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ABSTRACT

Does an Aging Population Increase Inequality?*

The paper reviews recent research on the impact of an aging population on the distribution of income. After briefly discussing the demographic conditions responsible for population aging, a short account is given of demographic trends in the industrialized world. In order to disentangle the many potential channels by which an aging society affects the dispersion of income, several levels of aggregation are distinguished. The paper differentiates between intra- and intergenerational issues, between direct and indirect demographic inequality effects, and between the distribution of current and lifetime income. It emphasizes the critical role of age-related redistributive tax-transfer systems, like public pension schemes and health-care systems. Sources of distributional policy conflicts are identified at both the cross-section level and the lifetime level of income inequality. The institutional design of intergenerational burden sharing, individual disincentive reactions, shifts in age-income profiles related to cohort size, and politico-economic repercussions are shown to drive the relation between population aging and income distribution in distinct and partially opposite ways.

JEL Classification: D31, H55, J18
Keywords: income distribution, population aging, fiscal-demographic policy conflicts, social policy design

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NON-TECHNICAL SUMMARY

'Does an aging society increase inequality?' This question is posed by policy-makers in many industrialized countries today. A main message of the research presented in this paper is that this question is too ill-defined to have a simple answer.

General insight into the complexities involved is neither large nor undisputed. This is due to the intricate demo-economic causes of changes in fertility and mortality, the consequences for the financing of demographically-sensitive public expenditures, and its combined impact on the distribution of income.

In order to understand, at least partially, how observed relationships may have been generated, a highly stylized framework is applied to four separately treated though, of course, related issues: compositional effects, fiscal and institutional repercussions, optimizing responses and cohort-size effects, as well as current versus lifetime incidence.

The nature of a basic problem can be illustrated at the compositional level, i.e. when holding all economic variables fixed. The impact of a changing age structure on the current distribution of income has been studied by a number of authors, but the results have been mixed in one important respect: there is considerable confusion regarding the overall distributional effect of an aging society. Here is a first indication why this may be so. If overall inequality is decomposed into intra- and intergenerational components it can be shown that under fairly mild conditions an aging population yields two conflicting signals: the intragenerational component of income dispersion falls, while the intergenerational component rises.

Several other difficulties in arriving at firm conclusions about the distributive role of a shifting age structure are identified. An aging society not only affects relative population shares, but it also changes relative incomes. Regarding the latter, one important channel is created by public old-age insurance and health-care systems. The respective budget constraints entail inter-relations between fiscal and demographic variables, causing an additional indirect demographic impact on the distribution. It is shown that fundamental policy decisions responding to the solvency problems caused by an aging population may induce contrary demographic inequality effects.

A further obstacle to a meaningful interpretation of the empirical evidence is caused by politico-economic repercussions. If the current distribution is an

important determinant of re-election strategies, then the fact that an aging society changes not only the financial relations of a state pension scheme (or a public health-care system), but also the relative number of votes cast by workers and pensioners, may put conventional conclusions in a different light. Factors like political power distribution come into force, alongside population aging and institutional constraints.

The interactions outlined so far go several steps further when explicitly considering disincentive reactions of utility-maximizing individuals, the sensitivity of age-specific incomes to the relative sizes of age groups (cohort-size effects), or even the findings of the endogenous fertility literature. No general cross-section result can be given. For future research, this may suggest a closer demo-economic examination of the life-cycle profile of within-cohort inequality.

What about the lifetime perspective? Contrary to the widely held belief that the distribution of lifetime income (as opposed to the distribution of current income) remains largely unaffected by changes in the population age structure, the mechanism of the pension formula as well as optimizing responses – to give just two forces – lead to demographic distortions also of lifetime inequality.

Thus, the analysis reveals that there is a substantial danger of underestimating the distributional significance of an aging population. Without a proper understanding of the demographic component, however, normative inferences cannot be drawn from changing inequality and no meaningful policy recommendations can be given. Theoretical and, in particular, intensive empirical research into the distributive repercussions of an aging society (including a careful collection of appropriate data) are very much needed.

1. Introduction

"Does an aging society increase inequality?" This question is posed by policymakers in many industrialized countries today. A main message of the research presented below is that this question is ill-defined to have any simple answer.

Though most economists and demographers may have expected the vagueness, they nevertheless tend to know little about why they are having this expectation. The general insight into the demo-economic complexities involved is still neither large nor undisputed. This is not primarily due to the complex issue of defining and measuring inequality, but relates to the intricate demo-economic causes of changes in fertility and mortality, the consequences for the financing of demographically sensitive public expenditures, and its combined impact on the distribution of income.

Any economic variable or decision having an age or life-cycle aspect bears upon this interrelation. Moreover, numerous demographic variables come into play.[1] In order to isolate at least some of the most basic effects, the analysis has to be rather restrictive. Once a few first results have been established, further factors may be introduced. Most of the extensions, however, prove to be analytically untractable. Empirically supported numerical simulations constitute fairly quickly the only possibility to gain further insight into the distributive consequences of an aging population. It turns out to be a thorny path to introduce some transparency to the policy debate.

