4	1.6	1	-0.4
Poland	2.8	4.6	3	0.6	1.9	0.6	3	1.7	0.4	1.4
Portugal	1.8	1.7	2.1	2.8	1.5	0.7	1	1.3	1.5	0.4
Spain	2	2.8	2	3.1	2.2	0.7	1	1.7	1.6	0.1
Sweden	2.2	2.1	2.1	1.2	0.2	1.3	1.8	0.9	0.4	-0.4
Switzerland	1.8	2.7	2.2	1.1	1	1.6	2	2.3	0.9	-0.6
Turkey	3.6	4.8	3.1	1.4	4.9	2.6	3.5	4	3.4	2.6
OECD Total	2.2	2.4	2.2	1.6	1.8	1.6	2.2	2	1.1	0.4
Memorandum item: Total population aged 65 and over, in millions										
OECD Total	66.2	83.6	103.6	121.5	145.8	170.2	211.2	256.5	286.9	298.1

1. Average annual percet change over 10 years to date shown.

Source : United Nations Population division, *World Population Prospects:* The 1998 Revision.

Table 3: Assumptions for fertility, life expectancy and immigration

Country	Fertility (children per woman)		Life expectancy at birth		Immigration per cent of total population	
	2000	2050	2000	2050	2000	2050
Australia	1.7	1.6	79.4	85.2	0.9	0.4
Austria	1.3	1.5	78.1	83.2	0.1	0.3
Belgium	1.5	1.8	78.4	83.0	0.1	0.1
Canada	1.6	1.5	78.4	82.0	0.6	0.4
Czech Republic	1.1	1.5	75.0	78.4	0.1	0.2
Denmark	1.8	1.8	77.0	81.0	0.2	0.2
Finland	1.7	1.7	77.5	82.4	0.1	0.1
France	1.7	1.8	78.8	83.5	0.1	0.1
Germany	1.4	1.5	77.8	82.5	0.4	0.3
Hungary	1.3	1.6	71.0	77.9	-0.1	0.0
Italy	1.2	1.5	78.7	83.5	0.1	0.2
Japan	1.4	1.6	80.8	83.0	..	..
Korea	1.7	1.6	74.4	79.6	..	..
Netherlands	1.7	1.8	78.2	82.5	0.2	0.2
New Zealand	..	..	77.7	82.5	..	..
Norway	1.8	1.8	78.5	82.3	0.3	0.2
Poland	1.3	1.6	74.0	81.6	..	..
Portugal	1.5	1.7	75.6	81.0	0.1	0.2
Spain	1.2	1.5	78.5	82.0	0.1	0.2
Sweden	1.5	1.8	79.7	84.0	0.2	0.2
United Kingdom	1.7	1.8	77.6	82.5	0.2	0.1
United States	2.1	2.0	76.8	81.3	0.3	0.2

.. Indicates unavailable data.

1. Data are for 1996 and 2051.

2. OECD average is unweighted and excludes countries where information is not available.

Source : OECD (2001a).

Table 4: Disablitiy-free and total life expectancy

Years

Country		Life expectancy at 65	Moderate Disability-free life expectancy	Severe Disability-free life expectancy
			Males	
Australia				
	1981	13. 9	7. 9	11. 9
	1993	15. 7	6. 5	13. 4
Canada				
	1986	14. 9	8. 5	12. 8
	1991	15. 6	8. 3	13. 3
France				
	1981	14. 1	8. 8	13. 1
	1991	15. 7	10. 1	
			Female	
Australia				
	1981	18. 1	10. 1	13. 8
	1993	19. 5	9. 1	14. 8
Canada				
	1986	19. 2	9. 4	14. 9
	1991	19. 7	9. 2	15. 4
France				
	1981	18. 3	9. 8	16. 5
	1991	20. 1	12. 1	

1. Health expectancy concepts are not yet totally harmonised.The "severe disability" measure are more comparable than those for "moderate disability".

Source : OECD (1999a), *A Caring World: The New Social Policy Agenda* .

Table 5: Employment rate of older workers in the OECD[1]

Country	1980	1985	1990	1995	1998
United States	53.8	51.8	54	55.1	57.7
Japan	61.3	60.5	62.9	63.7	63.8
Germany		37.1	39.2	37.8	38.8
France		37.2	35.6	33.5	33
Italy		33.3	32	27	26.9
United Kingdom		47	49.2	47.6	48.3
Canada	51.5	47.2	47	43.6	45.4
Australia	43.5	37.3	41.8	41.4	43.7
Austria				29	28
Belgium		26	21.4	23.3	22.5
Czech Republic				34.5	37.1
Denmark		50.1	53.6	49.3	50.4
Finland	47.1	45.4	42.6	34.4	36.2
Greece		45.1	40.8	40.5	38.5
Hungary				17.1	16.6
Iceland[2]			85.4	85.1	86.7
Ireland		40	38.6	39.2	41.6
Korea			61.9	63.5	58.9
Luxembourg		25.4	28.2	24	25
Mexico[2]			54.1	51.2	53.9
Netherlands	36.3	27.3	22.4	22.7	33.3
New Zealand			41.8	50.4	55.7
Norway	63.9	65.5	61.8	63.1	66.9
Poland				33.8	32.3
Portugal			46.8	45.5	50.9
Spain	44.7	38.3	36.8	32.1	34.8
Sweden	65.7	65	69.4	61.9	63
Switzerland[2]				69.8	73.3
Turkey			42.7	42.4	41.1
Total OECD[3]			48.4	46.4	47.9

1.Employment of workers aged 55-64 as a percentage of the population aged 55-64.
2. The year 1990 refers to 1991.
3. For above countries with available data.

