Intergenerational Fairness During Demographic Transition

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Abstract

Implementing a fairness component into a standard overlapping-generations model and allowing young individuals to vote on their own pension payments, we show that they adapt the pay-as-you-go pension scheme to future demographic changes. In particular, we explain why young generations cut their retirement benefits thus partially phasing out social security during a fertility decline. Carrying out a simulation, we furthermore calculate the costs of implementing fairness into utility. From the viewpoint of an individual, these costs are reduced by equalizing generational accounts. Hence, under certain conditions policy actions based on generational accounts may be compatible with intertemporal welfare maximization.

JEL classification: H55; D63

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1 Introduction

Almost all OECD countries facing demographic transition can be observed to reform their social security systems. Germany for example recently implemented a "sustainability factor" in the pension formula in order to avert the effect of an ageing population on the pay-as-you-go system, thus obtaining more financial sustainability. What seems noteworthy in this context is firstly the fact that today's implementation entails adjustments only tomorrow and secondly the fact that this benefit rule change depends on the future demographic development. For the past, Borgmann and Heidler (2003) find similar but implicit benefit rule changes of social security wealth in Germany. Analyzing what caused these changes, Borgmann and Heidler (2003) assess an influence of the future demographic development: Increases in the future old-age dependency ratio reduce the generosity of the pension scheme. Within the framework of this paper, we want to put fair individuals into context with this phenomenon. Thus, we develop a simple model of political economy with intergenerational fairness to illustrate adjustments that take place during a demographic transition, i.e. a period of baby bust or baby boom. We particularly want to give emphasis to cuttings in generosity that can be individually optimal in case of a fertility decline.

The notion of fairness is relatively wide-spread in economic theory as it serves to explain why people behave the way they do. "Fairness" has turned out to be a more accurate way of analyzing behavior than "altruism" because observations of individual behavior show that the willingness to help is not unconditional and definite as in the case of altruism, but rather contingent on an unequal situation – or at least one perceived as such. Hence, this approach may be more appropriate to actually describe the social motivation of individuals. Surely fairness can be interpreted in numerous ways, we will however restrict ourselves to the interpretation of fairness as a self-centered inequity aversion.[1]

Amongst the few authors that formalize the notion of fairness, Fehr and Schmidt (1999) and Bolton and Ockenfels (2000) are probably the most prominent. Both papers incorporate fairness, or rather inequity aversion, into their analysis by implying a loss in utility if an individual experiences a difference in his payoff compared to the payoffs of other agents. Taking up this idea we apply it to a two overlapping generations model, now considering intergenerational fairness.[2] We assume that a generation suffers a negative utility if the net contribution payment to the pay-as-you-go pension scheme deviates from that of the following generation. In other words, instead of selfishly maximizing his lifetime utility, a representative individual cares for differences in net

[1] In the following we will use these two expressions synonymously.

[2] To our knowledge, there are no papers dealing with individuals who are *inter*generationally fair, whereas there are papers regarding *intra*generationally fair individuals, e.g. see Galasso (2003).

social security payments and may consequently lower or force up his own retirement benefit, thereby diminishing or enhancing his life-cycle consumption. Clearly, the notion of fairness implies that an individual is averse to both higher and lower net payments, so the concern for differences in net social security payments is not just one-sided, as it is the case with altruism. Rather, each individual is benevolent towards himself as well as towards the generation succeeding him.

Another strand of literature regarding fairness, not on the individual level, but on the level of policy actions, understands intergenerational fairness as a situation where the net payments to the fiscal sector are the same for all generations. Accordingly, intergenerational fairness can be achieved by a policy aiming at equalizing generational accounts. There have been several papers studying the coherence of policy actions based on generational accounts and welfare implications resulting from them, e.g. Raffelhüschen and Risa (1997). Due to the fact that generational accounts do not cover all generation-specific effects, it is problematic to use generational accounts alone as indicators for welfare, since they might be misleading.

Using our model we now want to demonstrate under which circumstances not only sustainable politics in terms of equalized generational accounts but also welfare increasing policy actions can be transmitted into individual behavior. In other words, we provide an example where the adjustment of generational accounts enhances one's own utility and the utility of all succeeding generations, thus implicating that an intervention of the social planner is not needed since individuals act in the same spirit. Additionally we want to show that extending utility by a fairness component is not accompanied by extensive "costs". Only a small fraction of the income actually has to be assigned to our fairness construction.

The paper is organized as follows: After presenting the model of intergenerational fairness in section 2 we define a voting rule for the individuals in section 3. In accordance with this definition section 4 further analyzes the voting behavior and demonstrates the basic implications of fairness in case of a fertility decline. Taking up the results of Borgmann and Heidler (2003) section 5 carries out a simulation. We demonstrate that the concept of fairness is to all intents and purposes a plausible extension to purely selfish utility functions. Furthermore we go into the coherence of different degrees of fairness, equalizing generational accounts and welfare. Finally, section 6 concludes.