After a conceptual clarification in the next section, some demographic facts and projections are presented in Section 3. The question of how an aging society might affect the dispersion of income will be taken up in Section 4. Using a highly stylized framework, the many potential interrelations are reduced to four separately treated, though of course related issues: Compositional effects, fiscal and institutional repercussions, optimizing responses and cohort-size effects, and current versus lifetime incidence. Section 5 concludes.

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[1] See the general surveys by Lam (1987, 1992), Birdsall (1988), and Pestieau (1989).

2. Population Growth versus Population Aging

As opposed to the distributive repercussions of an aging population, the relation between population *growth* and income distribution constitutes an old issue in the economics literature. Classical writers like Malthus, Smith, and Ricardo were concerned with the depressing effect of rapid population growth on relative wages. Long theoretical debates tackled the question of how population growth might influence factor shares, and many empirical efforts have been undertaken to investigate the conjectured effects.[2] From today's perspective, this line of research has to overcome two problems before being able to say something about our focus of interest: the *inequality* of income. First, the studies are typically keyed to the distribution among factors of production; despite considerable research efforts, it is still a long way from shares of factors to the distribution of income among persons. Secondly, population growth alters the distribution in two ways: It changes relative wages, at the same time, however, it changes the composition of the population. The ensuing difficulty of separating pure compositional from real welfare effects is a standard problem in this area. As will be shown below, it is also of central importance when considering the distributive implications of an aging population.

From a worldwide perspective, population growth (related to poverty and hunger) may be considered to be the more pressing issue. In the developed countries, however, it is population *aging* that has become a dominant policy issue.[3] What is the difference? Doesn't slower population growth imply an older age structure, thus linking the two concepts in a consistent way? Though there are demographic constellations where this is true, the alleged relation between population growth and population aging is not, in general, that simple.

The stable population model has been the main device to gain insight into the determinants of population aging. Focusing on long-term impacts it turns out that fertility and mortality have rather divergent effects on the age composition. Fertility shows a pivoting pattern, having a large positive effect on the shares of the very young age groups and a declining impact on less

[2] The interested reader is referred to the reviews of Rodgers (1978, 1983), Kuznets (1980), Lee (1987), Lam (1987, 1992), or Heerink (1994).

[3] See the large number of NBER-studies in the economics of aging edited by David A. Wise (e.g., 1994).

young age groups, turning to a negative effect from (about) previous mean age onwards. The impact of mortality on the age structure is more intricate due to its combined effects on the stable rate of natural increase and the survival rates, starting with a negative impact on very young age groups that changes its strength and direction in a non-linear way at higher ages.[4]

Thus, whether slower population growth is caused by a decline of fertility or an increase of mortality makes quite a difference for the age structure. Moreover, as pointed out by Lam (1986, 1987), once you allow for differential fertility rates across income groups, a reduction in the fertility of high-income groups will have a very different effect on age composition and income inequality from a general fertility decline for all income groups that produces the same change in the population growth rate. It becomes clear from these observations that there can be no simple mapping of the population growth rate onto changes in the age distribution, or vice versa.

A further misunderstanding may also be noted here. Population aging cannot, in general, be attributed to high or low *levels* of fertility or mortality. As long as the demographic regimes have been in place long enough (a span of two or three generations is typically sufficient), the age composition of a population will be fixed whatever levels of fertility or mortality apply. This classic lesson[5] is overlooked by those who assume that populations with below-replacement fertility are necessarily aging populations. Persistent *deceleration* in the rate of growth of births is required to produce an older population.

By the same token, when discussing the possible age structure impact of immigration,[6] it is not immigration per se that affects population aging, rather it is *changes* in immigration rates. A large inflow of younger people will not affect the rate of population aging, unless it is a new event; but, the disappearance of what had been a persistent influx of younger people will increase the rate of population aging.

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[4] See Heerink (1994, Ch. 6) and, for the non-stable case, Preston et al. (1989) for further details.

[5] Euler (1760); Lotka (1907, 1922).

[6] This is an important issue, e.g., in Germany; see the interesting paper by Steinmann (1993).

3. Demographic Facts and Projections

In many regions of the world – a notable exception is Africa – the populations are growing older (United Nations 1985, OECD 1995). Figure 1 depicts the age structure of the world population in 1990, 2050, and 2100, manifesting the enormous momentum of overall population development and the implied expected changes in the shares of all age groups.[7]

< *Figures 1, 2 and 3* >

The impressive aggregate demographic picture disguises regional differences which are large and important for the fiscal and distributional implications of an aging society. A stylized representation of the aging process, pointing at some relation between population growth, population aging, and economic development, is given in Figure 2. The age pyramid of today's developing countries is thus characterized by a broad basis (high fertility) and concave flanks (relatively low life expectancy). An increasing life expectancy with no change in fertility will fill the flanks until a triangular form is reached. A continuation of this process will lead to a bell-shaped age composition. Once fertility starts declining, as is the case in the industrialized world, the pyramid constricts at the basis and becomes urn-shaped (low fertility and high life expectancy), as projected for, e.g., Germany. The prospective shift in the age structure of the German population constitutes a drastic example indeed of a shrinking and aging society – see Figure 3.[8]

< *Tables 1 and 2* >

Tables 1 and 2 present some aggregate indicators for the major seven OECD countries. All of these countries will experience a rapid aging of the population during the first half of the next century. The combined impact of increased life expectancy and declined fertility will raise the proportion of the population aged 65 and over from 12.2 percent in 1990 to 19.5 percent in 2030 in the US, from 11.4 percent (1990) to 20 percent (2030) in Japan, and from 15.5 percent (1990) to 25.8 percent (2030) in Germany. At the same time, sharp falls are

[7] The figure is taken from Birg (1995) and is based on a 'medium' projection variant. See in addition, United Nations (1993) and World Bank (1994).