Source: OECD Labour Force Statistics, 1978-1998, Part III, forthcoming

Table 6: Distribution of educational attainment of the labor force aged 45 to 64 years, 1995 and 2015

Percentage

Country	1995				2015			
	Less than upper secondary	Upper secondary	Non-university tertiary	University	Less than upper secondary	Upper secondary	Non-university tertiary	University
Australia	44.8	29.0	11.6	14.6	37.1	31.8	12.1	18.9
Austria	33.0	59.7	1.5	6.8	17.5	69.8	2.8	9.8
Belgium	46.2	27.0	13.3	13.5	25.7	35.6	19.1	19.6
Canada	27.7	24.8	29.3	18.2	14.1	30.1	33.8	21.9
Czech Republic[2]	15.2	72.4	..	12.4	7.1	78.3	..	14.6
Denmark	35.5	42.4	8.6	12.0	23.5	49.6	8.3	18.6
Finland	43.4	36.0	8.6	12.0	17.9	56.2	10.5	15.4
France	38.4	44.0	6.5	11.1	15.4	57.8	11.0	15.8
Germany	15.4	58.1	11.7	14.8	8.6	63.5	10.8	17.1
Greece	71.4	14.4	3.6	10.6	41.5	29.6	9.9	19.1
Ireland	61.3	18.9	8.5	11.3	36.4	31.4	15.1	17.1
Italy[2]	67.2	21.9	..	10.9	44.6	42.3	..	13.1
Korea[2]	65.0	24.8	..	10.2	22.6	51.7	..	25.6
Luxembourg[2]	62.0	20.1	..	17.9	53.2	25.8	..	20.9
Mexico	85.1	7.0	0.5	7.4	64.7	16.7	1.9	16.7
Netherlands[3]	36.9	38.1	..	25.0	23.5	46.1	..	30.4
New Zealand	41.6	31.1	17.3	9.9	31.1	41.1	14.2	13.6
Norway	20.6	51.2	11.2	16.9	9.4	53.2	13.1	24.2
Poland	34.5	49.6	2.4	13.5	12.7	69.9	4.8	12.6
Portugal	84.0	5.2	3.8	7.0	67.8	14.7	4.3	13.2
Spain	78.8	7.1	2.7	11.5	49.5	20.1	8.4	22.0
Sweden	35.8	37.4	11.5	15.3	14.7	54.3	16.4	1.6
Switzerland	19.4	57.9	14.2	8.5	10.8	63.5	14.0	11.7
United Kingdom	27.6	51.3	9.9	11.2	13.0	61.3	9.4	16.4
United States	12.4	51.0	7.6	29.0	9.2	51.7	9.5	29.6
Unweighted average	44.1	35.2	9.1	13.4	26.9	45.9	11.5	18.1

.. Indicates unavailable data.

1.The distribution of the labor force in 2015 is based on applying education-specific participation rates individuals aged 45-64 years in 1995 to the population aged 25-44 years in 1995.

2. Data for non-university tertiary education are included in university education.

3. Non-university tertiary education is not applicable.

Source : OECD Education Database except for Mexico where data were provided by the national autho as part of the OECD project on ageing populations.

Table 7: Participation in professional and career-upgrading training

Percentage of the labor force taking a course in the previous year

Country	Participation in professional and career-upgrading training			
	Total	Standard error	Paid for by the employer	Standard error
Australia	24.4	0.5	17.3	0.4
15-24 years	14.9	1.1	8.1	0.9
25-44 years	28.1	0.8	20.8	0.7
45-54 years	26.2	1.3	19.1	1.2
55-64 years	21.7	2.1	15.5	1.9
Belgium	10.5	0.9	7.4	0.9
15-24 years	7.2[a]	3.5	4.2[a]	2.8
25-44 years	11.6	1.1	7.9	1.1
45-54 years	9.5	1.9	7.6[a]	1.7
55-64 years	6.6[a]	3.1	6.4[a]	3.1
Canada	26.6	1.8	18.8	1.6
15-24 years	18.5	3.3	10.1	3.1
25-44 years	28.8	2.6	21.9	3.6
45-54 years	25.5	4.6	15.5	1.5
55-64 years	28.4	9.5	21.7[a]	15.9
Ireland	11.9	1.1	7.6	0.9
15-24 years	10.9	2.0	5.8[a]	1.0
25-44 years	13.1	1.0	9.1	1.0
45-54 years	11.8[a]	2.8	7.0[a]	2.2
55-64 years	6.7[a]	2.7	4.1[a]	1.9
Netherlands	13.9	0.7	9.5	0.6
15-24 years	18.4	3.1	9.7[a]	2.5
25-44 years	14.8	1	10.2	0.9
45-54 years	11.6	1.9	10.1	1.9
55-64 years	2.3[a]	1.4	1.7[a]	1.3
New Zealand	34.4	1.4	26.2	1.3
15-24 years	27.3	3.6	18.8	2.5
25-44 years	37.6	1.5	28.9	1.6
45-54 years	38.3	3.1	29.7	3.2
55-64 years	22.4	3.1	17.6	2.7
Poland	13.1	1.0	8.6	0.5
15-24 years	9.5[a]	1.8	3.7[a]	1.3
25-44 years	14.2	1.4	9.5	0.9
45-54 years	13.3	1.7	9.7	1.9
55-64 years	8.3[a]	3.8	6.5[a]	3.3
Switzerland	26.0	1.2	16.8	1.0
15-24 years	21.0	3.9	12.6[a]	4.5
25-44 years	28.7	1.7	17.8	1.4
45-54 years	25.6	2.3	18.8	2.0
55-64 years	20.7	2.8	12.9	2.8
United Kindom	15.4	1.0	12.9	0.9
15-24 years	14.4	2.0	12.1	1.7
25-44 years	18.1	1.4	15.0	1.4
45-54 years	13.1	1.4	11.1	1.3
55-64 years	8.6	2.1	7.4	1.9
United States	29.7	1.3	24.1	1.2
15-24 years	9.4	2.2	6.2[a]	2.0
25-44 years	32.5	1.8	26.9	1.7
45-54 years	35.8	2.5	29.4	2.0
55-64 years	28.4	3.9	21.4	4.2
Unweighted average	20.6		14.9	
15-24 years	15.2		9.1	
25-44 years	22.8		16.8	
45-54 years	21.1		15.8	
55-64 years	15.4		11.5	