2 A Model of Intergenerational Fairness

We concentrate on a standard overlapping generations framework with two generations. Each generation t ($t = 0, 1, \ldots$) consists of N_t identical individuals. Population growth from any period t to period $t+1$ is given by

$$N_{t+1} = (1 + n_{t+1})N_t. \tag{1}$$

We can formulate individual lifetime utility, which captures the trade-off between pure self-interest and fairness, as

$$U_t = \ln(c_t^1) + \gamma \ln(c_{t+1}^2) - \beta \left[\left(B_{t+1} - \frac{P_{t+1}}{R_t} \right) - \left(B_t - \frac{P_{t+1}}{R_t} \right) \right]^2. \tag{2}$$

An individual of generation N_t gains utility from consumption in youth c_t^1 and consumption in old age c_{t+1}^2, whereby the latter is discounted to the base year period with the variable γ. Disutility on the other hand is triggered by inequalities in net payments to the public sector: An individual of generation N_t suffers disutility in case his net payment – consisting of the contribution payment B_t and the discounted transfer P_{t+1} – does not equal the net payment of an individual of generation N_{t+1}. Since generation N_t presumes its own future pension transfer P_{t+1} to hold for the generation succeeding them, the net payment which generation N_t assigns for generation N_{t+1} is given by $B_{t+1} - \frac{P_{t+1}}{R_t}$. Finally, we assume that an individual of generation N_t discounts the pension transfer with the base year interest rate R_t and $R_t \equiv 1 + r_t$.

The variable $\beta > 0$ rules out purely selfish individuals. The higher β, the more inequity averse the individuals. Put differently, β is a weighting factor for the inequity in net payments compared to the weighting of life-cycle consumption. Since inequality matters whether advantageous or disadvantageous, we implement a quadratic function in order to capture positive as well as negative deviations in net payments. As we do not compare purely monetary payoffs[3] but rather a logarithmic utility of consumption with net payments to the public sector, there is no straightforward interpretation of β. Therefore the use of a quadratic function to capture these net payments does not complicate matters for the interpretation of β, but rather simplifies optimization. Nevertheless, how β is to be interpreted properly will be shown later on.

An individual of generation N_t has the following budget constraints

$$c_t^1 = w_t - s_t^1 - B_t \quad \text{and} \quad c_{t+1}^2 = R_{t+1}s_t^1 + P_{t+1}. \tag{3}$$

[3] Fehr and Schmidt (1999) compare purely monetary payoffs, so they can – in contrast to us – use a parameter to directly measure the inequality aversion relative to one's own payoffs.

During the first period, the working age, each representative young individual inelastically supplies one unit of labor and receives a gross wage given by w_t. The young individual consumes a part of this labor income, pays a social security contribution B_t and saves the remaining part s_t^1 for retirement, his second period of life. During old age each retiree receives a pension P_{t+1}. We assume that $s_t^1 > 0$, $B_t \in [0, w_t]$ and $P_{t+1} \in [0, (1+n_t)w_t = P^{max}]$. Given these budget constraints, individuals maximize equation (2) subject to (3) which yields the indirect utility function

$$\begin{aligned} V_t(w_t, &r_{t+1}, B_t, P_{t+1}) \\ &= \max_{c_t^1, c_{t+1}^2} \left\{ \ln(c_t^1) + \gamma \ln(c_{t+1}^2) - \beta \left[\left(B_{t+1} - \frac{P_{t+1}}{R_t} \right) - \left(B_t - \frac{P_{t+1}}{R_t} \right) \right]^2 \right\} \end{aligned} \tag{4}$$

$$\text{s.t.} \quad c_t^1 = w_t - s_t^1 - B_t, \quad c_{t+1}^2 = R_{t+1} s_t^1 + P_{t+1}.$$

Concerning the public sector, we assume it only to comprise a pay-as-you-go (PAYG) pension scheme, i.e. we disregard both other than PAYG public expenditure and initial public dept. Hence, the governmental budget constraint is given by

$$N_t B_t = N_{t-1} P_t. \tag{5}$$

The PAYG pension system is of the defined benefit (DB) type, i.e. the benefits are kept constant, whereas the contribution payments are adjusted according to population growth in order to guarantee the fixed pension payment.[4] Rearranging this equation yields the contribution payment of a young individual at the beginning of period t, namely $B_t = \frac{P_t}{(1+n_t)}$. Since the PAYG system is the only governmental action and equation (5) always has to be fulfilled, the above denoted net social security payments of the individuals can be interpreted as generational accounts (GA). A generational account of an individual of generation N_t can be written as $GA_{t,t} = B_t - \frac{P_{t+1}}{R_t}$, with the first index indicating the period under consideration and the second index denoting the generation. Assuming a dynamically efficient economy, where the market interest rate exceeds the growth rate of the population,[5] the GA of a generation N_t in period t is positive. As already mentioned above, individuals of generation N_t assign a certain net payment for their succeeding generation as they assume that $P_{t+2} = P_{t+1}$. In other words they create a "pseudo GA" for generation N_{t+1}, i.e. $\widetilde{GA}_{t,t+1} = B_{t+1} - \frac{P_{t+1}}{R_t}$.

