

Can Rich Countries Afford to Grow Old?

by

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Abstract

Observers in many industrialized countries believe population aging represents a serious economic threat. Increases in the percentage of the population past retirement age may impose unsustainable burdens on future workers. Either taxes or government debt will have to rise substantially to pay for old-age income support. This paper considers the extent of these burdens and corrects the widespread impression that the burdens are unsupportable. Population aging means that contributions needed to support the retired elderly must rise. But this extra burden will be at least partly offset by a reduced need to support the dependent young, who will become relatively less numerous. The extra burden of an aging population would be smaller still if labor force participation rates among the working-age and elderly populations increased. Indeed, employment rates among the nonaged have risen in nearly all the industrialized countries as a growing percentage of women has entered the work force. Many countries, including the United States, have adopted policies to encourage work among people past the traditional retirement age.

From the 1940s through the 1980s, the most common policy response to old-age dependency in rich countries was to increase taxes and public income support in order to improve incomes among the aged. By the end of the 1980s most wealthy countries had achieved rough parity in the equivalent incomes received by their elderly and non-elderly populations. Faced with large prospective deficits in their pension accounts in the 1990s, governments in rich countries began to scale back future benefit promises. With few exceptions, rich nations have decided to cut future benefits in order to keep their systems affordable. If governments stick to the pension formulas adopted in recent years, public pensioners in 2050 will obtain a much smaller wage replacement rate than the one enjoyed by people who retired in the recent past. In countries such as Britain, Italy, and Japan, future replacement rates could be one-third or more lower than they are today.

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Let your mind wander toward the future ... to the year 2030. What do you see?

... You see a country where walkers outnumber strollers. You see a country with twice as many retirees but only 18 percent more workers to support them. You see a country with large numbers of impoverished elderly citizens languishing in understaffed, overcrowded, substandard nursing homes.

You see a government in desperate trouble. It's raising taxes sky high, drastically cutting retirement and health benefits, slashing defense, education, and other critical spending, and borrowing far beyond its capacity to repay. It's also printing tons of money to "meet" its bills.

You see major tax evasion, high and rising rates of inflation, a growing underground economy, a rapidly depreciating currency, and more people exiting than entering the country. They're leaving because they're sure things will get still worse.

You see political instability, unemployment, labor strikes, high and rising crime rates, record-high interest rates. You see financial markets in ruin.

— Laurence J. Kotlikoff and Scott Burns, *The Coming Generational Storm* (Cambridge, MA: MIT Press, 2005), pp. xi – xii.

VOTERS AND POLICYMAKERS in many industrialized countries think population aging represents a grave threat to their futures. They believe increases in the percentage of the population past retirement age must eventually impose intolerable burdens on workers and public budgets, since pensions and old age health insurance are largely financed out of current taxes. According to a common view, either taxes or government debt will be pushed to unsustainable levels unless public programs are significantly overhauled to curtail retirement benefits.

This way of viewing the problem of population aging is incomplete because it treats aging within the narrow perspective of government budgets. Population aging also has effects that reduce demands on public budgets. In addition, it has an impact on the private spending obligations of working-age households. In the past many active workers would have supported a greater number of children. Falling birth rates have reduced average family size. Since

workers now support fewer children, reduced spending on child care represents a major offset to the most obvious effect of aging, which is to boost public spending on old-age pensions and health insurance. Less obviously, the shrinking number of children has increased the number of years that women devote to paid employment, boosting the fraction of working-age adults who work for pay. The higher employment rate of working-age adults represents another offset to the increase in old-age dependency burdens.

Population aging is the result of two developments, lower birth rates and longer life spans. Holding constant the mortality rate, lower fertility inevitably boosts the fraction of the population past any given age, including the retirement age. However, it also reduces the percentage of the population below a given age, such as age 20. Both the old and the young are dependent populations that derive most of their support from the current output of active workers. Rich societies finance much of the consumption of the aged through government-financed retirement programs, while most (though not all) of the consumption of the dependent young is financed out of private household budgets. Young labor force entrants also require public and private investments to equip them to earn as much as the current working-age population. Lower fertility reduces spending requirements for the young, a fact missed when observers focus narrowly on the budgets of government old age programs. The apparent crisis connected with population aging is partly an illusion stemming from a narrow focus on the spending needs of a handful of public programs. If analysts took account of the full range of private as well as public burdens arising from an older population, the increase in the dependency burden associated with population aging would appear more manageable.

Longer average life spans also increase the percentage of the population past a given age. If people value longer lives, this development unambiguously makes us better off, regardless of whether it increases the percentage of our lifetime income we must set aside to pay for our consumption when we are past age 65. If population aging represents a genuine crisis for present or future generations, it must be the case that those generations expect to suffer a sizeable loss in lifetime net income or in net income per year lived. This might occur as a result of excess net contributions to support younger or older generations. The paper will attempt to describe the circumstances under which this outcome could occur.

The analysis focuses on the rich industrialized countries, though poor and middle-income countries will also see their populations grow older over the next five decades. Among the industrial countries Japan and southern European countries face some of the biggest increases in old-age dependency. These countries' birth rates are below the industrial-country average. In addition, they have enjoyed unusually rapid improvements in expected life spans, and the population shortfall caused by low birth rates has not been offset by population inflows from immigration. Within the next three decades these countries will have some of the oldest populations in the industrialized world.

Old-age dependency burden

A common way to measure the burden imposed by the aged on the working age population is to calculate the ratio of old to the number of working age adults. The U.N. Population Division performs its calculation of the old-age dependency ratio under the assumption that the working age population is between 15 and 64 years old (U.N. Department of Economic and Social Affairs, Population Division, 2004). The U.N. calculations show that in 1950 there were 13 Europeans past age 64 for every 100 adults between 15 and 64 years. The aged dependency ratio rose to 22 by 2000, and the U.N.'s central forecast implies it will reach 48 by 2050. In southern Europe, the old-age dependency rate more than doubled between 1950 and 2000, and it will more than double again between 2000 and 2050, rising from 26 to 65.¹ Comparable estimates for the United States show an old-age dependency ratio of 13 in 1950, 19 in 2000, and 34 in 2050. The old-age dependency ratio will clearly rise faster and to a higher level in Europe, and especially southern Europe, compared with the United States.

Under very simple assumptions regarding the pension formula and work patterns among the young and the old, the trend in the old-age dependency ratio will parallel the trend in the payroll tax rate needed to finance retirement benefits. In a pay-as-you-go (or “paygo”) pension program, the taxes imposed on current wage earnings are just high enough to pay for benefits provided to the retired population. Assuming all aged adults receive a pension and all working-age adults are employed, a balanced-budget rule in the pension program requires that current benefit payments must equal tax revenues:

$$(1) \quad P a_2 = \tau W a_1$$

where P = Average pension benefit;

W = Average wage;

τ = Tax on wages;

a_1 = Proportion of population that is working age; and

a_2 = Proportion of population that is aged.

This implies that the tax rate needed to pay for old-age benefits is

$$(2) \quad \tau = \frac{P a_2}{W a_1}$$

In other words, the tax needed to maintain paygo pension solvency is the old-age dependency ratio times the ratio of the average benefit payment to the average wage. If a pension formula sets the average benefit payment so that it is a fixed percentage of the average wage, the paygo tax rate, τ , needed to support the pension program will vary over time in proportion to the old-age dependency

¹ The U.N. Population Division defines “Europe” to include Russia and eastern Europe as well as western Europe. I define “southern Europe” in this paper to include Greece, Italy, Portugal, and Spain.

ratio, a_2/a_1 . An increasing share of the aged in the population will inevitably boost the percentage of earnings that must be set aside to pay for benefits to the elderly.

A rising old-age dependency ratio can be associated with other effects on public spending however. Partly offsetting higher spending needs for the dependent old is the shrinking need to provide support to the dependent young. Some of this burden is financed through public budgets, for example, as spending on schools and universities and as social assistance payments to help low-income families containing children. If spending for the young is partly financed by taxes imposed on earnings, the combined tax to pay for pensions and education will bear a less direct relationship to the old-age dependency rate than the relationship implied by equation 2. Of course, government transfers and other public spending are not provided only to the young or the old. Some working-age adults also derive support from government transfers. Nor are the taxes used to pay for transfers imposed solely on wages. Means-tested government transfers and most public health insurance benefits are financed out of general government revenues, which are derived from taxes on personal income, property, and consumption as well as on labor earnings.

If transfers are financed with a proportional tax on all factor income, that is, on all gross income from capital, property, and labor, the balanced-budget tax rate needed to pay for age-related transfers can be expressed as

$$(3) \quad \tau = \frac{P_{TOT}}{W_{TOT} + R_{TOT}} = \frac{\sum a_i P_i}{\sum a_i (W_i + R_i)}$$

where P_i = Average transfer benefit received by persons in age group i ;

W_i = Average labor income earned by persons in age group i ;

R_i = Average capital income earned by persons in age group i ;

τ = Tax rate on total factor income, $F_{TOT} = W_{TOT} + R_{TOT}$;

a_i = Proportion of population in age group i .