a. Estimate based on a maximum sample size of 30 observations.

Source : *OECD* (1998)."Workforce ageing in OECD Countries", *Employment Outlook, Chapter 4.*

Table 8: Relative hiring intensities by age group, 1995

Ratio of share of new hires to share of total wage and salary employment[1]

Country	15-24 years	25-44 years	45-64 years
Australia[2]	1.7	1.0	0.6
Austria	2.3	0.9	0.4
Belgium	3.7	0.9	0.3
Canada	2.5	0.9	0.4
Denmark	2.1	1.0	0.4
Finland	3.3	1.0	0.4
France	3.4	0.9	0.4
Germany	2.2	1.0	0.4
Greece	2.9	0.9	0.5
Ireland	2.3	0.7	0.4
Italy	3.3	0.9	0.3
Japan	3.0	0.7	0.5
Luxembourg	2.9	0.9	0.3
Netherlands	2.5	0.8	0.3
Portugal	2.6	0.9	0.4
Spain	2.2	1.0	0.5
Sweden	3.1	1.0	0.4
Switzerland	2.8	1.0	0.3
United Kingdom	2.3	0.9	0.5
United States[2]	2.3	0.9	0.5
Unweighted average	2.6	0.9	0.4

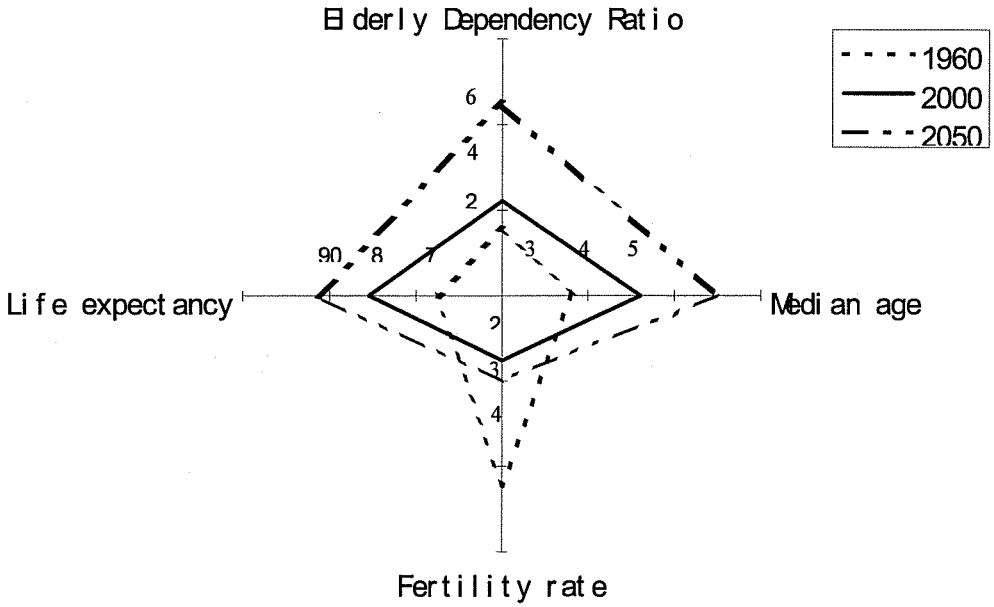
1.Workers with tenure less than one year are defiend as new hires.

2. Data refer to 1996.

Source : Data from the European Union Labor Force Survey were supplied by EUROSTAT.

For Australia, Canada, Japan, Switzerland and the United states, see OECD (1997a).