[8] According to Birg and Flöthmann (1993, p. 97), allowing for immigration will render the demographic change in Germany only slightly less dramatic.

projected for the share of the working-age population in the course of the next three decades in Japan, Germany, and Italy, and moderate falls in France, the United Kingdom, and Canada. Moreover, the labour force itself will also be aging.

Old-age dependency ratios will climb up to 0.44 (Germany), and elderly dependency ratios[9] are expected almost to double by around 2030 to 2040 before stabilizing or falling slightly. In Japan, Germany, and France, elderly dependency ratios are projected to peak at 0.6 and in Italy at over 0.7, while the peak for the United States, the United Kingdom, and Canada will be around 0.4 to 0.5.[10] Note that the prospective change in the ratio of retirees to workers, a ratio that is closer to the fiscal problems entailed by the aging process, is even worse, particularly in Germany where it is expected to approach 1 by 2030.

4. Age Composition and Income Inequality

4.1. Intra- versus Intergenerational Incidence: Compositional Effects

The effects of a changing age structure on the current distribution of income have been studied by a number of authors.[11] The empirical findings underline the importance of the demographic shift. However, the results have been mixed in one important respect: there is quite a confusion regarding the *overall* distributional impact of an aging society. The following stylized set-up gives a first indication why this may be so.

Consider a population consisting of two groups: workers and pensioners. Net earnings of worker j, Y_j, are given by:

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[9] Here, the working-age population is defined as from age 20 to legislated retirement age (as opposed to the standard definition of 15 – 64 years).

[10] OECD (1995).

[11] Lydall (1968) stressed the importance of age composition, but it was the empirical work of Paglin (1975), not undisputed, that set off a series of studies. See, e.g., Danziger et al. (1977), Winegarden (1978), Repetto (1978), Blinder (1980), Morley (1981), Schultz (1981), Mookherjee and Shorrocks (1982), Cowell (1984), Lam (1987, 1992), Formby et al. (1989), v. Weizsäcker (1989), Heerink (1994), Klevmarken (1994), Ermisch (1994), and Jenkins (1994).

$$Y_j = (1-c)A_j, \quad 0 < c < 1,\ A_j > 0, \tag{1}$$

where c denotes the rate of contributions to the state pension fund[12] and A_j marks gross earnings of worker j. Pensioner i's retirement income, P_i, is specified as:

$$P_i = p\mu_A L_i, \quad 0 < p < 1,\ L_i > 0, \tag{2}$$

where p is the retirement benefit rate, μ_A the average gross earnings of the working population, and L_i the pension claim basis for retiree i (which is typically linked to his earnings history and his number of insurance years). Equation (2) is based on pension formulas currently used in a number of nations. In particular, it reflects the built-in flexibility of state pensions increasing in line with gross earnings per worker.

To move from the micro level characterized by (1) and (2) to the macro level, i.e. to the population as a whole and thus to the *distribution* of individual incomes, we have to aggregate across all j's and i's. For illustrative purposes, the present study concentrates on the first two central moments, indicating per capita income (μ) and the variance of income (σ^2). The latter may be expressed as:[13]

$$\sigma^2 = \underbrace{x\sigma_Y^2 + (1-x)\sigma_P^2}_{\text{intra}} + \underbrace{x(1-x)(\mu_Y - \mu_P)^2}_{\text{inter}}. \tag{3}$$

The distributional influence of an aging population is captured by $x := E/(E+R) = 1/(1+\theta)$, which is a monotonically decreasing function of the *old-age dependency ratio* $\theta := R/E$, the ratio of the number of retirees R to the number of active workers E. The dispersion of income of the total population is thus decomposed in an intra- and intergenerational component. The impact of an older age structure is obtained as:

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[12] For expositional reasons, other redistribution systems are ignored.

[13] Note that (3) [or (5)] is based on a moment aggregation over *population subgroups*, which is not to be confounded with a moment calculation of the sum of correlated random variables as met, e.g., in an inequality decomposition by *income components* [like (10)]. See Theil (1967, Chapter 4.A), Shorrocks (1980, 1984), or Lam (1986).

$$\frac{d\sigma^2}{d\theta} = \underbrace{(\sigma_Y^2 - \sigma_P^2)\frac{dx}{d\theta}}_{\text{intra-effect } (<0)} + \underbrace{(1-2x)(\mu_Y - \mu_P)^2\frac{dx}{d\theta}}_{\text{inter-effect } (>0)}. \tag{4}$$

If the number of workers exceeds the number of retirees, i.e. $E > R \geq 0$ (or $\frac{1}{2} < x \leq 1$), and provided that the variance of net earnings of the working population is greater than the variance of retirement incomes, i.e. $\sigma_Y^2 > \sigma_P^2$ – an empirical constellation met in most industrialized countries – then an aging society yields two *conflicting* signals: The *intra*generational component of income dispersion goes down, and the *inter*generational component goes up. This constitutes one of the sources of confusion. Others will be identified in the next sections. The reader may already envisage here the problems of drawing firm conclusions about the distributive role of a shifting age structure.

