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Intergenerational Fairness During Demographic Transition

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DISKUSSIONSBEITRÄGE

DISCUSSION PAPERS

**Intergenerational Fairness During
Demographic Transition**

**Jasmin Häcker
Matthias Heidler**

121/04

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Intergenerational Fairness During Demographic Transition

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Preliminary Version

Abstract

Using the results of Borgmann and Heidler (2003), we attempt to explain why young generations cut their own retirement benefits. Driven by rising future old-age dependency ratios they partially phase out social security. We capture this behavior by implementing a fairness component into a model of political economy. Moreover, we show that if individuals care about intergenerational fairness during a demographic transition, then generational accounts can by all means be an appropriate indicator for welfare judgements. Thus, an equalization of generational accounts can – contrary to the statement of Raffelhüschen and Risa (1997) – certainly serve as a valuable policy recommendation.

JEL classification: H55; D63

Keywords: intergenerational fairness, social security, political economy, demography

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1 Introduction

This paper has as its starting point the work of Borgmann and Heidler (2003) regarding benefit rule changes of social security wealth in Germany. They use the indicator of relative generosity of the pension scheme to show that substantial cuts in generosity of the German pension scheme have taken place since the end of the 1970's. By estimating a policy reaction function for the relative generosity, Borgmann and Heidler (2003) find that changes in the benefit formula can largely be ascribed to the *future* level of the old-age dependency ratio. In other words, increases in the future old-age dependency ratio reduce the generosity of the pension scheme. These results suggest that the German benefit rule is subject to a kind of implicit demographic factor. Within the framework of this paper, we want to explain this phenomenon considering a model of political economy with intergenerational fairness.

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, the equity approach may be more appropriate to actually describe the social motivation of individuals. 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. Within the framework of this paper we take up exactly this idea and apply it to a two overlapping generations model, now considering intergenerational fairness.¹ We assume that a generation t suffers a negative utility if the net contribution payment to the pay-as-you-go (PAYG) pension scheme deviates from that of the following generation. In other words, instead of selfishly maximizing his lifetime consumption, a representative individual of a generation t cares for differences in net 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 of generation t 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.

In this context, we want to pick up on the often discussed question whether genera-

¹To our knowledge, there are no papers dealing with intergenerational fairness so far, whereas there are papers regarding intragenerational fairness.

tional accounts are a good measure for policy recommendations or not. Thus, we refer to the results of Raffelhüschen and Risa (1997) who state that policy recommendations based on generational accounts can be welfare decreasing. By making individuals benevolent or rather "fair", i.e. caring about differences in social security net payments, we show that they are willing to give up a part of their retirement benefits in order to equalize generational accounts, thereby accepting (negative) repercussion effects triggered by the equalization process. Already at this point we want to emphasize that implementing fairness into individual utility is not accompanied by extensive "costs". Only about three percent of the income actually has to be assigned to our fairness construction. Moreover, it will be shown that the equalization of generational accounts reduces these costs by half.

The paper is organized as follows: Section 2 presents a model of political economy with intergenerational fairness in which the basic implications of fairness are demonstrated in a small open economy. By taking up the results of Borgmann and Heidler (2003), we conclude that fairness is to all intents and purposes a plausible way of explaining past empirical observations and thus future preferences and behavior. In section 3, we embed the model into a closed economy framework and carry out a simulation. In this context we refer to and comment on the results of Raffelhüschen and Risa (1997). Finally, section 4 concludes.

2 A model of intergenerational fairness

We concentrate on a standard overlapping generations framework with two generations and, for now, survey a small open economy, assuming all prices to be exogenous. Each generation $t(t = 0, 1, \dots)$ consists of $N_t \in \mathbb{N}$ identical individuals each of whom lives for two periods. Population growth from any period t to period $t + 1$ is given by $N_{t+1} = (1 + n_{t+1})N_t$. During the first period, the working age, each representative young individual inelastically supplies one unit of labor² 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 for retirement, his second period of life. During old age each retiree receives a pension P_{t+1} .³ Members of generation t derive utility from consumption c_t^1 during youth and consumption c_{t+1}^2 in old age. The

²Our simplifying assumption of a rigid labor supply does not conform to the line of argument Fehr and Kotlikoff (1996) use on the question whether generational accounts are suitable for welfare implications. Fehr and Kotlikoff (1996) presume individuals to react to changes in net social security payments.