Note that an age group's average factor income, F_i , is simply the sum of its average wage income, W_i , and average capital income, R_i . It is convenient to express the age profile of factor income by reference to the mean factor income received by the age group that receives the highest factor income, say, F_M . M can be interpreted to mean "middle aged," since income from earnings and capital usually reach a peak when people attain middle age. If there are N age groups and we define $f_i = F_i/F_M$, then the age profile of factor income is indicated by the sequence $f_1, f_2, f_3, \dots, f_M, \dots, f_N$, where each f_i is the mean factor income in group i expressed as a fraction of the factor income received by a middle-aged person and $f_M = 1$. Suppose that the average transfer benefit paid to a particular age group i is also measured relative to the mean factor income received by a middle-aged person. If $\beta_i = P_i/F_M$, we can re-write equation (3) as

$$(4) \quad \tau = \frac{\sum a_i P_i}{\sum a_i F_i} = \frac{\sum a_i \beta_i F_M}{\sum a_i f_i F_M} = \frac{\sum a_i \beta_i}{\sum a_i f_i}.$$

The paygo tax rate needed to support the transfer system is therefore a function of the age distribution of the population, $a_1, a_2, a_3, \dots, a_N$, the age profile of factor income, $f_1, f_2, f_3, \dots, f_N$, and the relative generosity of transfer payments compared to average factor income of the middle-aged, $\beta_1, \beta_2, \beta_3, \dots, \beta_N$. If the age distribution is skewed toward groups with low benefit payments and high factor incomes, the tax needed to finance paygo transfers will be low. As a graying population increases the proportion of people with high benefit requirements and low factor incomes, τ must rise (Burtless 2004).

An illustration. The effect of population aging can be illustrated with a simple example. Suppose the adult population is divided into four age groups: young adults (between ages 15 and 34), the middle-aged (between 35 and 54), the near-elderly (between 55 and 64), and the elderly (ages 65 and older). In addition, assume the age profiles of factor income and of paygo benefit payments follow the schedules shown in Figure 1. The age distributions of factor incomes and benefit payments in the figure are based on the average distributions in four countries where I have been able to collect and verify information on the age distribution of government benefit payments (Burtless 2004). The countries are Finland, Germany, the United Kingdom, and the United States. Both factor incomes and benefit payments are measured relative to the average factor income received by people between 35 and 54. The two bars on the right show the population average factor income (66) and average transfer payment (14).² The implied tax rate needed to support paygo benefits out of factor incomes is thus about 21 percent ($14 \times 100 / 66$). Given the pronounced tilt in the age distribution of factor incomes and benefit payments, it is obvious that shifts in the population age structure can affect average benefit payments, factor incomes, and the ratio of these two variables.

Consider the effects of a shift in the age distribution that mirrors the expected change that will occur in industrialized countries between 2000 and 2050. As a percentage of the total population, the population age 65 and older will increase from 18 percent to 33 percent over that interval.³ If each age group had an identical factor income equal to the overall population average in 2000, the shift in the age composition of the population would have no impact on average factor incomes. Because the population will shift toward age groups that earn lower incomes, however, by 2050 the tax rate will have to rise 2.5 percentage points (about 12 percent) above the required level in 2000 in order to compensate for the lower factor incomes that will be earned by the older population. Similarly, if each age group received an identical average transfer payment, the shift in the age structure of the population would have no impact on the average

² The population average factor income and benefit payment are derived using age group weights that reflect the average age distribution of the four countries in 2000.

³ These estimates reflect the unweighted average population trends in Finland, Germany, the United Kingdom, and the United States as predicted by the U.S. Census Bureau (2004).

transfer payment the government has to pay out. The actual age profile of benefit payments slopes upward with age, however, implying that the average transfer will have to rise. Because the population will shift toward age groups that receive larger benefits, by 2050 the tax rate must rise 7 percentage points (about 33 percent) to pay for higher average benefits. In addition, there is a small interaction effect between factor incomes and the benefit schedule that boosts the required tax rate a bit more. The total increase in τ needed to support paygo transfers between 2000 and 2050 is a little more than 10 percentage points, about 48 percent of the 2000 tax rate. Figure 2 shows the trend in τ between 2000 and 2050 under the assumption that the population age structure follows the trend predicted by the U.S. Census Bureau for a handful of industrialized countries. The figure also shows a decomposition of the tax rise between the part traceable to changes in the factor income distribution, the part due to higher benefit obligations flowing from the age profile of transfer payments, and the interaction effect. The bulk of the increase in required tax contributions is clearly due to the steep age profile of benefit payments.

Much of the cross-national literature on population aging focuses on the impact of a changing age structure on the burden of supporting an older population. As indicated in equation 4, however, the effect of aging also depends on the age distribution of factor incomes and the relative generosity of public transfers over the life cycle. If young people receive generous support under the transfer system, population aging may initially reduce tax burdens as the share of the population in young age groups declines (see Cutler et al. 1990; Burtless 2002). The young earn little income from wages and property, so a decline in fertility will initially reduce the relative size of an age group that has limited factor income and increase the relative importance of age groups with high labor or capital incomes. Two countries with an identical age distribution and identical trends in the age structure may face very dissimilar trends in tax burdens. Differences in the age pattern of factor incomes or in the age pattern of transfer generosity can produce marked differences in the trend of τ , even when the population-average level of transfers compared with factor incomes is initially quite similar. To take a simple example, a nation that provides little public income support to young or middle-aged adults and offers generous support to the population past 65 faces a much steeper increase in taxes when old-age dependency rises than does a nation providing moderate income support to young, middle-aged, and elderly alike.

Policy responses. The estimates in Figure 2 imply that the proportional tax on factor income needed to pay for public transfer benefits will have to rise almost 50 percent between 2000 and 2050. This calculation assumes that paygo transfer programs will obtain revenues just sufficient to pay for contemporaneous benefit payouts. It assumes the benefit formulas for government transfers will remain untouched and the age distribution of factor income will also remain unchanged. Only one factor is assumed to change in Figure 2: The age distribution of the population will grow older.

The actual trend in future tax burdens will diverge from the path predicted in Figure 2 because one or more of these assumptions will turn out to be incorrect. The future age structure of Finland, Germany, the United Kingdom, and the United States will almost certainly differ from the forecast of the U.S. Census Bureau. Government transfers may be financed through borrowing as well as through a tax imposed on current factor incomes. Even more important, the age distribution of future transfers and future factor incomes will not be the same as the distributions observed in recent years. If government programs are reformed to force workers to wait longer before collecting old-age pensions or to become insured under old-age health insurance programs, the age profile of benefit payments will differ from the distribution displayed in Figure 1. Transfer benefits received after age 55 will be lower than assumed in the figure. The change in the structure of benefits could in turn affect the age distribution of factor income. People 55 and older may remain in the workforce longer, increasing their average factor income. Alternatively, they may save a larger percentage of their earnings when they are under age 55, increasing their investment earnings when they are past age 55. Either of these behavioral changes would affect the age distribution of factor incomes so as to reduce the tax increase implied in Figure 2. In the discussion below, I will emphasize the potential effects of increasing the employment rates and labor earnings of working-age and retirement age adults.

An alternative view of the dependency burden

The framework proposed in the previous section offers a natural way to compare old-age dependency burdens in industrialized countries and to assess alternative policy approaches to deal with aging. Unfortunately, the data requirements are demanding. I have not been able to assemble data on the age profiles of factor incomes and benefit payments in most western European countries or Japan. Many countries, however, have published tabulations on employment and earnings by age, so it is possible to examine dependency burdens using a simpler framework than the one described above. Assume as in equations 1 and 2 that all transfer payments are financed with a tax on labor income. Assume also that the transfers are large enough so that non-working adults can consume as much as adults who work. Suppose an average child consumes α times the average adult's consumption, where $0 < \alpha < 1$. If total output is Y , then the average consumption of an adult is

$$(5) \quad C = \frac{Y}{\alpha \sum_{i=0}^{19} A_i + \sum_{i=20}^{95} A_i}$$

where A_i is the number of people in age group i . People aged 20 through 95 are assumed to be adults. Most dependency measures implicitly assume that all working-age adults are contributing to the support of people who are too young or too old to participate in the labor force. In fact, labor force participation rates are considerably below 100 percent, even among adults who are in the middle of their potential work careers. For example, the peak labor force participation rate in

Germany occurs among adults between 35 and 44 years old, but even in this age group the participation rate is less than 90 percent. If the fraction of the population that works at each age, i , is λ_i and the longest lived person dies on his 95th birthday, then output is

$$(6) \quad Y = W \sum_{i=0}^{95} \lambda_i A_i,$$

where W is the economy-wide average wage.

Suppose that all adults share equally in consumption, while all children receive identical consumption allotments equal to α times the adult share. This distribution pattern requires each worker to give up part of his output to support dependents, that is, to support nonworking members of the adult and child populations. The portion of the wage that each worker must sacrifice, τ , is one measure of the burden that aged and youth dependents impose on active workers:

$$(7) \quad \tau_{Total} = \frac{W-C}{W} = \frac{\sum_0^{19} (\alpha - \lambda_i) A_i + \sum_{20}^{95} (1 - \lambda_i) A_i}{\alpha \sum_0^{19} A_i + \sum_{20}^{95} A_i}.$$

The dependency burden can be further divided into the parts that are due to the young ($i = 0,19$), nonaged adults ($i = 20,64$) and the old ($i = 65,95$):

$$(8a) \quad \tau_{Young} = \frac{\sum_0^{19} (\alpha - \lambda_i) A_i}{\alpha \sum_0^{19} A_i + \sum_{20}^{95} A_i} ;$$

$$(8b) \quad \tau_{Nonaged\ adults} = \frac{\sum_{20}^{64} (1 - \lambda_i) A_i}{\alpha \sum_0^{19} A_i + \sum_{20}^{95} A_i} ; \text{ and}$$

$$(8c) \quad \tau_{Elderly} = \frac{\sum_{65}^{95} (1 - \lambda_i) a_i}{\alpha \sum_0^{19} A_i + \sum_{20}^{95} A_i}.$$

The intuition behind this measure of the dependency burden is straightforward. To the extent that the labor force participation rate of children falls below α or the labor force participation rate of adults falls below 100 percent, members of the

age group will require greater support from people who are at work. The dependency burden rises along with the percentage of the population in age groups that have low labor force participation rates. It falls when low-labor-force-participation groups decline as a share of the total population.