Opposing demographic effects of this kind are also revealed by measures of *relative* dispersion, i.e. by measures of inequality. In fact, as long as the specific inequality-indicator at hand is a member of the Generalized Entropy family[14] and hence, among other things, additively decomposable by population subgroups, it is possible, in principle, to derive analytical results similar to (4).

From the first two moments μ and σ^2 one may determine the squared coefficient of variation $V^2 := \sigma^2/\mu^2$, for example, which is a member of that family, and check for the conditions of a well-defined *overall* sign. From:

$$\begin{aligned} V^2 &= V_{intra}^2 + V_{inter}^2, \\ V_{intra}^2 &= x\frac{\mu_Y^2}{\mu^2}V_Y^2 + (1-x)\frac{\mu_P^2}{\mu^2}V_P^2, \\ V_{inter}^2 &= \frac{x(1-x)}{\mu^2}(\mu_Y - \mu_P)^2, \end{aligned} \tag{5}$$

it can be shown that $E > R$ and $\mu_Y \geq (1 + \frac{1}{x})\mu_P$ is a sufficient – and in many cases empirically corroborated – condition for the overall effect to be positive,

[14] Cf. Bourguignon (1979), Cowell (1980, 1995), and Shorrocks (1980; 1984). See also Jenkins (1991).

i.e. for $dV^2/d\theta > 0$.[15] Thus, under fairly weak conditions, aging *increases* inequality.

Note that the change in aggregate dispersion is caused by a pure *compositional* effect; all economic variables have been held fixed. This has to be borne in mind when trying to draw any normative inferences from the empirical evidence.

4.2. Fiscal and Institutional Repercussions: Budget Incidence

There is more to come beyond simple compositional shifts. Indeed, an aging society does not only affect relative population shares, it also changes *relative incomes*. Regarding the latter, one important channel is created by the demographically sensitive government budget.

In all industrialized countries projected population aging is likely to put significant fiscal pressure on public old-age insurance and health-care systems. According to a recent OECD study, future demographic changes are indeed the major source of generational imbalances.[16] Restricting our attention to the demographic incidence of the pension budget, we may continue our stylized investigation by stating the standard accounting equation for a pay-as-you-go financed state pension scheme:

$$\sum_{j=1}^{E} cA_j = \sum_{i=1}^{R} P_i. \qquad (6)$$

For (6) to hold in light of an aging society, the two principal policy options are raising the contribution rate, or lowering pension payments. Both kind of adjustments induce *indirect* demographic inequality effects which distort the cross-sectional picture above and beyond the direct impact depicted in the previous section. These effects may be critical to the conclusions drawn.

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[15] See v.Weizsäcker (1995) for further details.

[16] OECD (1995). As for the German economy, featuring one of the most rapid aging processes in the world, see in particular the profound paper by Börsch-Supan (1994).

If the pension budget is balanced by a variation of the contribution rate c, this will be endogenously determined by $c_{BB} = \theta\mu_P/\mu_A$, so that $V^2_{BB} = V^2[\theta, c_{BB}(\theta)]$. The incidence of an increasing population share of retirees is then captured by:

$$\frac{dV^2_{BB}}{d\theta} = \underbrace{\frac{\partial V^2}{\partial \theta}}_{>0} + \underbrace{\underbrace{\frac{\partial V^2}{\partial c_{BB}}}_{<0} \underbrace{\frac{dc_{BB}}{d\theta}}_{>0}}_{<0}. \tag{7}$$

If, on the other hand, the retirement benefit rate is adapted, we have $p_{BB} = (1/\theta) \cdot (c/\mu_L)$ and $V^2_{BB} = V^2[\theta, p_{BB}(\theta)]$, such that:

$$\frac{dV^2_{BB}}{d\theta} = \underbrace{\frac{\partial V^2}{\partial \theta}}_{>0} + \underbrace{\underbrace{\frac{\partial V^2}{\partial p_{BB}}}_{<0} \underbrace{\frac{dp_{BB}}{d\theta}}_{<0}}_{>0} > 0. \tag{8}$$

The additional aging effects in (7) and (8) have *opposite* signs. Whether the indirect effect in (7) is strong enough to produce an overall negative sign is an empirical question.[17] For Germany, e.g., these conditions are clearly met, i.e. we have $dV^2_{BB}/d\theta < 0$ for a contribution rate adjustment, and $dV^2_{BB}/d\theta > 0$ for a benefit rate adjustment.

In other words, fundamental policy decisions responding to the solvency problems caused by an aging population may induce *contrary* demographic inequality effects. Note that, whichever adjustment policy is chosen, the additional inequality impact results from a purely *fiscal* reaction to disturbances of budget equilibrium, not from any redistributional reaction to changes in the personal distribution of incomes. This constitutes another obstacle to a meaningful interpretation of the empirical evidence.