[4] The alternative to the DB-type would be a defined contribution (DC) pension scheme. Empirically, most PAYG systems, as is the case in Germany, are of the mixed type, i.e. benefits as well as contribution payments are adjusted according to demographic changes.

[5] We will presume this throughout the paper unless stated differently.

According to the definition of future GAs and their calculation, namely as a residual of the government's intertemporal budget constraint, it follows that our pseudo GA is identical to the true GA.

Finally we remain with embedding the production sector into our framework. We assume the production sector to be characterized by a simple Cobb-Douglas environment and perfect competition. The production per capita depends on the capital intensity where the parameter α is the production elasticity of capital

$$y_t = (k_t)^\alpha \tag{6}$$

$$w_t = (1-\alpha)k_t^\alpha \tag{7}$$

$$r_t = \alpha k_t^{\alpha-1}. \tag{8}$$

The capital market equilibrium condition is given by

$$k_{t+1} = \frac{s_t}{1+n_{t+1}}. \tag{9}$$

3 Voting Behavior

The decision rule used in the political process is as follows: At the beginning of each period, the respectively young generation decides upon the pension payment it will receive when old. In other words, in the first period of life young individuals have to pay a contribution payment to social security they cannot decide upon, i.e. they have to take the retirement benefit of the currently old as given. The voting process only concerns the pension payments that young individuals will themselves receive when old. This decision rule seems a good mapping for empirical observations since it allows firstly to give consideration to the time delay in law making and secondly to account for the fact that retirees are protected by their legitimate expectations of receiving a certain retirement benefit.

Being primarily interested in the voting behavior during a demographic transition and wanting to keep the model simple at the same time, we have a shortcoming in the stability of the PAYG-system in case of a constant population growth rate. In other words, to reach a stable steady state we need to impose a restriction on young individuals of the kind that they cannot vote.[6] Hence, during a period of constant

[6] To achieve a stability of the PAYG-system in case of a constant population growth rate and to give individuals the possibility to vote at the same time a model of e.g. heterogeneous individuals would be needed.

population growth individuals have no possibility of enlarging or downsizing their own pension payments compared to what the generation preceding them received, thus retaining the size of the social security system. If there is a change in population growth however individuals are completely free in their course of action. A demographic shock, whether positive or negative, breaks the constraint and young individuals can decide upon their retirement benefit entirely independent of the current pension level. We can thus formulate the restriction mechanism for an individual of generation N_t considering the vote on P_{t+1} in period t as

$$P_{t+1} \begin{cases} = P_t, & \text{iff } n_{t+1} = n_t, \\ \gtreqless P_t, & \text{iff else,} \end{cases} \tag{10}$$

whereby $P_t \in [0, P^{max}]$ must of course still hold.

In case of a demographic shock, no matter whether in terms of a rise or a drop in fertility, conventional models with purely selfish individuals would now suggest that a utility maximizing individual of generation N_t will vote for a retirement benefit in period $t+1$ of $P_{t+1} = P^{max}$. Thus, purely self-interested individuals will in all cases enlarge the pension scheme to its maximum. In our fairness model, on the other hand, we want to illustrate the following voting behavior: If there is a drop in population growth in period $t+1$, fair young individuals of generation N_t choose $P_{t+1} < P_t$. In other words, inequity averse agents cut their own pension payment because they are now willing to sacrifice a part of their own retirement benefit to prevent the succeeding generation from having to contribute a considerably higher net social security payment than they themselves have to. The analogous behavior can be observed in case of a fertility rise. Individuals of generation N_t will vote for $P_{t+1} > P_t$, whereby $P_{t+1} < P^{max}$ (contrary to conventional models), thus forcing their offspring to adjust their contributions according to the demographic boom.[7]

We now want to analyze the optimal voting behavior of a young individual of generation N_t. The maximization problem is thus given by

$$\max_{P_{t+1}} V(w_t, r_{t+1}, B_t, P_{t+1}) \quad \text{s.t.} \quad P_{t+1} \begin{cases} = P_t, & \text{iff } n_{t+1} = n_t, \\ \gtreqless P_t, & \text{iff } n_{t+1} \neq n_t. \end{cases} \tag{11}$$

Since each individual can foresee whether there is a demographic shock or not, we have to consider two cases. The first case, namely that of no demographic shock or rather a constant population growth, is clear-cut, as it is straightforward that $P_{t+1} = P_t$. As

[7] Note that this voting behavior is independent of the underlying assumption of whether we are in a dynamically efficient or inefficient economy. Thus, as will be seen later on, we may end up with suboptimal outcomes.

mentioned above we need this assumption so as to avoid having an unstable steady state.