Figure 1: Demographic pressures in the OECD area

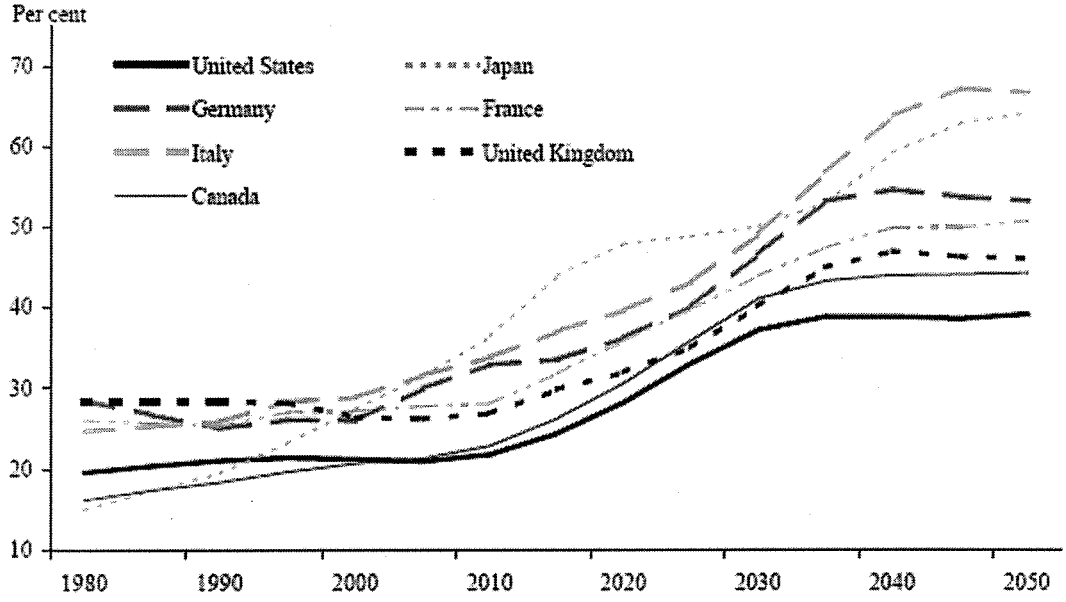


1. Weighed average of OECD countries, based on total population share in each period.

2. Population aged 65 and over as a percentage of the population aged 20- 64

Source: United Nations (1998).

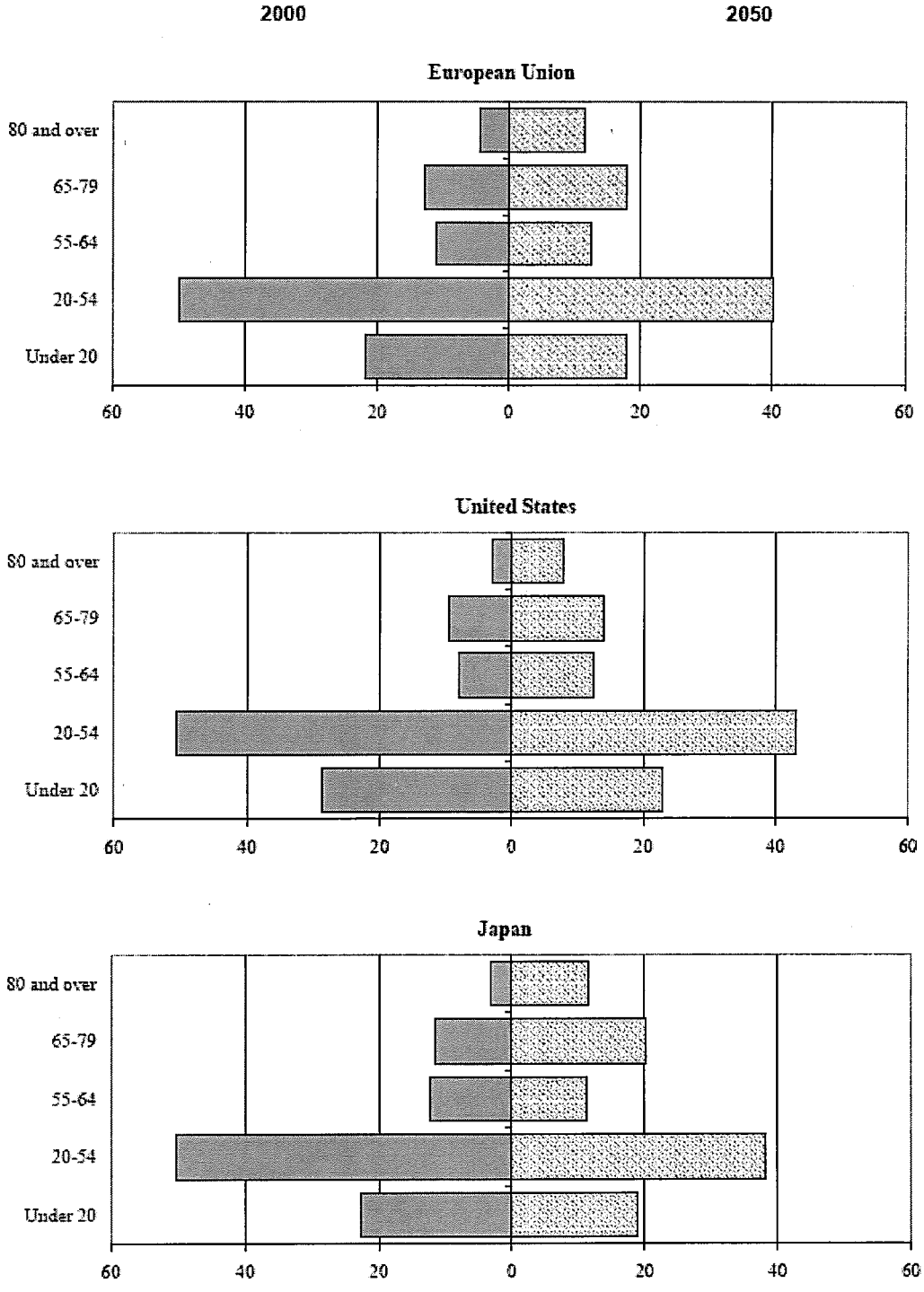
Figure 2: Elderly dependency ratios in G-7 countries
Population aged 65 and over as a percentage of the working-age population (aged 20-64)



Source: Eurostat; United Nations (1998).

