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**The Political Economy of
Intra- and Intergenerational Redistribution with
Asymmetric Information**

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The Political Economy of Intra- and Intergenerational Redistribution with Asymmetric Information

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Abstract: In this paper redistribution policy is analyzed in a 2-period overlapping generations model with heterogeneous individuals and asymmetric information between the government and the private sector. Individuals of the same generation differ with respect to their labor productivity. In each period, the respective government decides not only about the distribution of consumption between the working generation and the retired but also about the distribution within generations – between individuals with a high and with a low productivity of labor. The government in period 1 is not able to determine the policy of the subsequent government in period 2. In the political equilibrium, consumption of high- and low-productivity individuals is inefficiently allocated over their life cycle. For a given level of aggregate savings, a Pareto-improvement would be achieved, if high-productivity individuals consumed less during their working life and more during retirement in the following period, whereas low-productivity individuals had to consume more during their working life and less during retirement. In addition to this inefficiency, the government in period 1 may choose an inefficient level of aggregate savings in the equilibrium. It is shown for a specific example that an increase in aggregate savings would be Pareto-improving.

Keywords: Overlapping generations, redistribution, political economy, asymmetric information.

JEL-Classification: E 62, D 78, D 82.

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1. Introduction*

This paper deals with the political economy of redistribution policy in an overlapping generations model with heterogeneous individuals. The paper incorporates redistribution within generations as well as the standard redistribution between generations, allowing for two types of individuals per generation: those with a high labor productivity and those with a low labor productivity. The respective government in each period is assumed to maximize the aggregate utility of all individuals alive in this period. Choosing the appropriate transfers, the government in period t is able to determine the consumption levels of all individuals in t . In addition, the government determines individual labor supply and the level of aggregate savings.

There is asymmetric information between the government and the private sector; the government cannot observe labor productivities or the individual levels of labor supply. All the government can observe is individual labor income. This information structure is essentially the same as in the theory of optimal income taxation.¹ In choosing its policy, each government therefore faces an optimization problem comparable to the optimal taxation of income. However, in the political economy setting there is a mutual strategic relationship between the government in period t and the government in period $t+1$, which is absent in the normative theory of optimal taxation: On the one hand, the government in period t determines the capital stock that is left for the following period. On the other hand, the government in period $t+1$ determines the consumption level of retirees in this period, which in turn affects the decision problem of the government in period t .

As this paper shows, the political economy equilibrium is not Pareto-efficient. Starting from the equilibrium, a Pareto-improvement could be achieved without changing the aggregate level of savings. This could be done by shifting consumption of high-productivity individuals from their working life in period t to retirement in period $t+1$,

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¹ The seminal work on optimal income taxation is Mirlees (1971). Stiglitz (1985, 1987) analyzes optimal income taxation in an overlapping generations context.

whereas consumption of low-productivity individuals had to be shifted from retirement in $t+1$ to their working life in t . The Pareto-inefficiency of the political equilibrium results from the fact that the government in period $t+1$ does not consider the influence of its redistribution policy on the optimization problem of the government in period t . Because of asymmetric information, the government in t has to give a higher utility of consumption to the high-productivity individuals to prevent a pooling equilibrium. If the government in t was able to determine the level of individual consumption not only for t but also for period $t+1$, then it would give the high-productivity individuals a higher consumption level during their working life in period t as well as during retirement in period $t+1$. Such a policy would solve the asymmetric information problem while keeping individual consumption efficiently allocated over the life cycle. However, the government in $t+1$ distributes consumption equally within the generation of retirees, since the asymmetric information problem of period t is no longer relevant in $t+1$. As a result, consumption is not efficiently allocated – high-productivity individuals consume too much during their working life compared to their consumption during retirement, whereas consumption of low-productivity individuals is too low during their working life compared to their consumption during retirement.

This inefficiency of the political economy equilibrium is derived in a simple model of a 2-generations, 2-type, overlapping generations economy that lasts for 2 periods. This model is set up in section 2 of this paper, and as a reference point the properties of the second-best optimum are derived. In section 3, the inefficiency of the political equilibrium is shown for a given capital stock. In section 4, the model is further specified to analyze capital accumulation in the political economy equilibrium.

Although a considerable number of papers exist on the politics of redistribution with overlapping generations,² none of these paper seems to deal with redistribution within

² For surveys, see Breyer (1994) or Verbon (1993). Krusell, Quadriani and Rios-Rull (1997) characterize a general method of finding the equilibrium solution for intertemporal political economy models of redistribution.

generations as well as redistribution between generations in an asymmetric information setting.