Let us now consider the more interesting case of a demographic shock. Here, there is no restriction for voting on P_{t+1} whatsoever. Hence, maximizing the indirect utility function with respect to the pension level P_{t+1} yields

$$\frac{\partial V_t}{\partial P_{t+1}} = \frac{\gamma}{R_{t+1}s_t + P_{t+1}} - \frac{2\beta}{1+n_{t+1}}\left(\frac{P_{t+1}}{1+n_{t+1}} - \frac{P_t}{1+n_t}\right) = 0. \tag{12}$$

Equation (12) illustrates the trade-off between self-interest and fairness. Let us consider the case of a fertility decline e.g.: Starting from P_t a reduction in P_{t+1} enhances marginal utility from consumption in old-age more than it reduces marginal disutility from an "unfair" situation. The individuals reduce P_{t+1} until marginal utility and disutility are equal. Where exactly this point of interception lies crucially depends on how fair the individuals are, i.e. how big β is.

Rearranging (12) and solving for the pension level P_{t+1}, the optimal retirement benefit for generation t in old-age, i.e. in period $t+1$, is given by

$$\begin{aligned} P^*_{t+1} =& \frac{1}{2}\sqrt{\left[R_{t+1}\left(w_t - \frac{P_t}{1+n_t}\right) + \frac{1+n_{t+1}}{1+n_t}P_t\right]^2 + \frac{2}{\beta}(1+\gamma)(1+n_{t+1})^2} \\ & - \frac{1}{2}\left[R_{t+1}\left(w_t - \frac{P_t}{1+n_t}\right) - \frac{1+n_{t+1}}{1+n_t}P_t\right]. \end{aligned} \tag{13}$$

In the following section we want to look at some comparative statics for this second case of a change in the population growth rate and the optimal retirement benefit P^*_{t+1} resulting therefrom.

4 Comparative Statics and the Cutting of Generosity

How does a change in the population growth rate and thus a change in the current and the future old-age dependency ratio (OAD) influence the optimal choice of P^*_{t+1}? And what is the implication of the fairness variable β on P^*_{t+1}? We are going to proceed by doing some comparative statics before then turning to the case of a drop in fertility and its impact on P^*_{t+1}.

Defining all individuals aged 60 and above as old and all other individuals as young, $\frac{1}{(1+n_{t+1})}$ can be interpreted as the OAD because $\frac{N_t}{N_{t+1}}$ is equivalent to the ratio of the population 60+/population 59–. Thus regarding a change of n_{t+1} is equivalent to regarding a change in the future OAD. Since an individual of generation N_t chooses the size of P^*_{t+1} according to a change in fertility rate n_{t+1}, we are especially interested in what way this affects the retirement benefit P^*_{t+1}. Differentiating equation (13) for the future OAD, thus for n_{t+1} yields

$$\frac{\partial P^*_{t+1}}{\partial n_{t+1}} > 0 \quad \Longleftrightarrow \quad \frac{\partial P^*_{t+1}}{\partial OAD_{t+1}} < 0. \tag{14}$$

A rise (drop) in the future OAD is associated with a negative (positive) impact on generosity of the pension benefit P^*_{t+1}. Examining the effect of the current OAD and thus n_t on P_{t+1} is however not as clear-cut. The sign of $\frac{\partial P^*_{t+1}}{\partial n_t}$ or rather $\frac{\partial P^*_{t+1}}{\partial OAD_t}$ is ambiguous for $r_{t+1} > n_{t+1}$.[8]

Differentiating equation (13) with respect to β yields

$$\frac{\partial P^*_{t+1}}{\partial \beta} < 0. \tag{15}$$

The more inequity averse the agents are, i.e. the higher β, the more the individuals will adjust their own pension payment due to a demographic shock. In case of a positive demographic shock, i.e. $n_{t+1} > n_t$, we have

$$\lim_{\beta \to 0} P^*_{t+1} \to P^{max} \qquad \text{and} \qquad \lim_{\beta \to \infty} P^*_{t+1} \to a, \tag{16}$$

with $a \in \mathbb{R}^+$ and $a > P_t$. The latter condition illustrates that in case of a rise in fertility, young individuals will never vote for $P^*_{t+1} < P_t$, no matter how fair they are. This is straightforward, as there would not only be a fall in utility due to a lower old-age income but also due to the fact that the inequity aversion would rise. On the other hand, fair individuals would – unlike conventional models suggest – also not necessarily vote for a retirement benefit $P^*_{t+1} = P^{max}$ even if $n_{t+1} > n_t$, since they in turn suffer a disutility if the succeeding generation has higher net payments to the PAYG pension scheme than they themselves have.