Compared with very simple representations of the burden of population aging, the measure in equation 7 takes account of the burden of supporting children and non-aged adults who do not work for pay. However, unlike the more complete representation in equations 3 and 4 above, it ignores the fact that transfers can be supported with taxes on property and investment income in addition to a tax on labor earnings.

Obviously, the “tax” on wages needed to support transfers depends on α , the ratio of benefits provided to children relative to benefits provided to non-working adults. At one extreme, analysts could assume that the consumption allotment for an average child is exactly the same as that for an average adult ($\alpha = 1.0$). However, Cutler et al. (1990) estimated that the educational spending and consumption requirements of an American child represent a little less than three-quarters of the consumption requirements of a U.S. adult, implying that $\alpha \approx 0.75$. At the opposite extreme, we could assume that child dependents require virtually no support for their consumption, say, $\alpha \approx 0.10$. Figure 3 shows the implications of alternative estimates of α on the southern European dependency burden over the period from 1950 to 2050. For the historical period from 1950 through 2000 the estimates are based on reports from census tabulations showing the age distribution of the populations of Greece, Italy, Portugal, and Spain and from estimates of the International Labour Organization (ILO) showing labor force participation in 5-year age groups. The forecasts for years from 2000-2050 are based on the most recent U.N. population projections and the ILO labor force participation rate estimates for the year 2000. In other words, the forecast assumes that future labor force participation rates within age groups will remain unchanged at the levels observed in 2000.

All four estimates of the future dependency burden displayed in Figure 3 show that south European dependency burdens will increase. However, the proportional growth in the dependency burden depends critically on whether children require large transfers from the working population. If these transfers are small ($\alpha \approx 0.10$), the southern European dependency burden has risen almost without interruption since 1950 and will rise another 13 percentage points (or about 36 percent) between 2000 and 2050. On the other hand, if transfers to children are large ($\alpha \approx 0.75$), the tax burden will only increase about 11½ percentage points (23 percent) between 2000 and 2050. If each child is just as costly to support as an aged adult ($\alpha \approx 1.0$), the southern European dependency burden will be just 10 percent higher in 2050 than it was a century earlier in 1950. The intuition behind this result is straightforward. In 1950 southern Europe’s population contained a large number of children and relatively few non-working adults past age 65. More than one-quarter of southern Europe’s population consisted of children under age 15. If these children required few resources to support ($\alpha \approx 0.10$), the overall dependency burden was small. The burden of

supporting the non-working population has increased continuously as the cost of providing transfers to nonworking aged adults has risen. On the other hand, if we assume that support provided to children is costly ($\alpha \approx 0.75$), the steep decline in the importance of children in south Europe's population between 1950 to 2000 led to reduced burdens on workers for supporting non-working dependents. The dependency burden will grow in the future, but in 2050 it will be only modestly greater than the dependency burden in 1950.

The influence of labor force participation. Our evaluation of the relative importance of population aging in southern Europe also depends crucially on trends in adult employment rates. In many rich countries, including Scandinavian and English-speaking nations, adult women have experienced a bigger rise in employment and older people have experienced a slower reduction in employment than has been the case in southern Europe. It is instructive to compare the actual trend in southern Europe's dependency burden (τ) with what the trend would have been if adult employment rates in southern Europe mirrored the rates in the United States.

Figure 4 shows the evolution of the southern European dependency burden under three assumptions about the trend in adult employment rates. All of the estimates assume that the average consumption requirements of a child are three-quarters of those for an adult ($\alpha \approx 0.75$). The top solid line, labeled "a", shows the actual trend in southern Europe's dependency burden using the actual adult employment rates observed in Greece, Italy, Portugal, and Spain.⁴ The bottom solid line, labeled "b", shows what the trend *would have been* if adult employment rates in southern Europe matched the contemporaneous rates in the United States. Since the U.S. adult employment rate was higher than southern Europe's in 1950, south Europe's dependency burden in that year would have been somewhat lower under the U.S. employment rate (49 percent rather than 51 percent). In addition, the gap between the U.S. and southern European employment rate has increased over time, increasing the gap between the actual and the hypothetical dependency burdens. By 2000, the actual dependency burden in southern Europe was 50 percent. If southern Europe's adult employment rate were as high as the U.S. rate, its dependency burden would have been 8 percentage points lower, or just 42 percent. The broken line in the graph shows what the trend in southern Europe's dependency burden would have been if its adult employment rate had trended toward the contemporaneous U.S. rate, closing one-fifth of the difference in each decade between 1950 and 2000. Notice that under either alternative assumption about the trend in southern European employment rates, the predicted dependency burden in 2050 is only slightly

⁴ To calculate dependency and labor force participation rates, I sum the populations of Greece, Italy, Portugal, and Spain and treat them as a single nation. Predicted dependency burdens after 2000 are calculated under the assumption that age-specific employment rates in 2000 will remain unchanged over the period from 2000 to 2050. At least in the United States this is unlikely to be true because female participation rates continue to rise, especially at older ages, and employment rates of men past age 60 have also been rising in recent years.

higher than the actual dependency burden in 1950 (53.5 percent versus 51.3 percent).

The estimates in Figure 4 are sensitive to the assumed cost of supporting children, of course. If we assume that the relative cost of supporting a child is a smaller percentage of the cost of supporting an adult (say, $\alpha = 0.50$ rather than $\alpha = 0.75$), then the proportional future rise in southern Europe's dependency burden would be greater. Nonetheless, the estimates in Figure 4 suggest that trends in adult employment rate can play a decisive role in the evolution of dependency burdens. This conclusion is confirmed in Figure 5, which shows the future trend in southern Europe's dependency burden under two assumptions about the future course of participation rates.

To see how much difference a higher future participation rate would make, I have calculated the southern European dependency burden under alternative assumptions about future labor force trends. Figure 5 shows the trend in the dependency rate under the definition implied by equation 7 above.⁵ For years between 1950 and 2000, the dependency burden is calculated using contemporaneous labor force participation rates within age groups. Thus, the estimates show the actual evolution of the dependency burden under the definition in equation 7. For years after 2000 the dependency burden is calculated under two different assumptions about future participation. The heavy lines in both panels show the evolution of the dependency burden if southern European labor force participation rates within 5-year age groups remain unchanged compared with their levels in 2000. The lighter lower line shows the dependency burden if participation rates in age groups past age 20 rise gradually to a higher rate. For people between ages 20 and 59 I assume that participation rates in southern Europe rise gradually to the 2000 participation rates observed for the same age groups in the United States. For example, the southern European participation rate among 20-24 year-olds was 70 percent in 2000, whereas the U.S. participation rate in the same age group was 75½ percent. Among 55-59 year-olds the southern European participation rate was 46 percent while in the United States the participation rate was 68 percent. I assume that participation rates in southern Europe rise gradually and steadily between 2000 and 2050 to attain the 2000 participation rates in the United States. For people who are 60 years old and older, I assume that southern European participation rates rise steadily between 2000 and 2050 to attain the participation rates observed in these age groups back in 1950. Under this assumption, all of the declines in labor force participation among people age 60 and older that have occurred over the past 50 years would be reversed.

Under these assumptions the southern European dependency burden is predicted to decline slightly between 2000 and 2050. This is in marked contrast

⁵ The calculations in Figure 5 are based on two contrasting assumptions about the relative support costs of children and adults. The results displayed in the top panel assume that the support cost of children is 75 percent of the support cost for adults, that is, $\alpha = 0.75$; results displayed in the lower panel assume that the support cost of children is 10 percent of the support cost for adults, that is, $\alpha = 0.10$.

to the situation if southern European participation rates remain constant. Consider the predicted trend in the dependency burden when $\alpha=0.75$ (the top panel in Figure 5). If labor force participation rates remain unchanged, the dependency burden in southern Europe will rise 11.6 percentage points (about 23 percent) between 2000 and 2050 . However, if the trend toward earlier retirement were reversed and if female participation rates rose to levels that now prevail in the United States, the dependency burden would *decline* 2.4 percentage points (about 5 percent). These calculations imply that an increase in the European labor force participation rates could substantially reduce the extra dependency burden resulting from an older population.⁶ The participation-rate increases I have assumed do not seem implausibly large. They rest on the assumption that participation rates past age 60 will return to a level that was observed during the past 50 years and that southern European participation rates will gradually rise to the levels now observed elsewhere in the rich industrialized world.

Generational burdens. The analysis so far has focused on the dependency burden borne by active workers at a particular point in time. From this perspective, the burden of population aging can be summarized by the implicit tax paid by active workers to support child and adult dependents who do not work. This framework does not fully capture the influence of changing population structure on successive generations, for it fails to measure the lifetime net benefits that individuals derive from membership in a relatively large or relatively small generation. Individuals receive transfers when they are children and, if they survive to join the work force, eventually provide for their own support and contribute toward the support of others. If an individual retires in old age, he again becomes dependent on support from others. Depending on the relative size of the working-age and dependent populations over the course of an individual's life, workers may be net tax payers or net transfer recipients during their lifetimes. It is natural to ask how variations in fertility and mortality affect the net transfers received by successive generations.