In the median voter model of Browning (1975), an unfunded public pension system is the only instrument available to redistribute from the generation of working individuals to the generation of retirees. This pension system, once introduced, cannot be scaled down by the following generations. According to Browning (1975), the middle-aged median voter then benefits from the unfunded pension system, since he or she contributes only for a comparatively short time before receiving benefits from the pension system. The assumption that policy makers of period t can introduce binding redistribution schemes for the following periods has been criticized by several authors. It also does not conform to the model structure analyzed in this paper, in which the government in period 2 can freely redistribute between all individuals.

Another approach to explain intergenerational redistribution that differs from this paper comes from folk-theorem models with an infinite time horizon (see Hammond, 1975 or Sjoblom, 1985). In these models the young generation gives transfers to the old to qualify for a similar transfer from the subsequent young generation.³ With a finite time horizon as in this paper, however, such folk equilibria do not exist.⁴

In several contributions, the government is assumed to maximize an additive aggregate utility function as in this paper. Such an objective function of the government may be founded, for example, on probabilistic voting models of the representative democracy (see Mueller, 1989, ch. 11).⁵ The government in period t then redistributes

³ A non-retired individual might also endorse public transfers to the old, if there is altruism between generations. See, for example, Veall (1988) and Hansson, Stuart (1989). In Tabellini (1990, 1991) altruism is combined with intra-generational heterogeneity to explain redistributive, unfunded pension systems and public debt. Altruism is not present in the model of this paper.

⁴ As Bhaskar (1998) shows, an equilibrium with voluntary transfers demands a high level of information of all agents: it exists in pure strategies only, if players in period t know the complete history of the game up to t .

⁵ In general, the probabilistic voting theory predicts that the vote maximizing policy platform in a two-candidate contest maximizes the weighted sum of all voters' utilities. If the voting behavior of all individuals can be described by the same probability function, then all individuals will have the same weight in the implicit political objective function.

to equalize the weighted or non-weighted marginal utility of all individuals alive in t . Perhaps, most closely related to this paper are the models of Lang (1996) and Hori (1997). In these models, the government in period t decides about the distribution of aggregate income between consumption of the young generation, consumption of the old generation and aggregate savings for the following period $t+1$. The government maximizes the aggregate utility of both generations alive in t .⁶ The equilibrium level of savings is inefficiently low in this setting and an increase in savings would be Pareto-improving. This result of Lang (1996) and Hori (1997) can be explained with an externality argument: an increase in aggregate savings in period t increases consumption and thereby the utility of the old and of the young generation in the following period $t+1$. The government in t , however, has no regard for the utility gain of the young in $t+1$ and therefore chooses an inefficiently low level of savings. Heterogeneity within generations and asymmetric information are not considered in the models of Lang (1996) and Hori (1997).⁷ As section 4 of this paper shows, the result of an inefficiently low level of aggregate savings can be carried over to the asymmetric information framework of this paper after assuming specific utility functions and a Cobb-Douglas technology.

⁶ Lang (1996) assumes equal welfare weights for all individuals in the objective function of the governments, whereas Hori(1997) allows for different weights of individuals of the young and of the old generation. Hori (1997) also incorporates altruism in his model.

⁷ Other papers with a government maximizing aggregate utility are Velthoeven, Verbon (1991), Verbon, Velthoeven (1992), Meijdam, Verbon (1996), Verbon et al. (1998) and Grossman, Helpman (1996). In some features, however, these models fundamentally differ from this paper. In the papers of Verbon et al., the government cannot control aggregate savings; in Grossman, Helpman (1996), the individuals are assumed to consume only during retirement.

2. The Model

Assume an overlapping generations economy that lasts for two periods ($t=1,2$). In each period there are two generations alive – a young generation and an old generation. Each generation consists of two representative individuals ($i=1,2$). In period t , individual i of the young generation supplies labor l_t^i and consumes $c_{y_t}^i$. Individual i of the old generation consumes $c_{o_t}^i$. Both young individuals differ with respect to their productivity of labor. These productivity differences are captured by the term a^i , which transforms physical labor units into efficiency units. Individual 1 is assumed to have a higher labor productivity than individual 2 ($a^1 > a^2$). The factor labor is used in combination with the factor capital to produce an aggregate consumption good according to a linear-homogenous technology $Y_t = F(K_t, L_t)$, with $L_t \equiv a^1 l_t^1 + a^2 l_t^2$. The product market and factor markets are perfectly competitive, and the price of the aggregate good is set equal to one. The wage rate for individual i then equals the marginal product of labor $w^i = a^i F_L$; the interest rate equals the marginal productivity of capital $r = F_K$. Each young individual is endowed with \bar{l} units of labor. The capital stock in the second period is given by aggregate savings of the first period $K_2 = s_1^1 + s_1^2$; the capital stock in period 1 is fixed $K_1 = s_0^1 + s_0^2 = \bar{K}^1$.