³ B_t and P_{t+1} should be decomposed to $B_t = b_t w_t$ and $P_{t+1} = \pi_{t+1} w_t$, in order to work with contribution and replacement rate ratios. Since generational accounts, however, do not comprehend changes in wages, i.e. w_t is treated as a constant, we refer to B_t and P_{t+1} for simplicity of notation.

budget constraints for these two periods in the life of a member of generation t are

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

with $R_{t+1} \equiv 1 + r_{t+1}$. 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 Disregarding both other than PAYG public expenditure and initial public dept, the governmental budget constraint is given by $N_t B_t = N_{t-1} P_t$. Rearranging this equation yields the contribution payment of a young individual at the beginning of period t , namely $B_t = \frac{P_t}{(1+n_t)}$.

We now remain with incorporating a fairness function into individual preferences. What does the fairness function look like? An inequity aversion arises if the present value of the net PAYG payments of two succeeding generations differs, whereby the net social security payment can be interpreted as a generational account (GA) and thus be written as $GA_{t,t} = B_t - \frac{P_{t+1}}{R_t}$, with the first index indicating the generation and the second index denoting the period of consideration. Assuming a dynamically efficient economy, where the market interest rate exceeds the growth rate of the population, the GA of a generation t in period t is positive. Since for an individual of generation t every inequality compared to an individual of generation $t+1$ matters (whether advantageous or disadvantageous), we use a quadratic function mapping intergenerational fairness in order to capture positive as well as negative deviations in the GAs.⁵ We can thus formulate individual lifetime utility, which captures the trade-off between pure self-interest and fairness, as

$$U_t = \ln(c_t^1) + \gamma \ln(c_{t+1}^2) - \beta_t \cdot \left[\mu GA_{t+1,t} - \nu GA_{t,t} \right]^2 \quad (2)$$

with the variable γ discounting future utility to the current period.⁶ The variable $\beta_t > 0$ rules out purely selfish individuals, and the higher β_t , the more inequity averse the individuals. The fairness component altogether gives the loss in the utility of generation t , if individuals of generation t and $t+1$ are not equal in their generational accounts. Besides, μ and ν give the importance of one's own generational account

⁴The 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.

⁵Since we do not compare purely monetary payments as Fehr and Schmidt (1999) do, we can without hesitation implement a nonlinear fairness function in utility, thus simplifying optimization.

⁶Clearly, choosing GAs as a means for valuing fairness is an arbitrary choice. But for an individual it is less expensive to evaluate GAs than e.g. lifetime consumption or utility levels, since the individual only has to take future demographic development into consideration and avoids the costs of information gathering for comparing life-cycle consumption or utilities.

compared to the one of an individual of the succeeding generation. For simplicity, we further assume that $\mu = \nu = 1$.