The institutional design of the pension formula decisively drives the relation between demographics and inequality. This insight offers some intriguing *politico-economic* aspects. As long as the question of intergenerational burden division has no well-founded basis, the political need for redistribution, as

[17] Precise conditions are given in v.Weizsäcker (1995).

derived typically from cross-sectional information (adequate longitudinal data are still missing and, above all, the lifetime view does not seem politically viable as a standard of distributional analysis[18]), is subject to the whim and will of policymakers, since the empirical inequality picture can be manipulated in both directions through the continuous transition from a contribution to a benefit rate adjustment. If the current distribution is an important determinant of reelection strategies, then demographic incidence effects like (7) or (8) may prejudice plans for an overdue old-age insurance reform. Moreover, the fact that an aging society changes not only the financial relations of a state pension scheme (or public health-care system) but also the relative number of votes cast by workers and pensioners, may put conventional conclusions drawn from simple accounting equations in a different light. Factors like political power distribution enter the stage, alongside population aging and institutional constraints.

4.3. Optimizing Responses and Cohort-Size Effects

There is another kind of demographically caused fiscal repercussion: *disincentive reactions* of income- or utility-maximizing individuals. Given our exploratory framework, potential implications for the distribution of income may be illustrated as follows.

Allowing for optimizing responses makes labour income A_j an endogenous variable: $A_j = A_j(c)$. Considering the usual case of contribution rate adjustment entails in budgetary equilibrium: $A_{j,BB} = A_j[c_{BB}(\theta)]$, or $Y_{j,BB} = [1 - c_{BB}(\theta)] \cdot A_j[c_{BB}(\theta)]$. Taking into account the institutional dynamics of retirement incomes [μ_A in (2)], we also have $P_{i,BB} = P_i[c_{BB}(\theta)]$. Given these feedbacks, intricate additional demo-economic inequality effects result (for illustrative purposes and to simplify matters, we stick to the variance decomposition):

$$\frac{d\sigma^2_{BB}}{d\theta} = \Bigg[\sigma^2_{Y,BB} - \sigma^2_{P,BB} + x \underbrace{\frac{\partial \sigma^2_{Y,BB}}{\partial c_{BB}} \frac{dc_{BB}}{dx}}_{>0} + (1-x) \underbrace{\frac{\partial \sigma^2_{P,BB}}{\partial c_{BB}} \frac{dc_{BB}}{dx}}_{>0}\Bigg] \underbrace{\frac{dx}{d\theta}}_{<0}$$

[18] Cf. Barthold (1993).

$$+\Bigg[(1-2x)(\mu_{Y,BB}-\mu_{P,BB})^2+2x(1-x)(\mu_{Y,BB}-\mu_{P,BB})$$
$$\times\underbrace{\Bigg(\underbrace{\frac{\partial\mu_{Y,BB}}{\partial c_{BB}}\frac{dc_{BB}}{dx}}_{>0}-\underbrace{\frac{\partial\mu_{P,BB}}{\partial c_{BB}}\frac{dc_{BB}}{dx}}_{>0}\Bigg)}_{>0\text{ (for most cases)}}\Bigg]\underbrace{\frac{dx}{d\theta}}_{<0}. \tag{9}$$

Since disincentive reactions involve modifications not only of the distribution of net incomes but also of gross incomes, all moments in (3) are affected. An aging society ($\theta\uparrow$) causes c_{BB} to rise, which in turn lowers gross and net incomes so that the additional terms [as compared to (4)] of the intra- [first line of (9)] and intergenerational effects [second and third line of (9)] tend to be *negative*. This identifies an interesting *demographic-fiscal* channel of maximizing responses which is quite different in character and sign from the usual result in the theory of personal income distribution that optimizing reactions tend to *increase* inequality.[19]

Another important demographic impact on relative incomes results from *cohort-size effects*. A number of empirical investigations have indeed revealed that individual age-income profiles are not independent of the age composition of the population – apparently because younger and older workers are imperfect substitutes in production.[20] What does this imply for the overall incidence of an aging society?

An alteration of individual age-income profiles triggered by changes in the population age structure entails a direct demographic effect on income dispersion since aggregation is based on individual life cycles. At the same time, this effect retroacts upon the micro level by its impact on government budget equilibrium: Fiscal instruments become functions of the mean slope of individual income profiles *as well as* functions of demographic variables related to the working-age distribution; allowing for incentive reactions, this involves modifications not only of the distribution of net incomes but also of gross incomes.

[19] See v.Weizsäcker [1993 (Chapter IV.2) and 1994] for further details.

[20] See, e.g., Freeman (1979), Stapleton and Young (1984), Dooley and Gottschalk (1984), Berger (1985, 1989), Ben-Porath (1988), Lam (1989), Burtless (1990), Katz and Murphy (1992), and Klevmarken (1993).

Thus, demographic shifts again interfere with the process of income formation, opening up yet another channel of demographic disparity bearings. Except for highly stylized cases, the additional complexities caused by the sensitivity of age-specific incomes to the relative sizes of age groups force a resort to numerical simulations.[21] No *general* cross-section result can be given. For future research, this suggests a closer demo-economic examination of the life-cycle profile of within-cohort inequality, i.e. a truly dynamic cohort approach.[22]

The interactions outlined above may even go one step further when considering the findings of the *endogenous fertility* literature,[23] rendering the age structure itself an economically determined variable [$\rightarrow \theta = \theta(c)$]. Conceptually, this complication undermines any positive or normative conclusion drawn so far.