In another paper (Burtless 2002) I suggested that the dependency burden faced by any particular generation could be measured by the ratio of lifetime consumption enjoyed by the generation compared to the lifetime gross wages earned by the generation. Favored generations enjoy lifetime consumption that exceeds their lifetime earnings, while less favored generations consume less than their lifetime earnings. The lifetime consumption of a generation is financed out of transfers received when some or all of its members are outside the work force plus the after-tax earnings received when members of the generation are at work. Fluctuations in the birth rate and reduced mortality have complicated effects on the lifetime tax burden faced by successive generations.⁷ It is clear, however, that

⁶ If we assume a lower value of α , say, $\alpha = 0.10$ instead of $\alpha = 0.75$, the results are qualitatively similar. See the lower panel in Figure 5.

⁷ The tax burden refers to the total burden of supporting non-working dependents over the taxpayer's lifetime. Other measures of the lifetime tax burden refer only to the taxes needed to support public spending and redistribution through the government (Auerbach and Kotlikoff 1987). These measures ignore the burden imposed by within-family transfers to support non-working relatives, including children and unemployed adults.

a generation that enters the workforce when fertility rates begin to decline enjoys a favorable situation. Because fertility is declining during its early working years, the burden of supporting children is reduced. Moreover, a reduced fertility rate has no immediate impact on the burden of supporting the aged. Compared with earlier generations, the low-fertility generation faces a smaller burden of supporting the young and an unchanged burden of supporting the elderly. Lower fertility rates must eventually increase the ratio of retired aged to active workers, but this development will not be reflected in support burdens for twenty or more years. When the old-age dependency ratio eventually rises, workers must set aside a larger percentage of their wages to support the elderly. Small generations that enter the workforce several decades after a drop in the fertility rate will face higher tax rates to finance old-age transfers throughout their careers. The ratio of lifetime consumption to lifetime gross earnings will be less favorable than the ratio enjoyed by the first low-fertility generation. Whether the ratio is less favorable than the ratio faced by high-fertility generations depends on the rate of wage growth and the relative cost of supporting aged versus child dependents. A crucial point, however, is that a generation which enters the labor force when fertility starts to decline will be more favored than generations entering earlier or later.

Rising average productivity and real wages. All of the analysis up to now has focused on some measure of the “dependency burden” imposed by the aged or by non-working children and adults on the working population. As is common in this literature, I have measured this burden as the percentage of wages or of total factor income that is used to support the consumption or benefits of non-workers. However, this measure of the dependency “tax” does not provide a meaningful measure of worker welfare. Workers are presumably much more concerned with the actual consumption they can afford after they have paid the dependency tax than they are with the tax rate *per se*. If real wages or real total factor incomes rise fast enough, future workers who face a higher dependency burden can enjoy higher levels of real consumption than present-day workers who face a smaller dependency burden. Under the assumption that real pre-tax wages and factor incomes will continue to rise as fast in the future as they have risen during the past 60 years, future workers will enjoy higher consumption than today’s workers *in spite* of facing a higher dependency “tax.”

According to national income and products account data for the United States, real final consumption per active U.S. worker increased 1.7 percent a year between 1950 and 2000 (Burtless 2002). Most industrialized countries had lower levels of real consumption than the United States in 1950 but enjoyed even faster consumption growth over the following 50 years. An overwhelming share of the growth in final consumption is due to higher worker productivity. Average hours of work per active worker have actually declined. The growth in output per worker has been fast enough so that it has overwhelmed the impact of a higher dependency burden, and this is likely to remain true in the future. Even if we take the most pessimistic measure of the dependency burden shown in Figure 3, which assumes that $\alpha = 0.10$, the increase in southern Europe’s dependency “tax” is

much smaller than the increase in workers' pre-tax wages. The rise in the dependency burden has increased the percentage of workers' earnings that is devoted to supporting the aged and non-workers, but it has not reduced workers' after-tax real earnings.

A couple of calculations are helpful in illustrating the relative effects of higher pre-tax wages and rising dependency burdens. If average real (pre-tax) earnings rose 1.7 percent per year between 1950 and 2000, then the "after-dependency-tax" earnings of southern European workers rose 1.4 percent per year (again, under the pessimistic assumption that $\alpha = 0.10$). Even after paying a higher tax to support non-working dependents, workers received net real incomes that were twice as high in 2000 as in 1950. If the growth of pre-tax wages from 2000 to 2050 is as fast as the growth of wages between 1950 and 2000, after-tax earnings will rise 1.2 percent a year *in spite* of a rising dependency "tax." Workers' real, after-tax earnings will be 87 percent higher in 2050 than in 2000. Even if the annual rate of growth in pre-tax real wages shrinks to just 0.5 percent a year, the after-tax real earnings of southern European workers will be higher in 2050 than they were in 2000. Suppose future workers want to reduce the dependency "tax" in order to speed up the growth in their after-tax real earnings. They can accomplish this by delaying their exit from the labor force and increasing the percentage of their lifetimes devoted to paid work. If instead, workers want to preserve the current retirement age or the current pattern of adult participation in the labor force, they must accept the inevitable price of this choice – a higher dependency "tax" on their wages or factor incomes.

Policy responses

A variety of policy responses can affect the trend in old-age support burdens. Old-age burdens will rise in all the major industrial countries because of low fertility and rising longevity. Figure 6 shows OECD estimates of the 2000-2050 change in the dependency ratio for the G-7 countries (Casey et al. 2003). The OECD defines the old-age dependency rate as the ratio of people 65 and older divided by the number who are between 20 and 64 years old. Its projections imply that the old-age dependency ratio will increase by between 16 and 38 percentage points over the next half century. Japan and Italy, which already have the highest old-age dependency rates, will experience the largest increases in old-age dependency.

If countries cannot alter the future age structure of their populations, they face three basic options in managing the future costs of old-age support programs. They can increase the contributions of active workers or boost general taxes in order to pay for higher benefit payments. They can reduce monthly pensions and health insurance benefits below the levels promised in current law. One variant of this policy is to increase the earliest age at which benefits can be claimed, reducing to zero the pensions paid to the "young elderly." Finally, governments can encourage higher employment rates among groups that currently have low or moderate participation rates. One population with a low employment rate is the aged. In most of southern Europe, adult women also have relatively low participation rates.

The leading industrial countries have adopted policies that combine all three of these options. With respect to pension policy, national governments have increased contribution rates to the public programs, overhauled pension schedules to reduce promised future benefits, and introduced new features in public pension and old-age unemployment programs to encourage employment after the early or standard retirement age (Kalisch and Aman 1998; Casey et al. 2003).

Advance funding. In addition, a number of countries have attempted to shift the funding basis of pensions away from pay-as-you-go financing toward greater capital funding. Note that this shift does not reduce the burden of paying for old-age pensions in the short run, although it may have an indirect effect on dependency burdens in the long run. Active workers must still bear the burden of financing paygo pensions promised to the retired elderly. In addition they also contribute to a voluntary or mandatory funded pension plan that will pay for part of their retirement income when they reach old age. Any reductions in the future old-age dependency burden occur because pensions from the paygo system will be gradually reduced below the amounts promised under the old schedule. The future reduction in the old-age dependency burden occurs because of the cut-back in the paygo pension, but this can take place with or without a shift toward capital funding. A political argument in favor of capital funding is that this shift may help persuade young workers to accept reforms in the paygo pension formula that will substantially reduce their benefits compared with the paygo pensions received by current retirees. The reduction in the future old-age dependency burden is achieved because young workers accept a smaller paygo pension, but they might be unwilling to accept the benefit cut unless policymakers can point to a new and reliable source of retirement income.

Shifting the retirement system away from paygo financing and toward capital funding could boost national saving, thus increasing the future flow of national income. This is a cherished goal of many proponents of capital funding, but it will require a consumption sacrifice in the near term. The sacrifice could be accomplished by reducing the consumption of active workers or of retired pensioners. Workers' consumption could be cut as a result of the requirement that workers increase their combined contributions to the old and new pension systems. If their payroll contributions to the paygo system are left unchanged and if they must contribute to a new capital-funded pension system, they will have less net income with which to pay for their current consumption. Workers' saving will rise and their current consumption fall. Retirees' consumption can be cut by requiring them to accept immediate benefit cuts under the paygo system. Because lower contributions will be needed to pay for current pensions, active workers can divert some of their payroll taxes into a new capital-funded pension system. Reform plans that do not impose a near-term consumption sacrifice, either on workers or on retirees, will not achieve a higher saving rate.

From an economic perspective, the shift away from paygo funding and toward capital funding offers the possibility of increased future consumption among both workers and retirees. The pool of resources for future consumption cannot be assumed to remain constant. It can rise or fall depending on today's

choice of pension funding policy. Current workers can fund a greater part of the cost of their own pensions by increasing their contributions into a retirement plan. If the contributions are saved and used to finance the accumulation of additional capital, the result will be an expansion of the resources available to pay for consumption by future workers and retirees. In neoclassical growth theory, increased saving is one of the few mechanisms that can boost future aggregate income. Larger accumulations in the retirement system could raise a nation's capital stock or foreign asset holdings and thus increase future national income. Over the next several decades, nations with aging populations would still be forced to spend a rising percentage of their national income on pensions, but they would pay for these obligations out of a larger economic pie, leaving a bigger slice for future workers. From the point of view of pension fund contributors, advance funding is also a way to increase the rate of return on their contributions. Part of each worker's retirement benefit would be financed out of earnings on capital investments, and the rate of return on these investments will probably be higher than the return obtainable in a paygo retirement program.