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 of the currently old generation and therewith the contribution it has to pay in its working period as well as on the pension payment it will receive when old. Take the beginning of period t for example as the point in time where P^0 illustrates the retirement benefit of the PAYG pension system for generation $t - 1$. The young generation t in period t now has two options. Either it can vote for $\frac{P^0}{(1+n_t)}$, i.e. maintaining the initial size of the social security system, and likewise receive P^0 when old. Or it can decide upon a higher tax $\frac{P_t^t}{(1+n_t)} > \frac{P^0}{(1+n_t)}$, thus extending the PAYG pension scheme, and likewise receiving the higher retirement benefit $P_{t+1}^t > P^0$ when old.⁷ But the latter is only rational if the economy is dynamically inefficient. In this case the individuals would support or even enlarge a PAYG system because the implicit return from the system is larger than the real return from private savings. However, in the realistic case of dynamic efficiency – and that is what we have assumed – the young generation t would prefer to cut the PAYG financed pension scheme, i.e. it would vote for a contribution payment $\frac{P_t^t}{1+n_t} < \frac{P^0}{1+n_t}$. However, this is not possible if we presume the old generation $t - 1$ to be protected by legitimate expectation of a certain retirement benefit. In other words, the young generation t simply has to take the retirement benefit of the old generation, namely P^0 , as a lower bound, i.e. it has to settle on a contribution payment of $\frac{P_t^t}{1+n_t} \geq \frac{P^0}{1+n_t}$. For the decision regarding retirement benefits, conventional models with purely selfish individuals would now suggest that a utility maximizing individual of generation t will consequently vote for a retirement benefit in period $t+1$ of $P_{t+1}^t = P^0$. Thus, purely self-interested individuals will in all cases maintain the DB-scheme. In our fairness model, on the other hand, we want to illustrate the following voting behavior: If the population grows at a constant rate n , then the initially implemented PAYG pension system is maintained. However, if there is a drop in fertility in period $t + 1$ for example, i.e. the economy is thrown out of steady state, fair young individuals of generation t choose $P_{t+1}^t < P^0$. 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 higher net social security payment than they themselves have to. Hence, we want to analyze the transition from the initial steady state, characterized by a constant population growth rate n and a pension payment P^0 to a new steady state confronted with a smaller population growth rate and, in case of fair individuals, a reduction in

⁷The upper index denotes the voting generation, the lower index denotes the period in which the retirement benefit is paid.

social security.

Writing out the generational accounts, the utility function of a representative individual of generation t changes to

$$\begin{aligned} U_t &= \ln(c_t^1) + \gamma \ln(c_{t+1}^2) - \beta_t \left[\left(B_{t+1} - \frac{P_{t+2}}{R_t} \right) - \left(B_t - \frac{P_{t+1}}{R_t} \right) \right]^2 \\ &= \ln(c_t^1) + \gamma \ln(c_{t+1}^2) - \beta_t \left[\left(\frac{P_{t+1}}{1+n_{t+1}} - \frac{P_{t+2}}{R_t} \right) - \left(\frac{P_t}{1+n} - \frac{P_{t+1}}{R_t} \right) \right]^2. \end{aligned} \quad (3)$$

For discounting the GAs, we use the same interest rate for both generation t and generation $t + 1$ for two reasons: First, fairness is not supposed to depend on how future generations discount their own retirement benefit. It is solely of interest how present generations value future pension payments. Secondly, the use of generational accounts necessitates a single interest rate, namely the interest rate of the base year t .

For analyzing the transition from the initial steady state to a new steady state, we consider the fertility decline to be in period $t + 1$ and thus the new steady state population growth rate is given by $n_{t+1} < n$. We focus on a symmetrical solution, i.e. all generations behave in the same way, taking the decisions of all previous and all succeeding generations as given. To economize on notation, we omit generation subscripts where possible. Let us first look at the initial steady state. The initial steady state is characterized by the retirement benefit P^0 , with $P^0 \in (0, w_\tau)$. Let us briefly describe why the choice of P^0 is optimal for a steady state individual: In the beginning of period $t - 1$, generation $t - 1$ votes over the contribution payment $\frac{P_{t-1}^{t-1}}{(1+n)}$ as well as over the retirement benefit P_t^{t-1} . Keeping in mind that the old generation in $t - 1$ is under the protection of legitimate expectations, an individual of generation $t - 1$ has to take the contribution payment $\frac{P^0}{(1+n)}$ as given. Hence he is left with maximizing utility over retirement benefit P_t^{t-1} . In steady state, here a situation with a constant population growth rate n , the fairness function is zero. Thus, the utility function of all steady state individuals is reduced to $U_\tau = \ln(c_\tau^1) + \gamma \ln(c_{\tau+1}^2)$, for $\tau = -\infty, \dots, t - 1$. Since an individual of generation $t - 1$ is upwardly restricted to $P_t^{t-1} \leq P_{t-1}^{t-1}$ for his retirement benefit, maximizing lifetime utility yields the pension level P_τ