For the case of a negative fertility shock, the fairness variable has the following implications on P^*_{t+1}

$$\lim_{\beta \to 0} P^*_{t+1} \to P^{max} \qquad \text{and} \qquad \lim_{\beta \to \infty} P^*_{t+1} \to b, \tag{17}$$

with $b \in \mathbb{R}^+$ and $b < P_t$. The latter condition now illustrates that individuals have to be fair to a certain degree for them to vote for $P^*_{t+1} < P_t$. Accordingly, in case there is

[8] For $r_{t+1} \leq n_{t+1}$ we have $\frac{\partial P^*_{t+1}}{\partial n_t} < 0 \iff \frac{\partial P^*_{t+1}}{\partial OAD_t} > 0$. In other words, a rise in the current OAD is associated with a positive impact for the choice over the retirement benefit P^*_{t+1}. The simulation in section 5 shows that in case $r_{t+1} > n_{t+1}$ the effects of OAD_t on P^*_{t+1} are positive.

a drop in the population growth rate, we have to earmark a "break-even" β (β^B). In other words, only if individuals are "fair enough", i.e. $\beta > \beta^B$, they will reduce their own pension transfer and thus partially phase out social security. This is clear, as the disutility from a reduced old-age income has to be outweighed by the inequity aversion. Before proceeding, we have to define a β for which $P^*_{t+1} < P_t$ so as to determine from when on it is utility maximizing for individuals to cut the generosity of their PAYG old-age income. Thus, we get

$$P^*_{t+1} < P_t$$
$$\Longleftrightarrow$$
$$\beta > \frac{(1+\gamma)(1+n_t)(1+n_{t+1})^2}{2P_t\left[(n_t - n_{t+1})\left(P_t + R_{t+1}w_t\right) - \frac{n_t - n_{t+1}}{1+n_t}R_{t+1}P_t\right]}. \tag{18}$$

From this equation we obtain $\frac{\partial\beta}{\partial n_{t+1}} > 0$. The greater the drop in fertility, or rather the bigger the future OAD, the less fair the individuals have to be in order for them to reduce their retirement benefits, as the marginal disutility from unequal GAs rises (see equation 12). Therewith β^B decreases. Again the effect of n_t on β is ambiguous and can only be solved in the simulation.

5 Simulation

We now want to demonstrate that our model of intergenerational fairness is a useful concept. This will be evaluated on the basis of what the costs of implementing fairness into the utility function are. In our simulation we derive these costs by using past data from public pension politics and by presuming that individual utility maximization was in conformity with empirically observed pension policy.[9] Surely this will overstate our results since individuals are most probably not fair to this extent, at least not to the extent the state would like them to be. Hence, the results derived here will serve as an upper bound for fairness costs in our case study. In this section we furthermore want to go into details of the consequences of different degrees of fairness on equalizing GAs and welfare.

For the purpose of illustrating the costs of fairness and the effects of adjusted GAs on welfare we are going to carry out a simulation. We therefore need to determine some parameter values. For the production elasticity of capital we set $\alpha = 0.25$. The variable γ, that discounts utility of the old-age period to the the working period, is set to 0.8. The parameters n_t and n_{t+1} are fixed to $n_t = 0.2$ and $n_{t+1} = 0$, which reflects

[9] The latter assumption arises from the fact that in pension politics individuals could not vote.

not only the quantitative population growth of the period between 1970 and 2000 and of the period between 2000 and 2030 in Germany, but also the annual growth rate of the labor-augmenting technical process. Finally, we need the appropriate contribution rate to the PAYG pension scheme. Setting this contribution rate to about 19 percent of the payroll we calculate an absolute retirement benefit of $P = 0.1$, which in turn equals a replacement rate ratio of 23 percent.[10]

What remains to be determined for the simulation is a parameter value for β, whereas we are going to take up the empirical observations in pension policy for this purpose: When looking at the past in German pension politics it becomes obvious that there has been a clear interference on the part of the state in terms of substantial cuts in generosity due to demographic changes. Borgmann and Heidler (2003) analyze these benefit rule changes enacted by the government. Regarding an average retirement period of 15 years Borgmann and Heidler (2003) assess an overall decline in pension generosity of 30 percent.[11] To fit our framework, i.e. a period of 30 years, these empirical observations are transformed into an overall decline in generosity of 15 percent. And presuming that the German pension policy was in fact in conformity with individual utility maximization, we have to set β to $\beta^e = 650$.