A shift in pension finance from paygo funding to capital funding does not automatically produce higher national saving, however. The only way this can be accomplished is to reduce, at least temporarily, the consumption either of workers or of retirees. This implies that to achieve higher saving the national pension system must be overhauled to cut paygo benefits or increase combined contributions to the unfunded and capital-funded parts of the system. Lower benefits will reduce the consumption of retirees; higher contributions will reduce consumption of active workers.

Benefit cuts. Recently, the most common policy response to rising old-age support burdens has been to reduce the benefits promised by public pension programs. This can be accomplished with sudden, across-the-board benefit cuts that apply to current pensioners. Abrupt policy shifts of this kind are rare in democracies, unless the legislature is forced to act as a result of severe economic crisis. In nearly all public pension systems, workers born in the same year who have similar earnings records expect to receive similar retirement benefits. They also expect benefits to be similar to those received by workers who are only a few years older. Because of political constraints on legislators, the public pension formula can only be changed very slowly and usually after protracted political debate. Since both contributors and beneficiaries have a voice in this debate, changes in contribution and benefit formulas tend to reflect a compromise between the interests of the two groups. The effects of unanticipated economic developments are rarely if ever borne by a single cohort. They are spread across a number of cohorts through gradual changes in contribution rates and benefit levels.

Gradual benefit cuts can eventually produce big reductions in pension spending, however. Figure 7 shows OECD estimates of the fraction of GDP that will be devoted to public pension spending in the G-7 countries over the period from 2000 to 2050 (Casey et al. 2003). The forecast for 2050 takes account of the effects of changes in the age structure of the population, in the public pension

formula, and in eligibility requirements for pensions. Measured as a fraction of national income, public pension spending will increase in every G-7 country except the United Kingdom. In most countries, however, it will increase by proportionately less than the old-age dependency ratio. In Japan, for example, the OECD expects pension outlays to climb from 7.9 percent of GDP in 2000 to 8.5 percent of GDP in 2050. Over the same period Japan's old-age dependency ratio will increase from 28 percent to 65 percent according to the OECD's estimates.

In most countries the slow anticipated growth in pension spending is the result of reforms in the pension formula and eligibility conditions that will curtail the future growth of public benefits. Figure 8 shows the OECD estimates of the expected decline in real pensions relative to average wages in the 50 years after 2000. It contains estimates of the drop in the ratio of average real pension payments to average real wages in the G-7 countries (Casey et al. 2003; Dang et al. 2001). This is roughly equivalent to the drop in the pension replacement rate scheduled under current law. Public pension replacement rates are expected to fall 30 percent or more in Italy, Japan, and the United Kingdom. In Britain the decline in average benefits is so large that public pension spending will actually shrink as a percentage of GDP. Benefit reductions will be achieved as a result of changes in the indexing formula linking pension payments with wage or price change, increases in the number of earnings years used to calculate pensions, or increases the age of eligibility for unreduced pensions.

It does not make sense to impose proportionate benefit cuts on all pensioners. Public pensions are the main source of income for most retirees, and are particularly important for the aged who are in the bottom half of the income distribution (Börsch-Supan and Reil-Held 1998). Because many of the elderly have incomes that are only slightly above the poverty line, the government cannot reduce public pensions at the bottom of the income scale without increasing poverty. Old-age poverty is already a serious problem in several G-7 countries (Figure 9). Poverty is especially high in the three countries planning to make the biggest cuts in pensions.

Some proposals for scaling back pensions emphasize some form of means-testing to spare the low-income elderly from big benefit cuts. Both Canada and the United Kingdom already have significant income testing of their basic state-provided pension. Means-testing public pensions on the basis of retirees' current income can certainly reduce costs. By imposing a high tax on asset and private pension income, however, the policy also discourages workers from saving privately for their own retirement, either in a household saving account or in occupational pension schemes. A means test that affects a large percentage of middle- and high-income retirees could substantially reduce private saving.

Means-testing raises other concerns. It can deprive the basic state pension system of crucial political support by changing the attitudes of high-income workers and retirees, who currently support the system but who would receive sharply lower benefits under a means-tested system. It may induce some retirees to shift assets to their children in order to avoid the means test. Finally, it could

encourage over-investment in assets, such as housing, that provide a stream of in-kind income that is not covered by the means test.

Incentives to encourage higher employment. The prospect of sharply higher pension costs has made policymakers mindful of the possible effects of pensions on labor force participation. Up until the early 1990s the labor force participation rate of people over 60 fell in almost all OECD countries. Participation rate declines were particularly noticeable among men, and the falloff in participation began among men as young as age 50. Among 50-54 year-olds, declines in participation among men were more than offset by participation rate gains among women, so the overall activity rate in this age group has typically increased. At older ages the drop in labor force participation among men was often larger than the increase among women, implying in many countries that overall labor force participation fell among people 55 and older. In all countries except Sweden the decline in activity rates of 60-64 year-old men has been greater than the rise among 60-64 year-old women, so total participation in the age group has declined.

One reason for earlier labor force withdrawal was the increased generosity of programs that replace lost earnings when older workers leave their jobs. Jobless workers past age 50 are now more likely to qualify for generous unemployment and disability benefits, and larger percentages of older workers are eligible for an early pension. The impact of pension incentives has been intensively studied in recent years. Surveys by the OECD and National Bureau of Economic Research have uncovered sizeable effects of disability and pension programs and special unemployment benefits for older workers on the activity rates of people past age 55 (Blöndal and Scarpetta 1999; Gruber and Wise 1999; Duval 2003). Researchers who have recently examined cross-national differences in pension incentives generally find they have predictable and significant effects on labor force withdrawal. Countries with early pension ages, generous income replacement, and heavy implicit taxes on earnings in old age tend to have earlier exit from the labor force than countries with pension systems that provide fewer work disincentives. An OECD survey of pension reform shows that a large number of countries, including Australia, Italy, Japan, and the United States, have changed the incentives in their pension systems to discourage early retirement or encourage pension recipients to continue working while collecting a pension (Casey et al. 2003). Whether these changes will have a big effect on labor force participation at older ages remains to be seen.

Some OECD countries, including most countries in southern Europe, have comparatively low labor force participation rates among adult women. Compared with female participation rates in France and the United States, for example, the participation rate of Spanish women between 25 and 44 is about 20 percentage points lower. The participation rate in Italy is 15 percentage points lower than U.S. and French rates. If the female participation rate were increased to the rate observed in high-participation OECD countries, southern Europe could substantially reduce the dependency burden on active workers.

Conclusions

The analysis in the first part of the paper suggests that the extra burdens connected with population aging are smaller than commonly supposed. To be sure, population aging implies that the tax rate needed to support the retired elderly must rise, a fact which has been emphasized and often exaggerated in popular discussion. But this extra burden will be at least partly offset by a reduced need to provide support to the young, who will become less numerous relative to the active workforce than has been the case in the past. Even if adults provide only modest consumption support to the dependent young, the large drop in the youth dependency ratio implied by current birth rates will offset some of the extra burden of supporting a larger retired population. The extra burden of an older population would be smaller still if labor force participation rates among the working-age and elderly populations are increased.

A couple of factors may account for widespread pessimism concerning the support burdens implied by current demographic trends. First, most rich countries have already derived much of the consumption benefit to be gained from a lower youth dependency rate, but they have not yet experienced the full impact of a higher old-age dependency burden. Recent generations of active workers and retirees have enjoyed the consumption advantages associated with a rising ratio of lifetime consumption to lifetime wages, but future workers will face the inevitable unwinding of part or all of this advantage. If future wage and population growth rates are low or negative, future workers may have to transfer more to the retired elderly than they can ever expect to receive themselves as transfers in old age. Disregarding the considerable improvement in their own life span compared with that of earlier generations, future generations may consider themselves worse off than earlier generations that had the opportunity to consume more than they produced during their lifetimes.

There is a second reason for pessimism. Many analysts believe the public and private transfers needed to support an aged adult are much larger than those needed to support a dependent child. For example, Cutler et al. (1990) estimated that the medical and non-medical consumption needs of a person older than 64 are 1.76 times those of a child. Even under this assumption, however, the extra dependency burden of a larger elderly population will be substantially offset by a relatively smaller population of dependent children. Moreover, the ultimate burden of old-age support does not depend on the amount of support needed to make an aged adult as well off as a nonaged adult. It depends on the actual level of support provided to the aged. It may be the case that an aged adult requires twice as much income as a nonaged adult to satisfy the same medical and non-medical consumption needs. However, if society enforces a distributional rule that provides less pensions and health insurance than this, the retired elderly must accept a consumption allotment that does not fully satisfy their consumption needs. There is no evidence that OECD countries provide enough support to their retired elderly so that the average income of the elderly is greater than that of nonaged adults. The best evidence is that the equivalent income of the elderly in

rich societies is approximately equal to or slightly less than the income of the nonaged (Bosworth and Burtless 1998).