$$P_\tau^* = P^0 = \arg \max_{P_\tau} U_\tau. \quad (4)$$

As we assume generation t to be the transition generation, we stipulate a demographic shock in period $t + 1$. Hence, from period $t + 1$ onward the population growth rate is given by n_{t+1} with $n_{t+1} < n$. One result Borgmann and Heidler (2003) mention is that the future old-age dependency ratio (OAD), i.e. $\frac{1}{(1+n_{t+1})}$, has a negative

impact on generosity, whereas the present OAD, i.e. $\frac{1}{(1+n_t)}$, has a positive influence.⁸ Taken together, the positive influence of the current OAD is eventually outweighed by the negative influence of the future OAD on generosity. Since our decision rule does not allow individuals to explicitly implement today's OAD into their own retirement benefit decision, they can only account for the difference in the OADs, but this fact states nothing else than that the future OAD outweighs the current OAD.

We now want to show that this fertility decline is accompanied by $P_{t+1} < P^0$, if individuals are fair. Accounting for the fact that, due to the demographic transition, the fairness condition now enters the utility function, equation 3 can be rewritten as

$$U_t = \ln(c_t^1) + \gamma \ln(c_{t+1}^2) - \beta_t \left[\frac{P_{t+1}}{1+n_{t+1}} - \frac{P^0}{1+n} \right]^2. \quad (5)$$

Given that $n_{t+1} = n_{t+2} = \dots = n_\infty$, i.e. a permanently lower fertility rate, it follows from the fixed capital stock assumption that we are instantly in a new steady state, hence $P_{t+2} = P_{t+1}$. Equation 5 illustrates the trade-off between self-interest and fairness: utility is always enhanced by a higher retirement benefit in old-age, but it is reduced by the fact that the generational accounts differ, i.e. the net social security payment of the succeeding generation $t+1$ is higher because of the higher contribution payment which is induced by the DB-scheme in case of a decline in cohort size. To find the optimal pension policy, we take the first derivative of the utility function with respect to the pension level P_{t+1} . Note that consumption of the first period is a constant

$$\frac{\partial U_t}{\partial P_{t+1}} = \frac{\gamma}{R_{t+1}s_t + P_{t+1}} - \frac{2\beta_t}{1+n_{t+1}} \left(\frac{P_{t+1}}{1+n_{t+1}} - \frac{P^0}{1+n} \right) = 0. \quad (6)$$

To solve for the pension level P_{t+1} , we have to solve a quadratic equation. The optimal pension level of generation t in old-age, i.e. in period $t+1$, is then – with respect to the optimal saving level – given by

$$P_{t+1}^* = \frac{1}{2} \sqrt{\left[R_{t+1} \left(w_t - \frac{P^0}{1+n} \right) + \frac{1+n_{t+1}}{1+n} P^0 \right]^2 + \frac{2}{\beta_t} (1+\gamma)(1+n_{t+1})^2} - \frac{1}{2} \left[R_{t+1} \left(w_t - \frac{P^0}{1+n} \right) - \frac{1+n_{t+1}}{1+n} P^0 \right]. \quad (7)$$

The pension payment P_{t+1}^* maximizes the utility of a representative individual of gen-

⁸If we define all individuals of age 60 and beyond as old and all individuals of age 59 and less as young, then $\frac{1}{(1+n_t)}$ can be interpreted as the old-age dependency ratio, because $\frac{N_{t-1}}{N_t}$ is equivalent to the ratio of the population 60+/population (30-59).