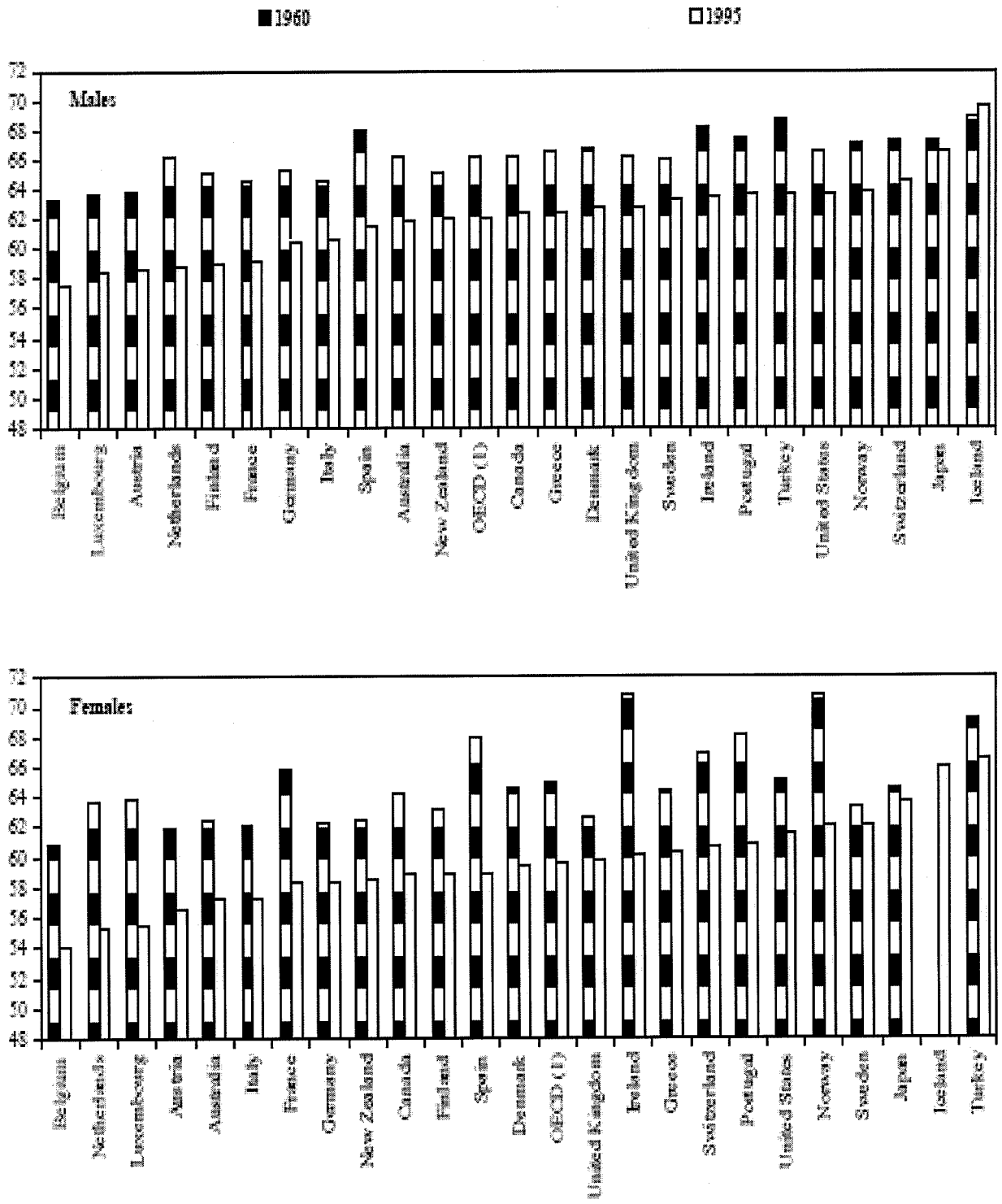
Figure 3: Breakdown of age groups in major OECD countries: estimates and projections

Percentage of total population



Source: Eurostat; United Nations (1998).