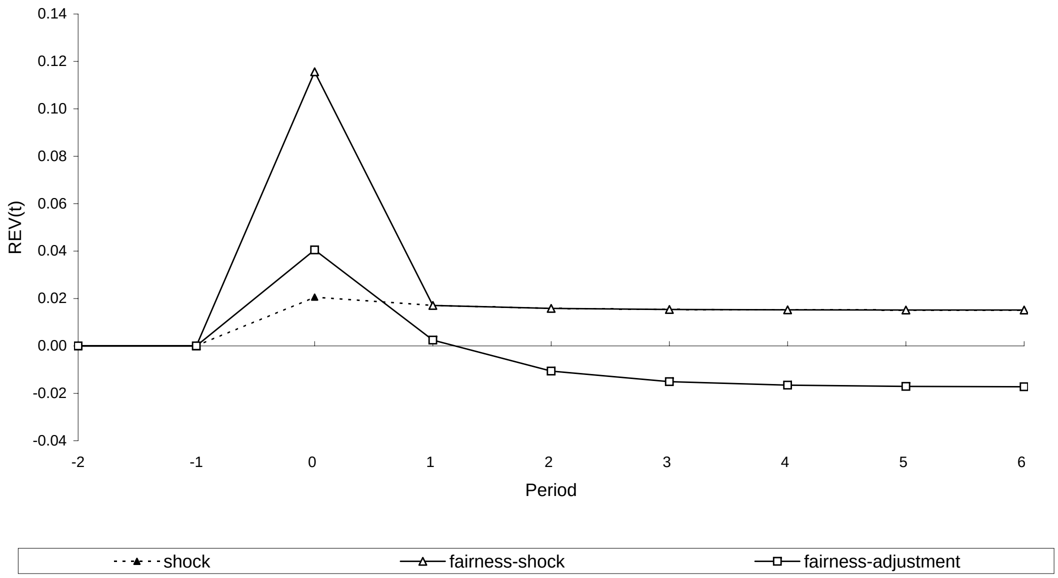
As fair behavior only occurs in case of a demographic change, it is the periods of transition that are of interest. For illustrative purposes we assume a constant population growth until period 0. Thereafter, i.e. period $t = 1$, we assume a negative demographic shock. In order to determine the costs of fairness, we are going to attribute different levels of inequity aversion to an individual of generation N_0. We either regard the individual to be purely selfish, i.e. $\beta = 0$, in a scenario s ("shock") or we consider the individual to be fair, thus adjusting his retirement benefits according to the above denoted $\beta^e = 650$ in the scenario *fa* ("fairness-adjustment"). In a third scenario, scenario *fs* ("fairness-shock"), we want to observe the same fair individual, but for the case he is not able to adjust his pension payments.

In all three scenarios, the drop in fertility in period 0 instantly leads to an enhancement in capital accumulation which entails an increase in output per capita (6) and in wages (7) and a decrease in interest rates (8). In consequence, the individual – when old – will in all cases be burdened by the fall in interest rates since it decreases the returns on his savings. In the "fairness-shock" scenario however, this individual is additionally burdened by the inequality in GAs: $\beta^e[\frac{P_0}{1+n_1} - \frac{P_0}{1+n_0}]^2$ as he cannot adapt

[10] These parameter values resemble those of Raffelhüschen and Risa (1997), since we want to refer to their paper later on. We have however updated the population projection as well as the contribution rate.

[11] We want to remark that this decline in generosity does not apply to all paths into retirement, e.g. paths into retirement due to unemployment and part-time work are not included. Hence, the decline of 30 percent must be seen as an upper bound.

Figure 1: Relative equivalent variation in transition



his pension payment to the demographic shock. In contrast to this, the individual in the "fairness-adjustment" scenario hardly has a disutility through differing GAs, but he is burdened by the reduction in old-age consumption ($P_1 < P_0$) as well as by additional repercussion effects triggered through this adjustment: As saving is augmented by $P_1 < P_0$ and this additionally enhances capital accumulation, the fall in interest rates is exacerbated, thus decreasing the returns on his savings.

The respective welfare burdens can be measured as relative equivalent variations (REV), which capture changes in utility in life-cycle earnings over the transition. In other words, we determine the difference between the individual's utility from one of the above mentioned scenarios and the initial level of utility. The latter is indicated by $\bar{V}$, which represents the utility the individual would have realized in the absence of the demographic decline. Hence, we have

$$REV_t^{scen} = \frac{e(V_t^{scen}) - e(\bar{V})}{e(\bar{V})}, \tag{19}$$

with $e(\cdot)$ denoting an expenditure function and $scen$ denoting the scenarios "shock", "fairness-shock" and "fairness-adjustment". On the basis of REV, each of the three scenarios – illustrated in figure 1 – defines what is needed in monetary terms to make the individual have the same utility as in the initial situation.