eration t . Solely from equation 7, it is not yet clear that $P_{t+1}^* < P^0$. Rather, an individual of generation t has to be fair to some degree in order to give up some part of his retirement benefit, thus obtaining more equitable generational accounts. Comparative static illustrates that $\frac{\partial P_{t+1}^*}{\partial \beta_t} < 0$. Hence we can state the following: If β_t is large enough, we can show that in case of a demographic decline, the individuals are willing to cut the generosity of their PAYG old-age income and thus partially phase out social security, without "hurting" other generations

$$P_{t+1}^* < P^0$$

$$\iff$$

$$\beta_t > \frac{(1 + \gamma)(1 + n)(1 + n_{t+1})^2}{2P^0 \left[(n - n_{t+1}) \left(P^0 + R_{t+1} w_t \right) - \frac{n - n_{t+1}}{1 + n} R_{t+1} P^0 \right]}. \quad (8)$$

Since it is rather difficult to interpret this inequation, we would like to refer the reader to section 3. For present purposes it is sufficient to note the following: Clearly the reduction in the retirement benefit P_{t+1} in period t leads to a burden on the individuals of generation t , as the GA of this generation increases. On the other hand, this decision behavior is to the benefit not only of generation $t + 1$ but to the benefit of all future generations, as $r > n$. Similar effects can be observed when evaluating generational welfare in the closed economy. There however, the utility effects of future generations are amplified by the repercussion effects associated with lower PAYG contributions relative to the DB-scenario. But before turning to the closed economy situation we want to look at some comparative statics first. We are especially interested in how the current and future OAD affects the retirement benefit P_{t+1} . Since we cannot directly differentiate for the respective OADs, we have to regard $\frac{\partial P_{t+1}^*}{\partial n} < 0$ which is tantamount to $\frac{\partial P_{t+1}^*}{\partial OAD_t} > 0$. In other words, a rise in the current OAD is associated with an increase in generosity. Accordingly we examine $\frac{\partial P_{t+1}^*}{\partial n_{t+1}} > 0$. This corresponds to $\frac{\partial P_{t+1}^*}{\partial OAD_{t+1}} < 0$, hence a rise in the future OAD is associated with a reduction in generosity. Furthermore, it is obvious that $\frac{\partial \beta_t}{\partial n_{t+1}} > 0$. 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 6). Therewith the "break-even" β_t decreases.

All in all, the demographic transition with permanently lower fertility rates will lead to a steady state with welfare levels that are lower than those of the initial steady state. However, given that the individuals are fair, the welfare level for future generations after the fertility decline is nevertheless higher than the level which purely selfish individuals would achieve, because phasing out a part of the PAYG system is always

utility enhancing in a dynamically efficient economy. Even the first fair transition generation is better off adjusting retirement benefits than not being fair and keeping the DB-scheme upright. So it seems that fairness is by all means a way of explaining the results of Borgmann and Heidler (2003), namely that due to increases in the future OAD, cuts in generosity of pension schemes take place – Borgmann and Heidler (2003) illustrate this for the case of Germany. With this result, we now want to turn to the closed economy. In this framework there will be other macroeconomic adjustments to the demographic transition and to the diminution of the social security system. We want to demonstrate that even with a variable capital stock it is utility maximizing for inequity averse individuals to reduce their retirement benefits in case of a demographic shock.

3 Implications of intergenerational fairness in a closed economy

Since the method of generational accounting has increasingly become an instrument in assessing fiscal policy, there have been several papers studying the coherence of policy actions based on GAs and welfare implications resulting from them. Amongst others, Raffelhüschen and Risa (1997) analyze whether GAs are an appropriate indicator for welfare judgements. They 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 are a bad measure for changes of generational welfare. In this section, we want to demonstrate that these results do not hold if individuals are not purely self-interested, but fair. This is obvious insofar as we implement an equalization factor into the utility function of individuals, thus making them benevolent. In other words, the benevolence which is normally only ascribed to the state now enters into the utility function of individuals.

So far we have assumed a small open economy with exogenously given factor prices. In this section, however, we also want to analyze the repercussion effects of a demographic shock on individuals. Hence the explicit adjustment function of capital is needed, so we integrate our model into a closed economy framework. In addition to this setting, we need to adjust our parameters to be able to numerically simulate this system through demographic transition between steady states. This simulation example will be the basis of our welfare judgement. In order to obtain realistic macroeconomic variables we need to calibrate our baseline parameters α , γ , n , n_{t+1} and P^0 .