4.4. Current versus Lifetime Income Incidence

What about the *lifetime* perspective? Does this level of aggregation avoid the demographic interference encountered in the proceeding sections?

Contrary to the widely held belief that the distribution of lifetime income (as opposed to the distribution of current income) remains largely unaffected by changes in the population age structure, the mechanism of the pension formula as well as optimizing responses by workers and/or the government – to give just two forces – lead to demographic distortions also of lifetime inequality.

< *Figure 4* >

Implementing the lifetime approach requires making some stringent assumptions, of course. Going on from the above descriptive set-up and ignoring discounting, lifetime income W of individual j may be expressed as:

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[21] Cf. v.Weizsäcker (1993). It may nevertheless be noted that empirical studies for the *U.S.* suggest that labour supply effects associated with fluctuations in age composition play a substantial role for the increase in earnings inequality during the 1980's (though shifts in labour demand seem to have played an even bigger one) – see Levy and Murnane (1992), and Danziger and Gottschalk (1993).

[22] See in this context the promising work of Deaton and Paxson (1994a, 1994b).

[23] See, e.g., Nerlove et al. (1987), Becker (1988) or Becker and Barro (1988). Cf. also the stimulating work of Lam (1986, 1987, 1992).

$W_j = Y_j + P_j$, where $Y_j = (1-c)A_j$ and $P_j = p\mu_{A_+}L_j$ (μ_{A_+} indicates average gross earnings one period up). Again considering the squared coefficient of variation for purposes of illustration, we arrive at:

$$V_W^2 = \frac{\sigma_W^2}{\mu_W^2} = z^2V_Y^2 + (1-z)^2V_P^2 + 2z(1-z)V_YV_P\varrho_{YP}, \qquad (10)$$

where:

$$z = \frac{(1-c)\mu_A}{(1-c)\mu_A + p\mu_{A_+}\mu_L},$$

and ϱ_{YP} (> 0) denotes the correlation coefficient of net labour and retirement incomes. The old-age dependency ratio θ – and hence the demographic change – enters z via the contribution rate c or the benefit rate p, depending on the prevailing pension formula. Though the direct effect of shifting relative population shares, i.e. the pure compositional effect of an aging society indeed disappears: $dV_W^2/d\theta = 0$, all other demo-economic channels known from the proceeding deliberations survive to the lifetime level: $dV_{W,BB}^2/d\theta \neq 0$.

A final remark in this context. Changes in the age composition also play a decisive part in an important *inconsistency* issue: As mentioned before, due to scarce empirical information on lifetime income disparity and due to politico-economic reasons, policy measures designed for achieving a more even distribution of income are typically oriented towards the current distribution. The crucial question then is whether distributional policy decisions made on this basis are generally compatible with those which would have been made on the basis of the distribution of lifetime income (which may be considered as the normatively superior incidence level). The answer is no, for there can be situations where a certain policy action successfully reduces current inequality, while at the same time it alters the allocation plans of optimizing individuals in such a way that lifetime inequality systematically rises. The main reason for this inconsistency is to be found in the aggregation function of the population age structure, assigning to each intra-cohort policy effect (across all income levels) its relative weight in the aggregate policy impact on current inequality.[24]

[24] See v.Weizsäcker (1994).

5. Conclusion

The main objective of this paper has been to sketch some of the potential effects of an aging society on economic inequality. Given the complex nature of demographic incidence, there seems to be no easy answer to the starting question: "Does an aging population increase inequality?" Policymakers face a difficult problem when trying to interpret the empirical evidence. An aging society produces simultaneous shifts in both population shares and relative incomes, interacting in numerous intricate ways. The available data today are too limited within and across generations for a refined multivariate analysis that could provide the required disentangling information.

To understand at least partially how the observed relationships may have been generated, a highly stylized framework has been applied for the identification of some basic demo-economic interactions. The analysis reveals that even at this level of structural simplicity there is a substantial danger of *underrating* the distributional significance of an aging population. Without a proper understanding of the demographic component, however, no normative inferences can be drawn from changing inequality and no meaningful policy recommendation can be given. Theoretical and, in particular, intensive empirical research into the distributive repercussions of an aging society (including a careful collection of appropriate data) is very much needed.