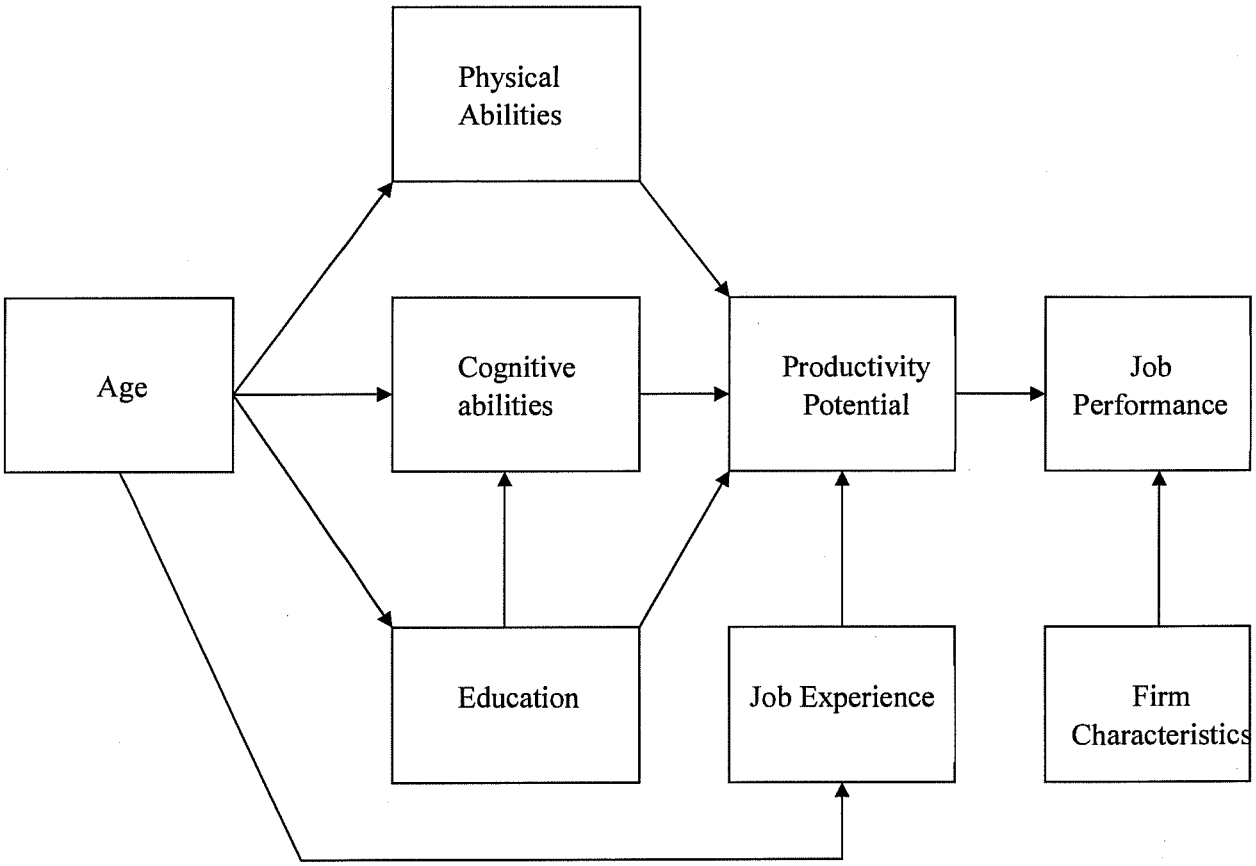
Figure 4: Estimates of the average age of retirement



1. Unweighted average

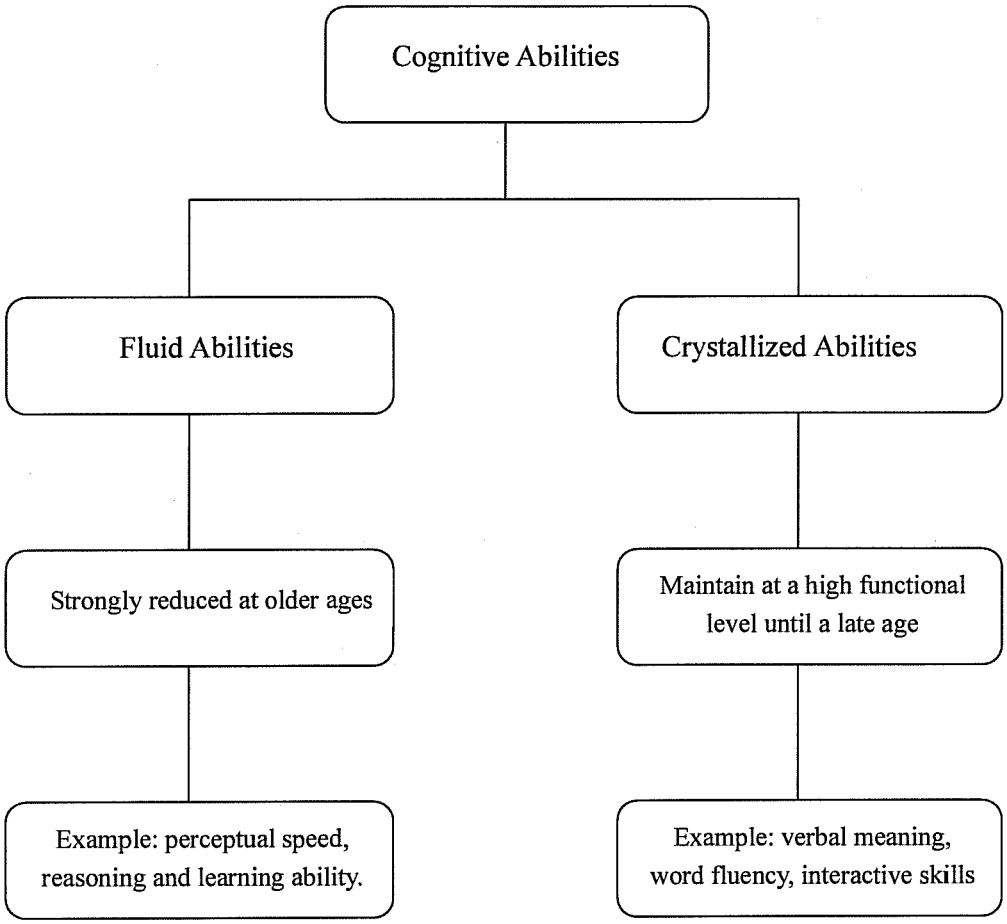
Source: ILO, *Economically Active Population 1950-2010*, December 1996.