The production sector is 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

$$y_t = (k_t)^\alpha \quad (9)$$

$$w_t = (1 - \alpha)k_t^\alpha \quad (10)$$

$$r_t = \alpha k_t^{\alpha-1}. \quad (11)$$

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 and n_{t+1} are fixed to $n = 0.2$ and $n_{t+1} = 0$, which reflects not only the quantitative population growth from the period between 1970 and 2000 and from 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 $P^0 = 0.1$, which in turn equals a replacement rate ratio of 23 percent.⁹

It is now the periods of transition that are of interest. The demographic shock, now set to be in period $t = 1$, instantly leads to an enhancement in capital accumulation, as can be seen from

$$k_1 = \frac{s_0}{1 + n_1}. \quad (12)$$

Besides the demographic shock, the fair individuals of generation 0, perfectly anticipating the fertility decline, react utility maximizing by voting for P_1 and at the same time augmenting their private savings¹⁰

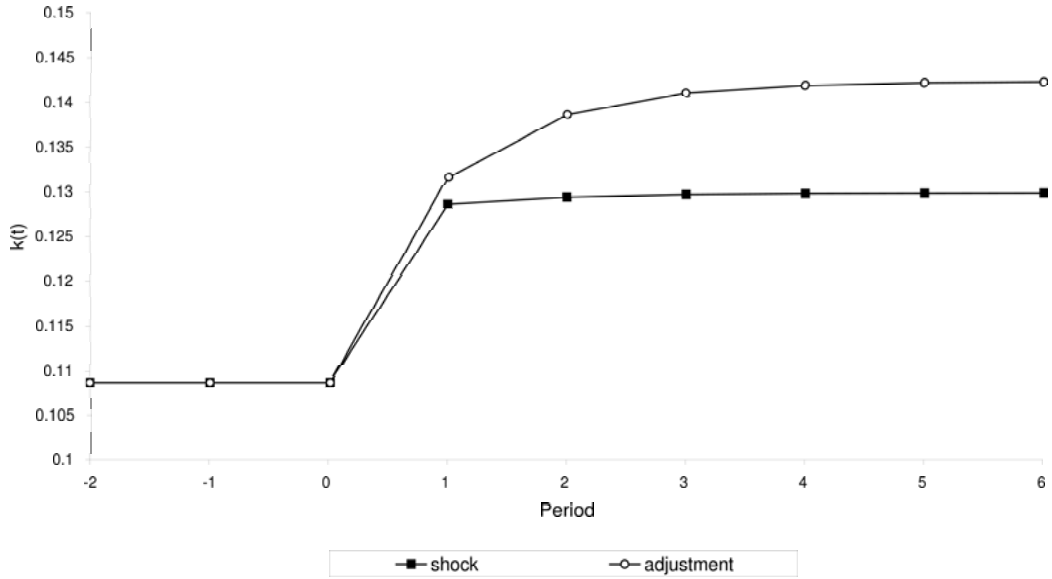
$$s_0 = \frac{\gamma}{1 - \gamma} w_0 - \frac{\gamma}{(1 + \gamma)(1 + n)} P^0 - \frac{1}{R_1(1 + \gamma)} P_1. \quad (13)$$

Hence, in case the economy is thrown out of steady state and individuals are inter-generationally fair, the rise in capital intensity is not only due to the drop in fertility (scenario: "shock"), but is accessorially amplified by higher private savings (scenario: "adjustment"). Both effects are depicted in Figure 1, which illustrates the capital intensity during transition. The higher capital stock per capita entails an increase in output per capita (9) and in wages (10) and a decrease in interest rates (11). The fact that individuals of generation 0 decrease their retirement benefits and thus the taxes

⁹With the choice of these numerical values, we yield quite realistic results, e.g. a real rate of return of 3 percent per annum.