Even though the total dependency burden is growing less than commonly supposed, it is nonetheless rising. Since most nations can do little to boost fertility or immigration rates, they must deal with the impact of rising dependency by hiking pension contributions, reducing retirement benefits, or increasing the percentage of adults who work. From the 1940s through the 1980s, the most common policy response to higher old-age dependency burdens was to increase taxes. During that period national governments liberalized public retirement systems in order to increase the real value of average pensions. The explicit goal of these reforms was to improve living standards among retirees and their dependents so that they might approach the living standards enjoyed by the working-age population. By the end of the 1980s most OECD countries came close to accomplishing this goal. Poverty rates among the elderly were sharply reduced, and most wealthy countries had achieved rough parity in the disposable incomes received by their aged and non-aged populations. The equalization of incomes received by the aged and non-aged is one of the great success stories of post-war social policy. To protect this achievement, national governments increased contribution rates and subsidized public pensions with large transfers from the public budget.

Faced with looming deficits in their pension accounts in the 1990s, national governments began to scale back future benefit promises. With few exceptions, rich nations have decided to reduce future benefits in order to keep their systems affordable. If Britain, Italy, and Japan stick to the pension formulas adopted in recent years, public pensioners in 2050 will obtain a much smaller wage replacement rate than the one enjoyed by pensioners who retired in 2000. There is a danger these cuts will lead to increased poverty rates among the aged and disabled. In countries where old-age poverty rates are already high, including Italy, Britain, Japan, and the United States, policymakers should be concerned that poorly structured benefit cuts will make poverty an even worse problem for the elderly.

Some governments have revised pension eligibility rules and payment formulas to encourage work in later life. Incentives for early retirement have been reduced, and disincentives that kept pensioners from holding jobs have been trimmed or eliminated. These reforms reduce the old-age dependency burden in two ways. They decrease the percentage of old people who are collecting a pension, and they increase the size of the earnings base that helps support pensions.

As life spans increase, the fraction of life spent in retirement will rise unless workers delay their exit from paid work. Improved longevity places heavier burdens on active workers if retirees are supported by contributions out of current payrolls. Even without any further improvement in life spans, the long-term decline in birth rates has slowed labor force growth and increased the ratio of retired to active workers. This places extra pressure on public retirement programs that depend on wage taxes for most of their funding. To reduce this

pressure, nations can adjust the age of eligibility for retirement benefits and take other measures to encourage workers to postpone their exit from the labor market. These steps directly improve the finances of public retirement programs. They encourage some workers to delay their departure from career jobs and induce others to find bridge jobs to tide them over until full retirement benefits begin. Several OECD countries have already taken steps in this direction, and the reforms have contributed to rising old-age employment rates in a few countries.

Workers in many rich countries oppose changes in the retirement system that would push them to retire at a later age. Many voters resist the idea that a higher retirement age is needed to protect public retirement programs. If given a choice, many workers would prefer to make bigger contributions to the retirement system rather than accept a higher entitlement age for retirement benefits. Contrary to a widespread view among economists and public policy analysts, this choice is neither irrational nor short-sighted. Nearly all of the OECD countries are very wealthy, and they have become steadily wealthier in recent decades. If part of their added wealth is used to permit workers to continue retiring at the current retirement age, no economic catastrophe will follow. As we have seen, however, workers will have to pay a price for this choice.

Zealous proponents of a higher retirement age often focus on the long-term trend in labor force participation among older people without considering what has happened to work effort among people before they reach the retirement age. Advocates of later retirement age fret about the budget cost of retirement at age 60 without reflecting on the fact that younger workers may be paying for their longer and healthier retirements by working harder and more productively in their pre-retirement careers. The trend toward higher paid employment rates among 25-55 year-olds obviously will not continue forever, because the employment rate cannot rise above 100 percent. But there is no reason that worker productivity must stop growing. As long as productivity continues to improve, rich countries and individual workers in those countries have a choice about how they want to divide the extra output. Evidence from the past century suggests they will use at least part of it to pay for a longer retirement.

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Figure 1. Stylized Distribution of Factor Incomes and Paygo Benefits, by Age

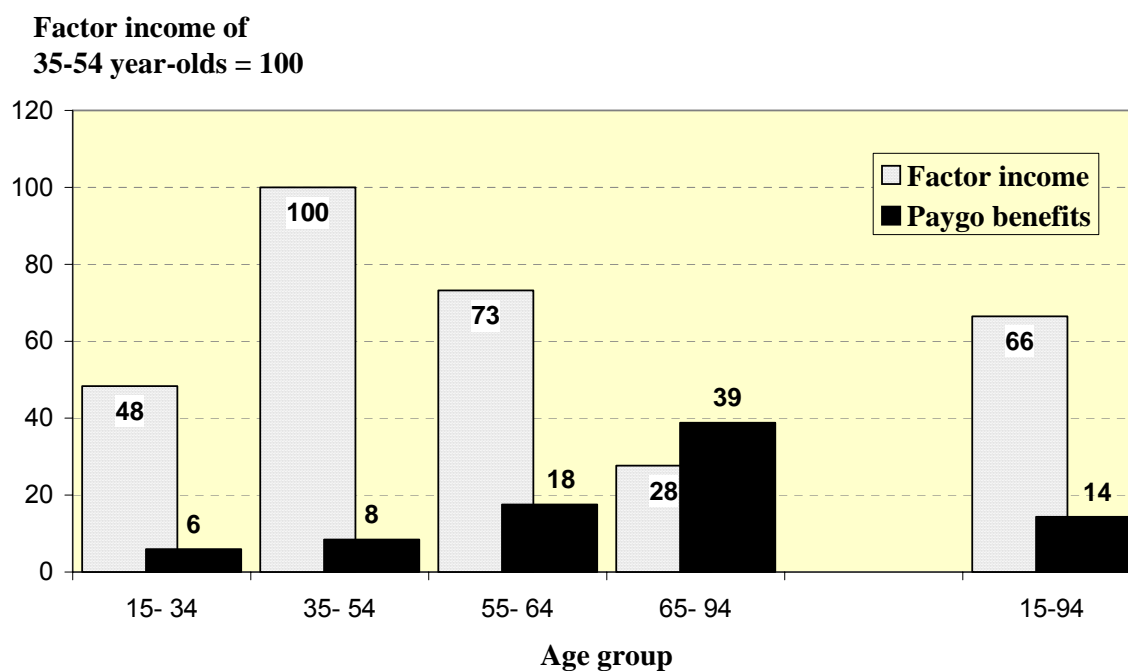
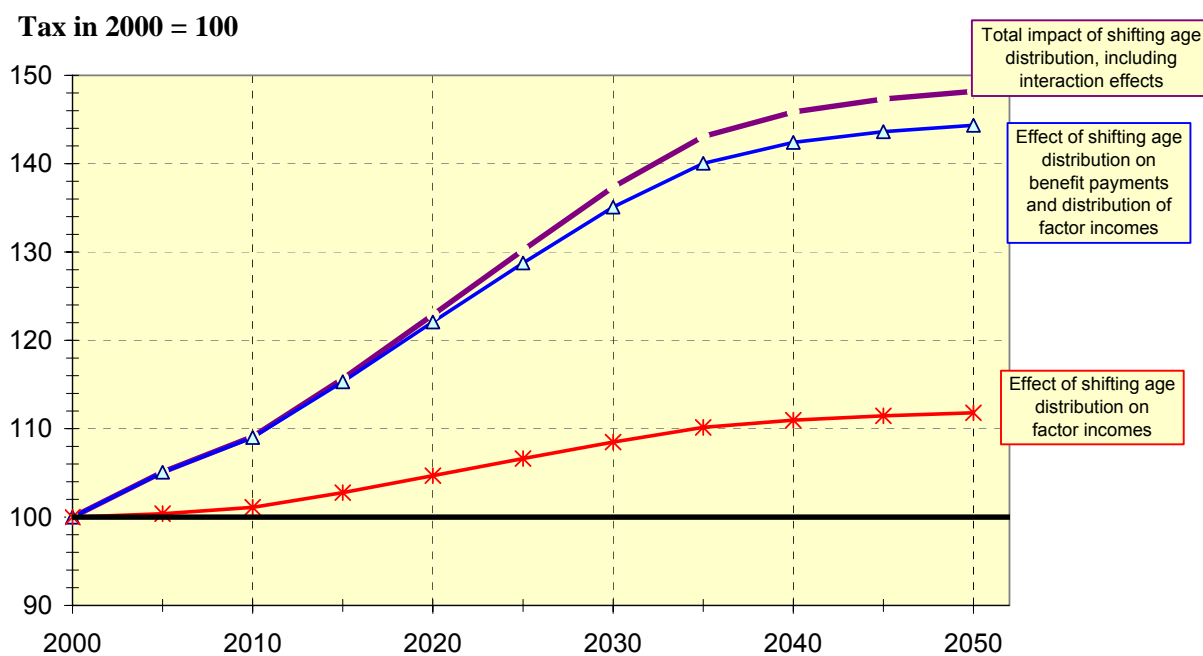
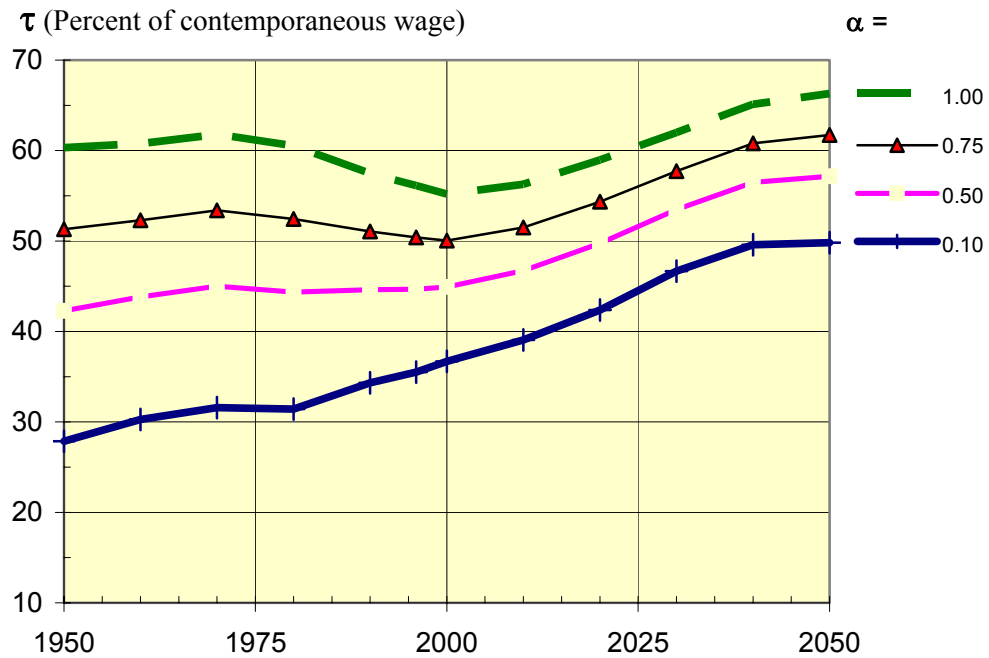