Figure 5: Causal factors affecting job performance



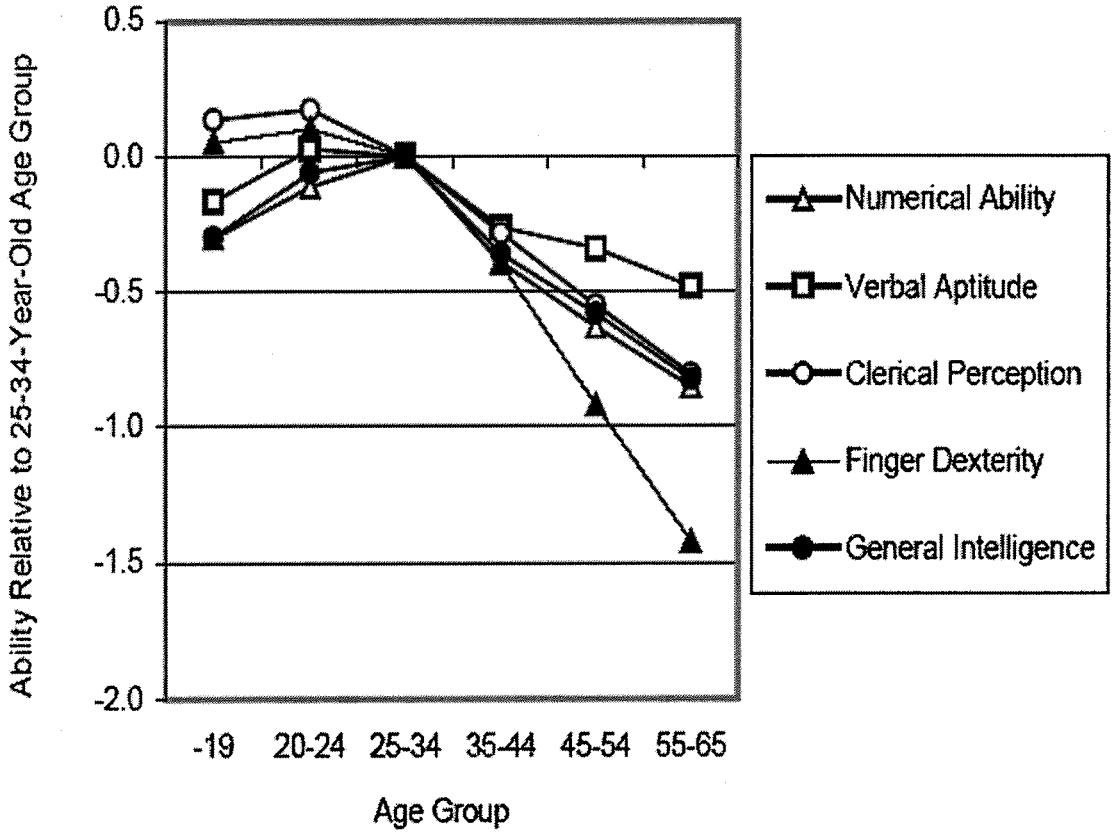
Source: Vegard Skirbekk (2003).

Figure 6: Categories of cognitive abilities



Source: Figure based on concepts used by Schaie (1994), Horn and Cattel (1966, 1967), Blum et al. (1970) and Schwartzman et al. (1987).

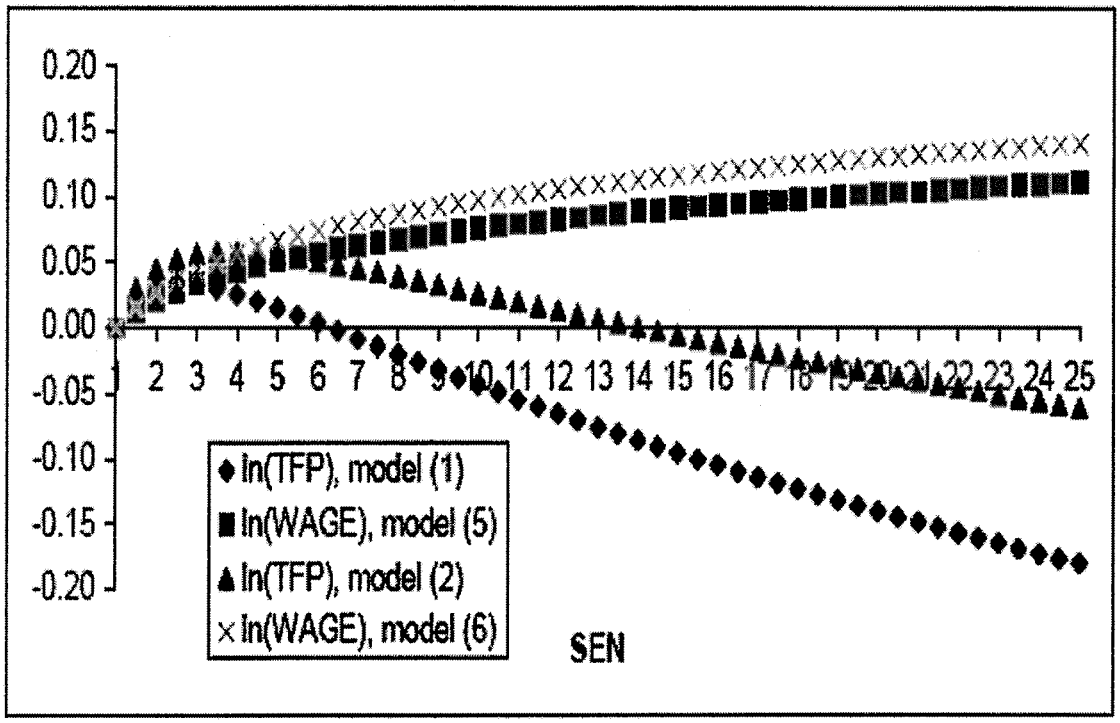
Figure 7: Ability levels relative to 25-34-years-olds average of white employees



1. The ability levels are measured in percentage of 25-34-year-old's standard deviation.

Source: General Aptitude Test Battery, Avolio and Waldman (1994).