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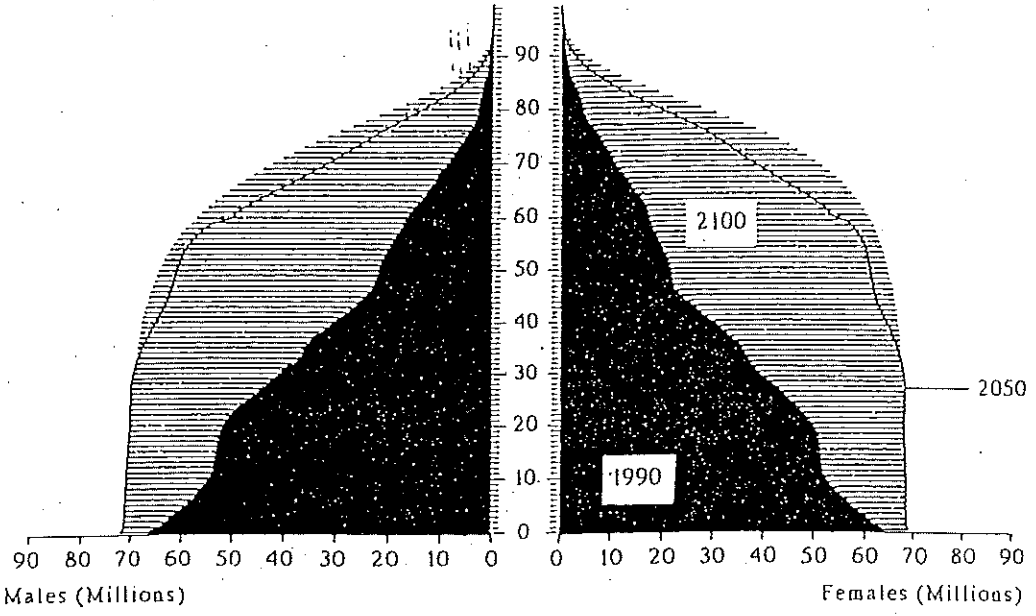

Figure 1: Age Structure of World Population 1990, 2050, 2100

Assumptions:

- Target year for replacement fertility level: 2050
  (total fertility rate = 2.13)
- Form of fertility decline: Hyperbolic
- Mortality level: Medium

Source: Birg (1995)