One way of assessing the actual costs of fairness now is to examine the difference between the REV of scenario "fairness-shock" and that of "shock", which accounts for the disutility that arises by implementing fairness into the individual utility function. In the illustrated example, these costs range around 10.8 percent of the life-cycle income. This being so expensive must be ascribed to the fact that the equalization of the GAs has to be worth something to the individual, as he would otherwise not accept the reduction in old-age income. In other words, the costs of 10.8 percent illustrate how fair the individual has to be in order for him to adjust pensions according to the empirical value. If the individual is not able to adjust retirement benefits, it is clear that he is in turn hit hard. Considering the case in which the fair individual can adjust his pension benefit, the adequacy of our model seems reinforced for these cost reduce to 2.2 percent of the income. This is calculated as $REV_0^{fa} - REV_0^s$ and reflects how much the individual is worse off by acting fairly compared to a situation where the individual has to bear solely the demographic shock and its consequences. Recalling that we are looking at an upper bound for the costs of fairness, these are not so high so as to reject this modification of individual utility.

A measure for the degree of equalized GAs is π, with $\pi = \frac{GA_{t,t+1}}{GA_{t,t}}$.[12] If $\pi = 1$ we have a perfect equalization and all generations bear the same net payments. However if $\pi > 1$, there is an additional burden on future generations. Looking at either the "shock" or the "fairness-shock" scenario from above, we have $\pi^s = 1.41$, indicating that consumption opportunities of future generations are reduced in favor of the current living generation. The "fairness-adjustment" scenario implicates $\pi^e \approx 1$, thus preventing shifts in consumption opportunities. A crucial point can be made from this, namely that fair individuals not only adjust or want to adjust GAs during demographic transition, but also enhance their utility by doing so. In other words, cutting generosity due to a drop in fertility not only increases utility of future generations, since $r > n$, but also – and this is decisive – the utility of the transition generation, as $V_0^{fa} > V_0^{fs}$ (see figure 1). Put differently, fairness can eliminate the trade-off between the short-term, i.e. the utility of the transition generation, and the long-term, i.e. the utility of future generations. Thus, the actions of individuals – at least to a certain extent – are in conformity with the actions of a social planner.

Let us briefly pick up on the work of Raffelhüschen and Risa (1997) in this context to point out on the differing results. Assuming $r > n$, Raffelhüschen and Risa (1997) analyze whether GAs are an appropriate indicator for welfare judgements and demonstrate on the assumption of a demographic aging shock that policy recommendations based on GAs can either be time inconsistent or welfare decreasing. In other words, changes of GAs do not seem a good measure for changes of generational welfare. The reason for this becomes obvious when looking at the (not fair) transition generation. This generation is hit not only by the equalization of the GAs but also by the additional

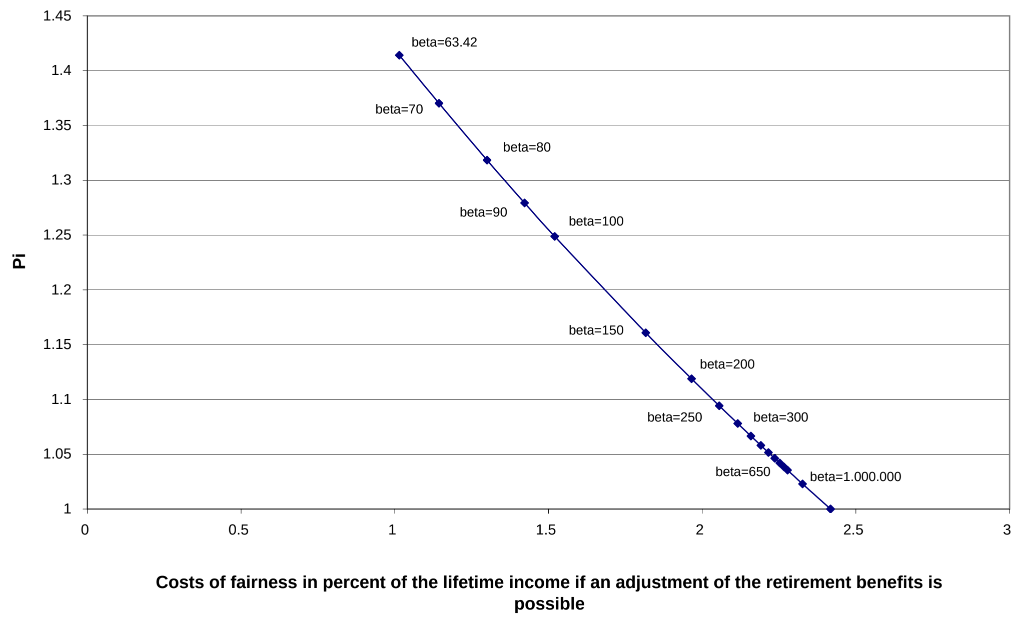
[12] The way we defined $GA_{t,t+1}$ above implicates that we evaluate this GA in $t = 0$.