Figure 2. Impact of Population Aging on Tax Rate Needed to Finance Paygo Transfers (Initial tax rate = 100)



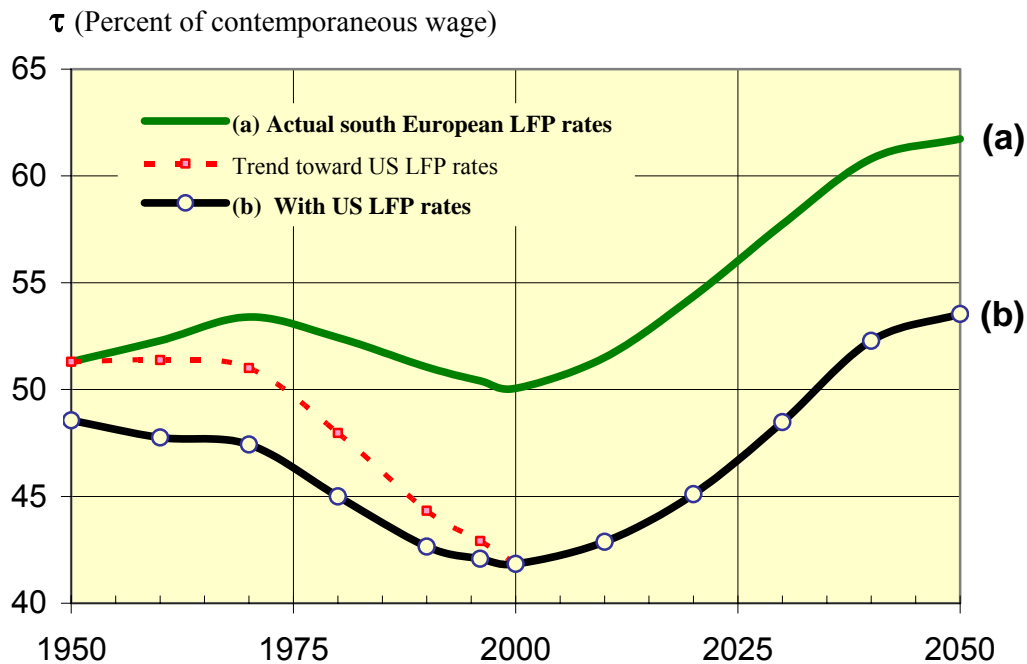
Source: Author's calculations as explained in text.

Figure 3. Southern European Dependency Burden under Alternative Estimates of Child Rearing, 1950 - 2050



Sources: Author's tabulations of U.N. population estimates and ILO labor force participation estimates as explained in text.

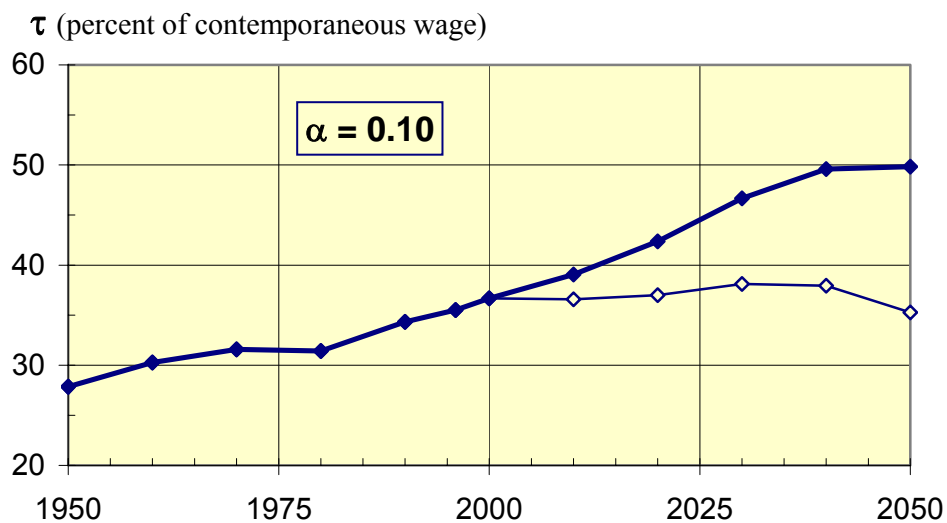
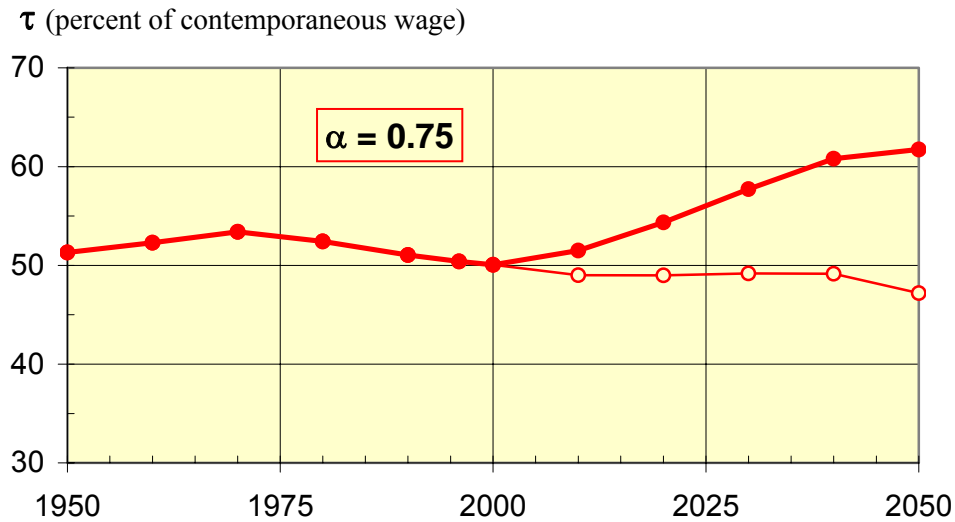
Figure 4. Southern European Dependency Burden under Alternative Labor Force Participation Assumptions, 1950 - 2050



Note: Per capita child support costs are assumed to be 75% of the cost of supporting an adult (that is, $\alpha = 0.75$).

Sources: Author's tabulations of U.N. population estimates and ILO labor force participation estimates as explained in text.

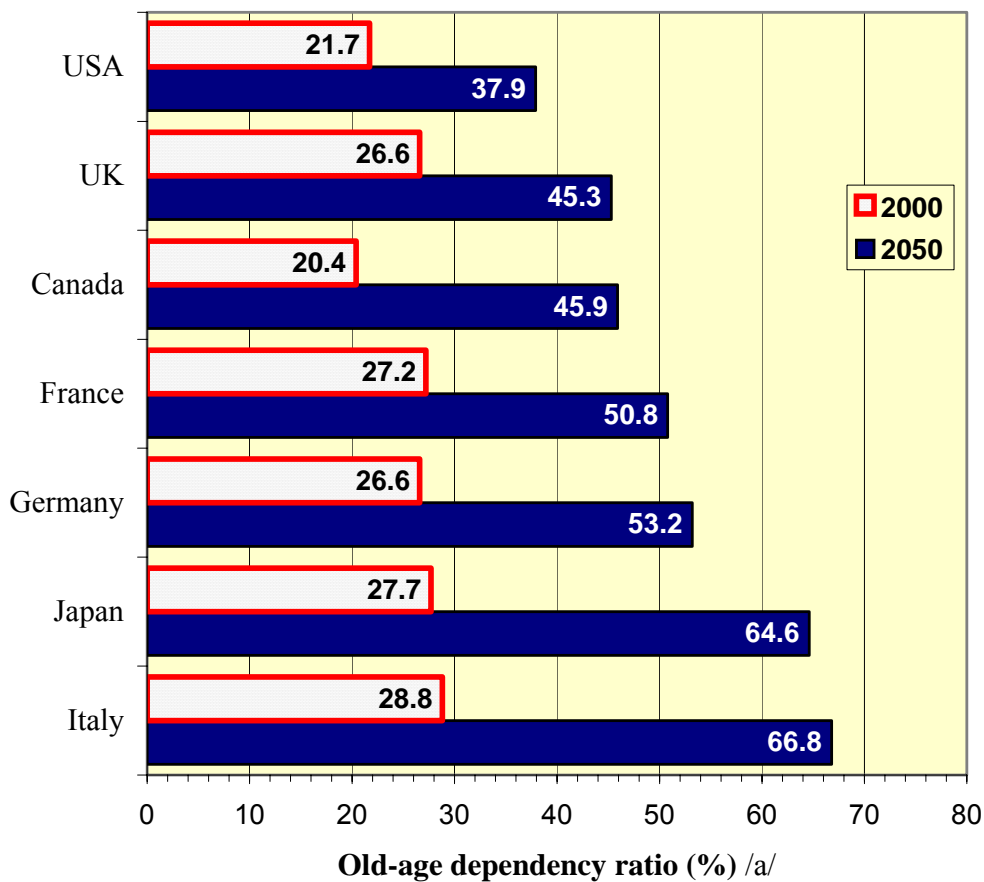
Figure 5. Projected South European Dependency Burden under Alternative Assumptions Regarding Future Labor Force Participation, 1950 - 2050



Note: Per capita child support costs are assumed to be 75% (top panel) or 10% (bottom panel) of the cost of supporting an adult.