¹⁰Taking account of the fact that Borgmann and Heidler (2003) regard an average retirement period of 15 years with an overall decline in pension generosity of 30 percent, we have to transform this result for our model. As we are regarding a retirement period of 30 years, we get an overall decline of 15 percent. In order to get this result, i.e. in order to make it utility maximizing for individuals of generation 0 to reduce its pension payment by about 15 percent, we have to set $\beta_0 = 250$. How this is to be interpreted will be shown below.

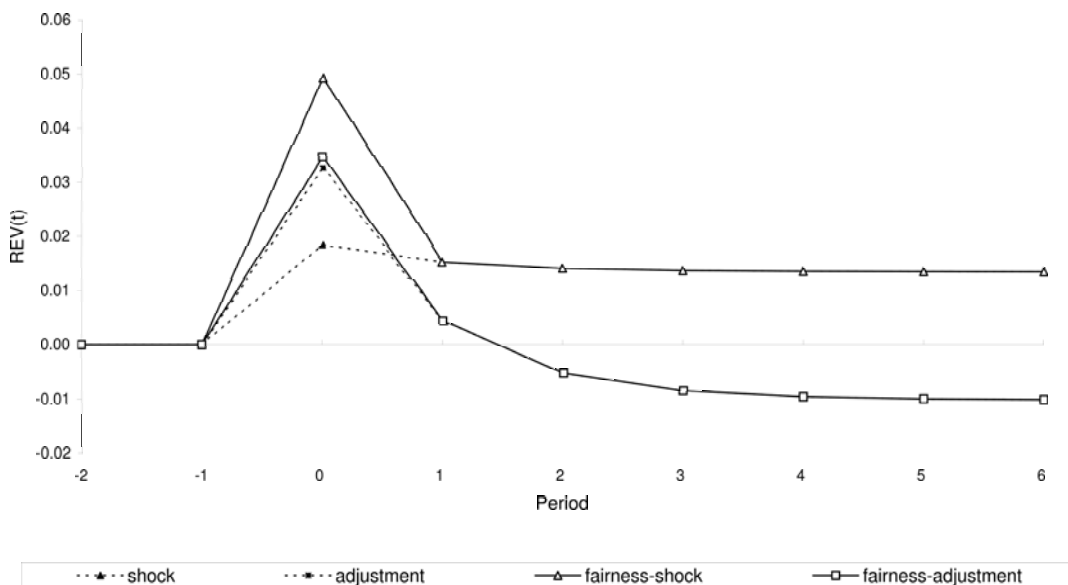
Figure 1: Capital intensity in transition



for the generation succeeding them (generation 1) reduces the burden that the demographic shock would have on generation 1 via the DB-scheme. In consequence, the old generation in period 1 (generation 0) will not only be burdened by the fall in interest rates that decreases the returns on their savings, but additionally by the increase in social security net payments. Furthermore the adjustment of the retirement benefit exacerbates the fall in interest rates. Nevertheless, an individual of generation 0 is better off adjusting his pension payment and lowering the contribution of an individual of generation 1, thereby accepting the additional reduction in interest rate, than being unfair and receiving the interest rate which results solely from the demographic shock.¹¹ We want to show that the augmented loss in interest rates is not as large as the loss which would result if individuals did not behave fairly. Therewith, we can demonstrate that GAs can be an indicator for intergenerational welfare. 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 each generation's utility under the new, adjusted pension policy and the initial steady state level of utility, indicated by \bar{u} , which represents the utility which

¹¹Note that fair individuals can be worse off in adjusting $P_1 < P^0$ by being fair but not "fair enough". In case β_0 is just slightly above its "break-even" value, the gain in utility from behaving fairly is less than the utility loss through the additional drop in interest rates.