(negative) repercussion effects caused by the adaption of the pensions. Both effects can be captured in a mere scenario "adjustment" which however is equivalent to the here depicted scenario "fairness-adjustment", since $\pi^e \approx 1$. Note that a perfect equalization implicates a fairness term of zero. According to Raffelhüschen and Risa (1997) a policy of adjusting the social security system to demographic changes is recommendable in the long-run, however it is to reject in the short-run as the transition generation is worse off. Comparing our results to the results of Raffelhüschen and Risa (1997), we observe that during transition fair individuals can enhance their utility by $REV_0^{fs} - REV_0^{fa}$ through equalizing GAs, whereas purely selfish individuals, as shown by Raffelhüschen and Risa (1997), experience a reduction in utility of $REV_0^{fa} - REV_0^{s}$.

We now turn to examining the coherence of different degrees of fairness on equalizing GAs and welfare. This is certainly of interest as one could argue that the degree of fairness implemented above ($\beta^e = 650$), or rather the costs arising therewith (2.2 percent of the lifetime income), is/are unrealistically high. Even though the assumption of individuals being inequity averse is a good mapping for empirically observable behavior it is more realistic to presume that individuals are only fair according to β^i, with $\beta^i < \beta^e$. Consequently individuals will put less weight on equalizing GAs, thus valuing consumption in old-age relatively more. Figure 2 displays the relationship between different degrees of fairness and the extent of equalizing GAs, whereby it is straightforward that $\beta^B < \beta^i < \beta^e \Rightarrow \pi^s > \pi^i > \pi^e$. Since the individuals have to be fair at least according to β^B, as only in this case $P_1 < P_0$, the run of the curve takes the costs that arise with $\beta^B = 63.42$ as a starting point. These range around one percent of life-cycle income and accordingly we have $\pi^s = 1.41$. Moving onward from there, relatively small changes in β bring about relatively big changes in π and in the costs of fairness. However, the bigger β gets, the smaller the effects on the costs and on π. All in all, infinite values of β bring about a perfect equalization, i.e. $\pi = 1$, and costs of 2.4 percent of the income at most. The reason for this is that with an increasing adjustment of the GAs due to the weighting parameter β the fairness term becomes continuously smaller and finally – in case of a perfect equalization – equals zero. Then, the only costs remaining arise from the reduction in old-age income and from additional repercussion effects. In other words, there is no more disutility triggered through the inequity aversion and thus no more direct costs of fairness. We want to particularly remark on the situation where individuals are fair but cannot adjust their retirement benefit. In this case being intergenerationally fair can cause great disutility, which is *not* upwardly bounded.

Finally the following question remains to be answered: Under what circumstances can sustainable politics in terms of equalized GAs as well as welfare increasing policy

Figure 2: Coherence of the degree of fairness and the equalization of GAs



actions be transmitted into individual behavior? Although the fairness construction seems to bring about a valuable extension of individual utility, it is nonetheless not an all-embracing instrument to an extent that it could substitute a social planner.[13] In other words, special circumstances are needed in order for fair individuals to not only act optimally on an individual level but also to act optimally on a welfare basis. The following two conditions have to hold: First, the economy must be dynamically efficient (inefficient), i.e. $r > n$ ($r < n$), and secondly, there must be a drop (rise) in fertility, this not altering the efficiency of the economy. Only if both criteria are fulfilled, the social planner on the one hand need not intervene, because individuals will act in his spirit. He on the other hand should not intervene, e.g. by trying to impose a different degree of equalized GAs as the individuals chose it, since they would then again suffer a disutility. In the latter case the argument of Raffelhüschen and Risa (1997) would apply, thus again having the trade-off in current and future utility.

[13]To pick up on the work of Raffelhüschen and Risa (1997) again, one can think of the social planner evaluating current and future utility using a Benthamite welfare function.

6 Conclusion

By implementing intergenerational fairness into a model of political economy, we have found a way of extending the individual utility function, thereby being able to outline adjustments that individuals would enforce during a period of demographic transition. As most countries are today facing a demographic aging process, we were especially interested in the case of a fertility decline and the thus resulting individual behavior pattern. We demonstrated that cuttings in the generosity of the benefit rule can by all means be optimal for an inequity averse individual.

Transforming past empirical observations of the German pension scheme into our framework and by assuming that these institutionally determined changes were in conformity with individual utility maximization we calculated the actual costs of implementing fairness into utility. As it turned out, these – although depicting an upper bound – are not so high as to reject this concept. What is more, the implementation of fairness can overcome the trade-off between current and future utility or rather between individually optimal and welfare optimal action. Thus, we have outlined a behavior pattern where – under the conditions defined above – an individual operates in conformity with the social planner.

In contrast to other models of political economy, we have established a relationship between the future ageing structure and the size of the PAYG pension system. In our opinion, the often feared increase in the old-age dependency ratio is no problem for social security systems, since fair individuals will – although having only a marginal influence on the benefit rule in reality – put forth necessary alterations of a PAYG pension system. And assuming individuals to be intergenerationally fair most probably reflects reality better than one might think at the first glance. Yet we have to acknowledge that, empirically, it might be difficult to distill the notion of "fairness" from the various complex factors that influence individual preferences and thus future pension policy.

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