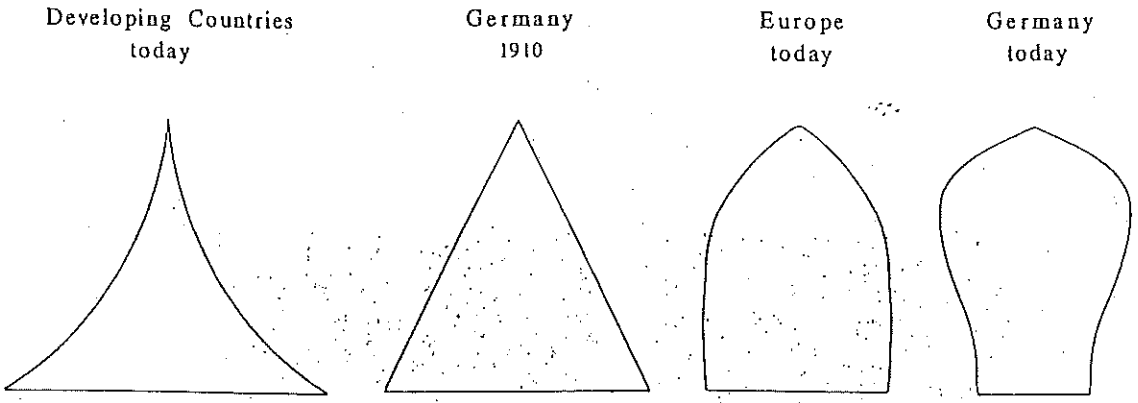

Figure 2: Stylized Age Pyramids

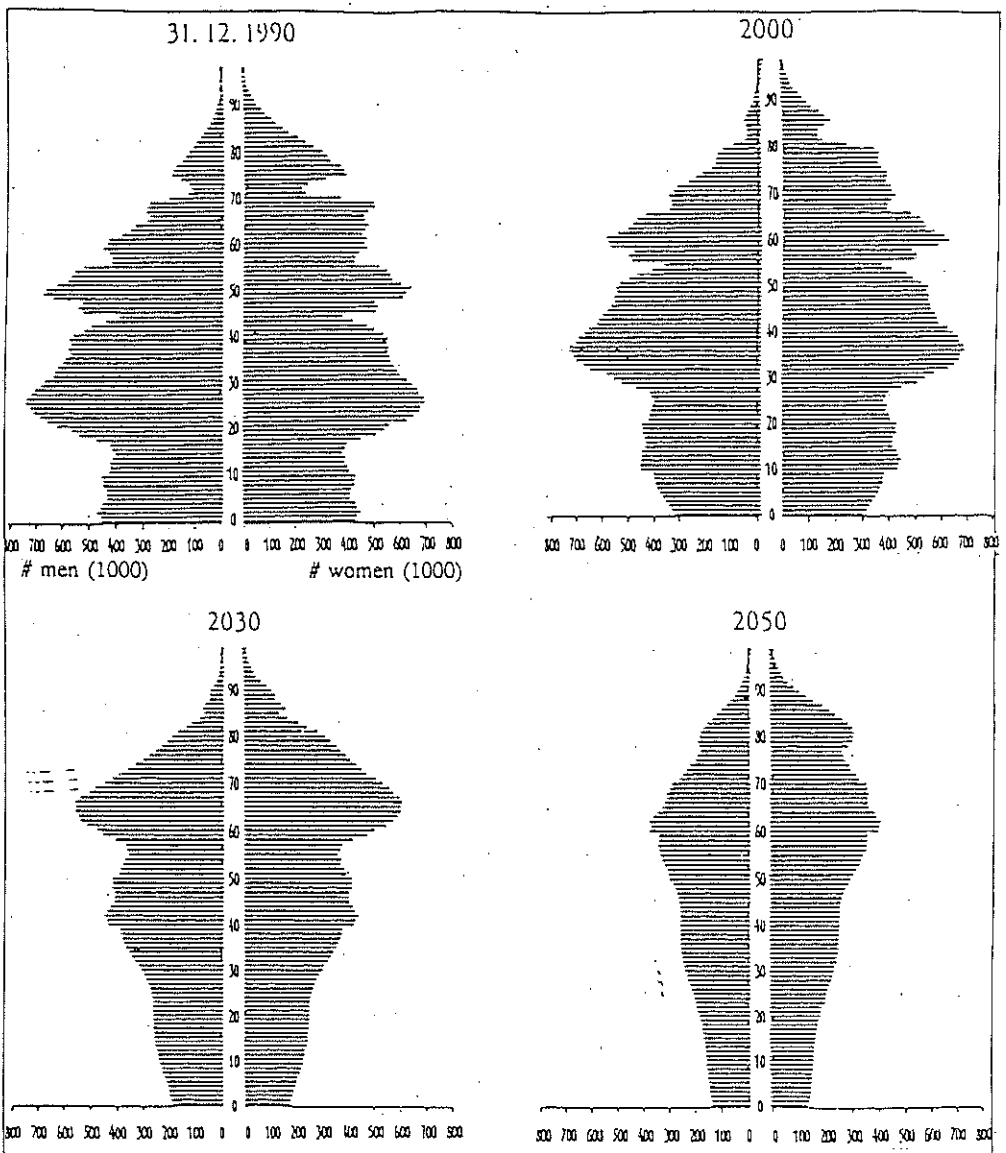

Figure 3: Population Age Structure in Germany, 1990-2050

Assumption: Fertility and mortality constant at 1990 level

Source: Birg (1994)

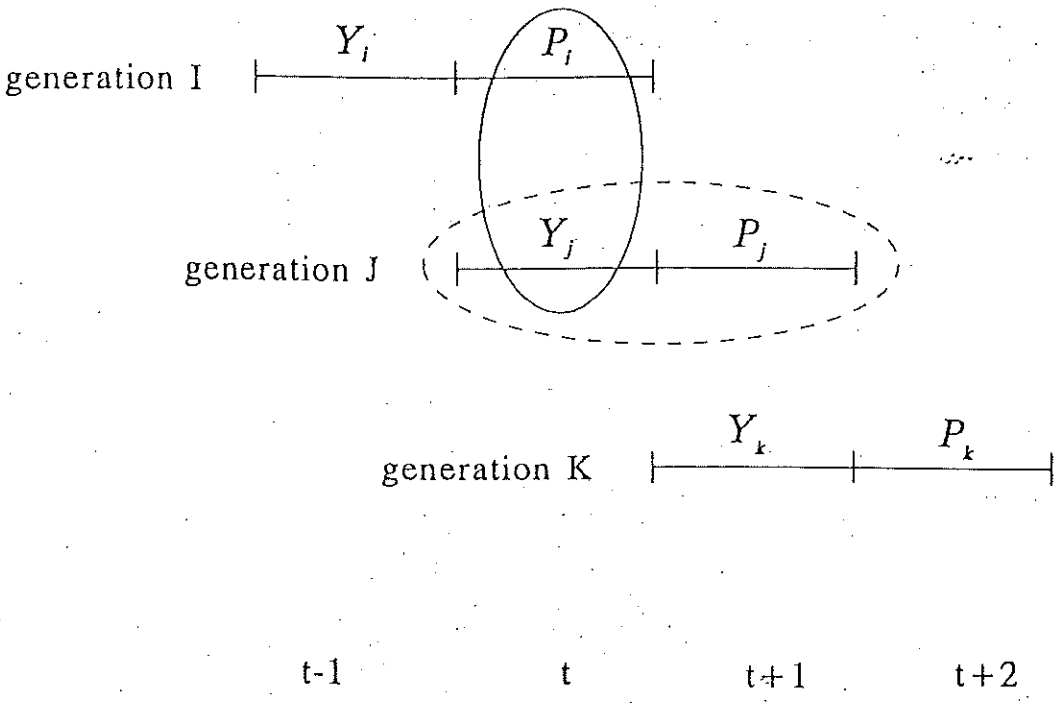

Figure 4: Current versus Lifetime Perspective

Table 1 Population Aged 65 and Over

(%)

	1900	1950	1990	2030
Canada	5.1	7.7	11.4	22.4
France	8.2	11.4	13.8	21.8
Germany	4.9	9.4	15.5	25.8
Italy	-	8.0	13.8	21.9
Japan	-	5.2	11.4	20.0
United Kingdom	4.7	10.7	15.1	19.2
United States	4.1	8.1	12.2	19.5

Source: OECD (1988, 1995)

Table 2

Old-Age Dependency Ratios

Population Aged 65+ / Population Aged 15-64

(%)

	1990	2010	2030
Canada	16.8	21.4	37.3
France	20.9	24.5	35.8
Germany	22.3	30.6	43.6
Italy	20.1	25.7	35.3
Japan	16.2	29.5	31.9
United Kingdom	23.0	22.3	31.1
United States	18.5	18.8	31.7

Source: OECD (1988, 1995)