Figure 2: Relative equivalent variation in transition



the generation would have realized in the absence of the demographic decline

$$REV_t = \frac{u_t}{\bar{u}} - 1. \quad (14)$$

Using REV in order to compare different utility settings, we examine four scenarios, as shown in Figure 2. The scenarios "shock" and "adjustment" correspond to the "low fertility"- and "all changes"-scenario of Raffelhüschen and Risa (1997). Furthermore, the scenarios "fairness-shock" and "fairness-adjustment" capture the inequity aversion of individuals, whereby only the latter scenario contributes to an adjustment of retirement benefits in case of a demographic shock. Raffelhüschen and Risa (1997) now suggest that if an equalization of the GAs is at issue due to a decline in fertility and the government reduces retirement benefits (which corresponds to a partial funding strategy), then generation 0 is additionally burdened by repercussion effects in terms of a greater fall in interest rates. This, however, is not the result we get when implementing fairness into the utility function. In fact, our outcome indicates that an individual of generation 0 is better off when adjusting his retirement benefits and equalizing his own GA to future GAs than he would otherwise be.

Contingent on how large β_0 is, a fair individual can at most reach the utility of the "adjustment"-scenario, i.e. of the scenario with purely selfish individuals.¹² In this

¹²But note that if purely self-interested individuals could vote, they would never decide upon a $P_1 < P^0$.

case, the inequity averse individual chooses a \tilde{P} which perfectly equalizes his own generational account ($GA_{0,0}$) to the generational account of his offspring ($GA_{1,0}$). There-with, the fairness function becomes zero, which is equivalent to $\pi_0 = 1$ in the work of Raffelhüschen and Risa (1997).

Certainly a question to be answered is how much it costs individuals to be fair towards future generations. This question is of importance since exorbitantly high costs of fairness would certainly not be in favor of the concept of inequity aversion, and thus render it useless. On the basis of REV, each of the above scenarios implicates what is needed in monetary terms to make an individual of the transition generation (or an individual of a new steady state generation) have the same utility as in the initial steady state. In the "shock"-scenario, the individual has to be compensated for an interest rate drop. The "adjustment"-scenario, on the other hand, illustrates what is needed if the individuals has to be compensated not only for the drop in market interest rate due to the demographic shock, but also for the partial funding strategy with a retirement benefit of P_1 and thus for the additional drop in the real interest rate. For assessing the actual costs of fairness, we examine the difference between the REVs of scenario "fairness-shock" and that of "shock". In the illustrated example, the costs of being fair range around three percent of the income. Taking into account that when individuals behave fairly they adjust their retirement benefits, this cuts the fairness costs by about half to 1.6 percent of the income. In other words, a benevolent generation will always experiences a reduction in utility which is solely to be ascribed to the fact that it is fair. Yet these costs are not tremendously high as to reject this modification of individual utility.

4 Conclusion

By implementing intergenerational fairness into a model of political economy, we have found a way of explaining past empirical observations in the German pension system. The inequity aversion of individuals only arises during a demographic transition.

Taking the results of Borgmann and Heidler (2003) as a starting point, we have demonstrated that in case of a fertility decline a fair generation is better off adjusting its pension payment and lowering the contribution of its offspring, thus accepting additional repercussion effects in form of a reduction in interest rates, than being unfair and receiving the interest rate which results solely by the demographic shock. In other words, besides selfishly maximizing lifetime consumption the individuals pursue an equalization of GAs. This in turn implies that in a situation where individuals cannot vote, but are nonetheless fair, the government should intervene, since an equalization

of GAs can be an indicator for welfare adjustments.

In contrast to other models of political economy, we can moreover establish 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 are fully capable of enforcing the necessary alterations of a PAYG pension system. The assumption of fair individuals seems apposite here, since the implementation of fairness can be an appropriate modification of utility describing individual behavior. There are neither exhausting costs caused by extending the self-interested utility function, nor is the individual lifetime consumption profile distorted. Yet we have to acknowledge that, empirically, it might be difficult to distill the notion of "fairness" from the various complex factors that influence pension policy. In spite of this, we keep track of reality: we are able to explain ongoing reforms in social security systems by attributing fairness to individuals.

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