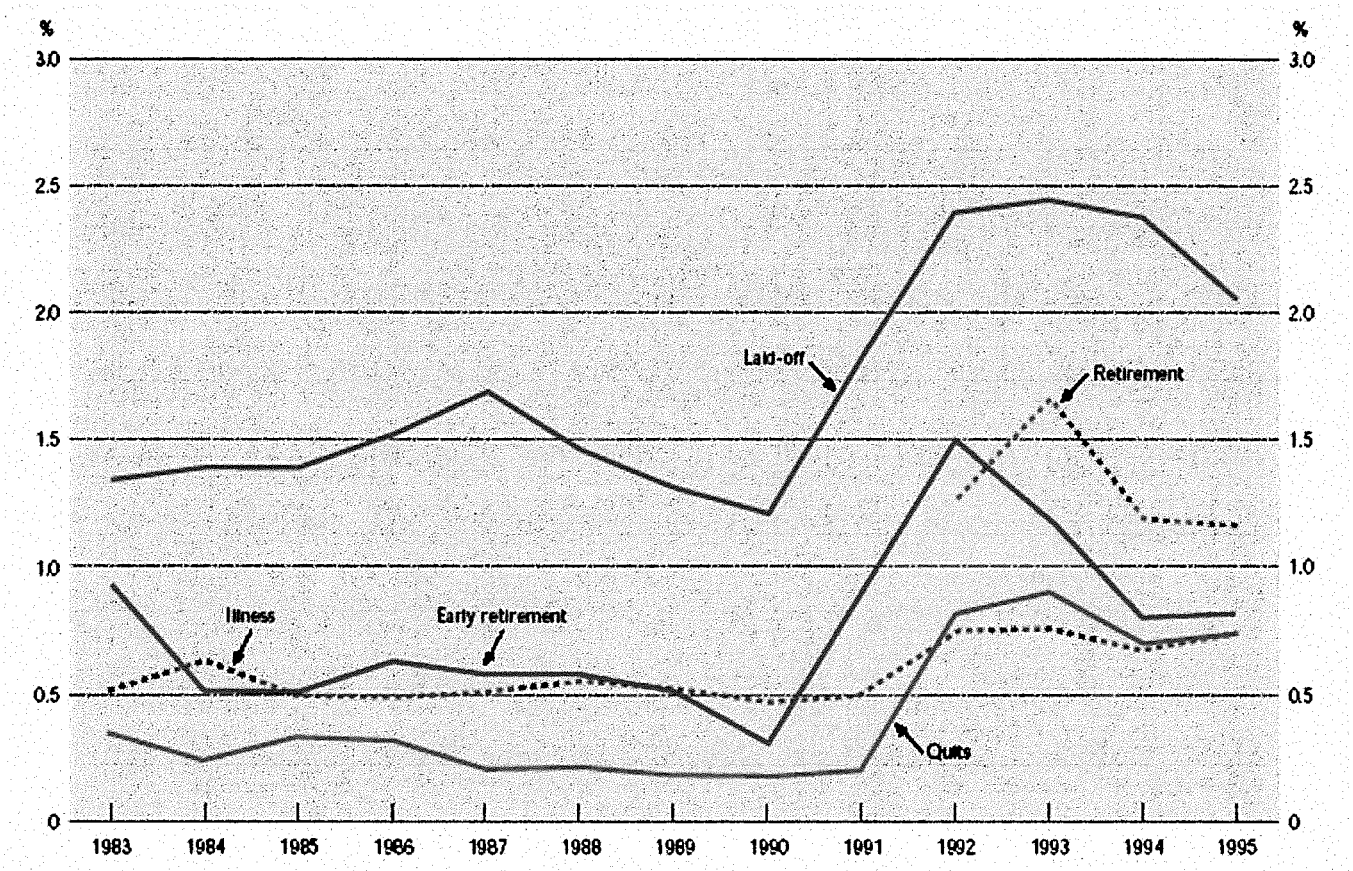
Figure 8: Seniority-productivity and seniority-wage profiles



Source: Ilmakunna et al. (1999), "The Roles of Employer and Employee Characteristics for Plant Productivity." *Helsinki School of Economics and Business Administration Working Paper W-223.*

Figure 9: Persons aged 45-64, currently without a job, by reason for leaving their last job, selected European countries [1]

Percentage of employment



1. Persons currently without a job refer to those currently unemployed or not in the labor force who left their job during the previous six months. Data are a weighted average for Belgium. Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands and the United Kingdom. Data for retirement are unavailable prior to 1992.

Source: OECD (1998), Unpublished data provided by EUROSTAT on the basis of the *European Union Labor Force Survey.*