Sources: Author's tabulations of U.N. population estimates and ILO labor force participation estimates as explained in text.

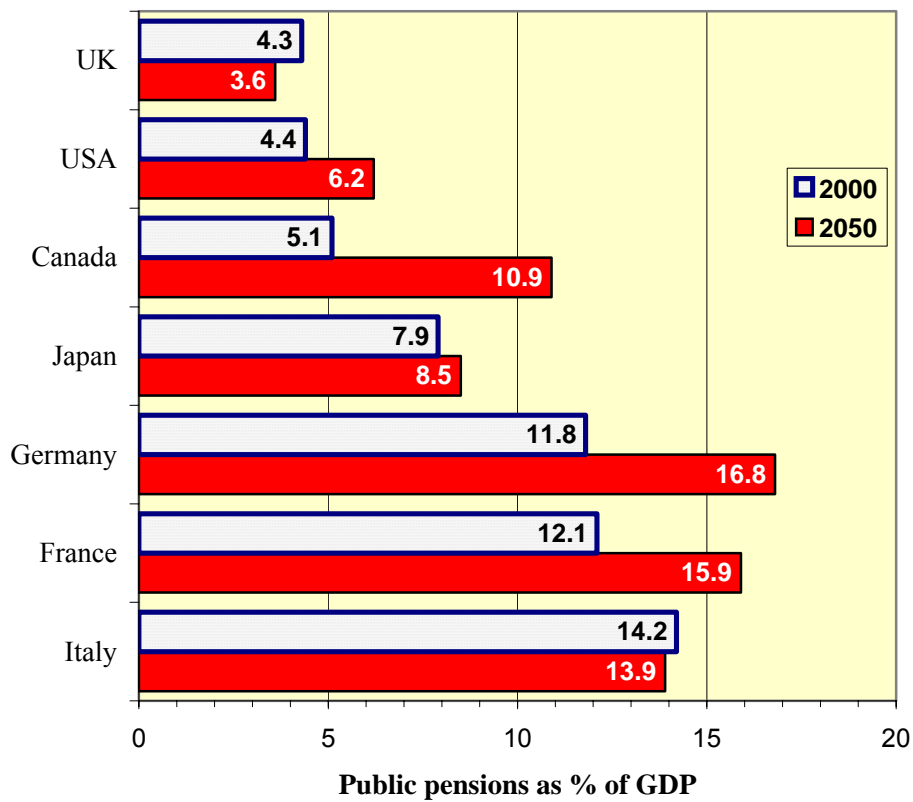
Figure 6. Old-Age Dependency Ratios in G-7 Countries, 2000-2050



/a/ Old-age dependency ratio is equal to (persons aged 65+)/(persons aged 20-64).

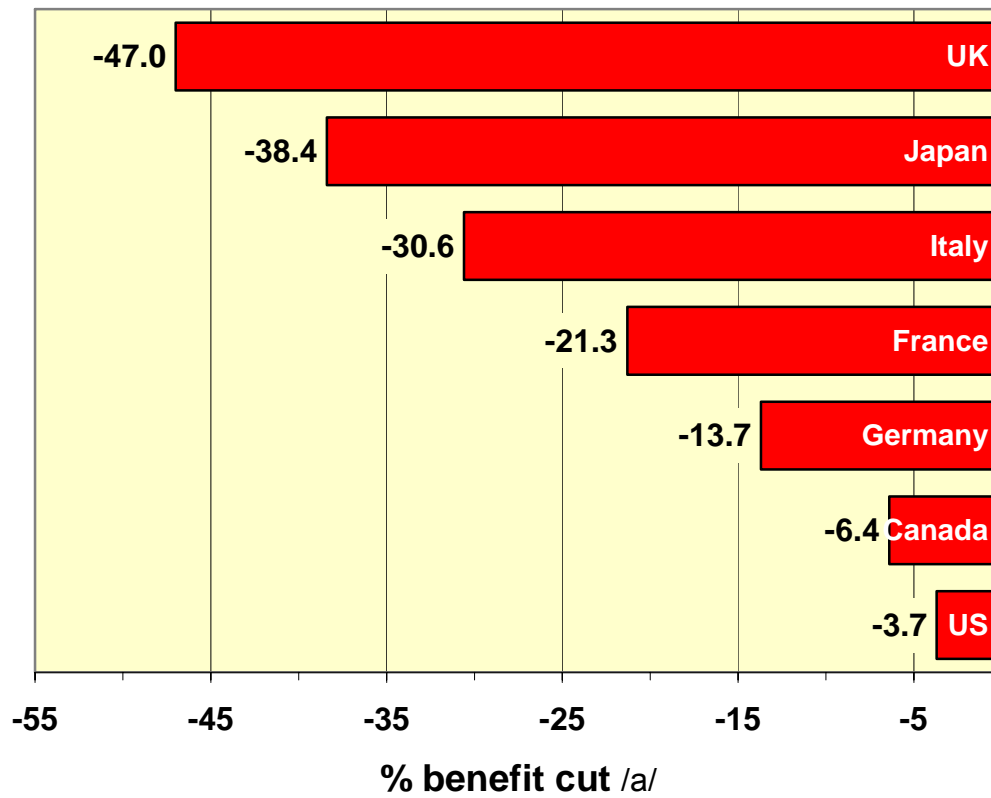
Source: Casey et al. (2003).

Figure 7. Old-Age Pension Spending in G-7 Countries, 2000-2050



Source: Casey et al. (2003).

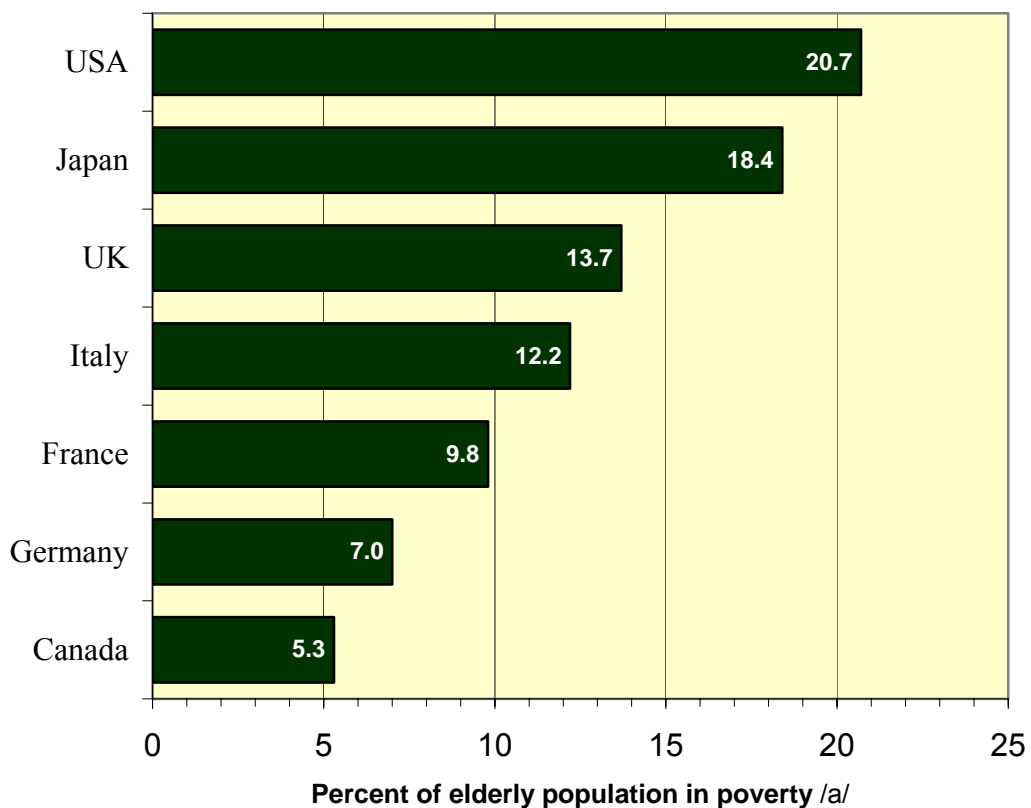
Figure 8. Decline in Average Old-Age Pension Relative to Real Average Wage, 2000-2050



/a/ Percent decline in the ratio of the average old-age pension over the average wage.

Source: Casey et al. (2003).

Figure 9. Poverty among Aged Persons in G-7 Countries, 1992-1997



/a/ A household is classified as poor if its income, adjusted for household size, is less than 50 percent of the median size-adjusted income in the country

Source: Smeeding and Williamson (2001).