The utility function of each individual is assumed to be additively separable. The life-time utility of a young individual in period 1 is given by the utility function $\tilde{u}_{y_1}^i = u_y(c_{y_1}^i) + \beta u_o(c_{o_2}^i) + v(\bar{l} - l_1^i)$; the utility of a young individual in period 2 is given by $\tilde{u}_{y_2}^i = u_y(c_{y_2}^i) + v(\bar{l} - l_2^i)$; the utility of an old individual in both periods is given by $\tilde{u}_{o_t}^i = u_o(c_{o_t}^i)$.

There is asymmetric information between the government and the private sector: the government can neither observe the productivity term a^i nor individual labor supply l_t^i ; the government can, however, observe labor income $e^i \equiv l^i w^i$. In this setting, the respective government chooses its optimal policy. To redistribute between households, the government may use income-dependent transfers to the young and to

the old $\tau'_{y_i} = \tau_{y_i}(e'_i)$ and $\tau'_{o_i} = \tau_{o_i}(e'_{i-1})$.⁸ In addition to this, the government controls individual savings $s'_i = s(e'_i)$.⁹ The individual consumption levels are then given by $c'_{y_i} = e'_i + \tau'_{y_i} - s'_i$ and $c'_{o_i} = s'_{i-1}r + \tau'_{o_i}$.

Before the political economy equilibrium is analyzed in section 3, the properties of the second-best optimum are derived in the following. The second-best optimum serves as a reference point to evaluate the political economy equilibrium and it helps to illustrate the main mechanisms at work in this model. As mentioned in the introduction, the second-best optimum closely corresponds to the solution of the optimal income tax problem with overlapping generations, which has been analyzed by Stiglitz (1985, 1987). Assume at the beginning of period 1, a social planner maximizes the following social welfare function:

$$\tilde{W} = \tilde{u}_{y_1}^1 + \tilde{u}_{y_1}^2 + \tilde{u}_{o_1}^1 + \tilde{u}_{o_1}^2 + \beta \tilde{u}_{y_2}^1 + \beta \tilde{u}_{y_2}^2. \quad (1)$$

Two features characterize this social welfare function: First, the social planner discounts future utility with the same rate β as the private individuals do.¹⁰ Second, the planner weighs the utility of both individuals in the same period equally. Both assumptions are made for simplicity.¹¹

The maximization problem of the social planner can be transformed into finding the optimal consumption levels c'_{y_i} , c'_{o_i} , labor supply l'_i and capital stock K_2 subject to two types of constraints. First, there are the budget constraints in both periods:

$$c'_{y_1} + c'_{y_1} + c'_{o_1} + c'_{o_1} + K_2 \leq F(\bar{K}_1, a^1 l_1^1 + a^2 l_1^2), \quad (2.a)$$

⁸ Alternatively, it could be assumed that transfers to individual i not only are a function of the observed income of individual i but also of the income of other individuals as well. However, such a setting, which may lead to superior outcomes for the government, does not seem to be realistic.

⁹ Without loss of generality, savings of the government are not considered.

¹⁰ This assumption ensures that the social welfare function in itself is time-consistent (see Fischer, 1980, or Calvo, Obstfeld, 1988).

¹¹ Stiglitz (1985, 1987) considers the more general case of Pareto-efficient taxation.

$$c_{y_2}^1 + c_{y_2}^2 + c_{o_2}^1 + c_{o_2}^2 \leq F(K_2, a^1 l_2^1 + a^2 l_2^2). \quad (2.b)$$

Second, because of the information asymmetry, the social planner has to obey a self-selection constraint in both periods ($a \equiv a^2 / a^1$):

$$u_y(c_{y_1}^1) + \beta u_o(c_{o_1}^1) + v(\bar{l} - l_1^1) \geq u_y(c_{y_2}^2) + \beta u_o(c_{o_2}^2) + v(\bar{l} - al_1^2), \quad (3.a)$$

$$u_y(c_{y_2}^1) + v(\bar{l} - l_2^1) \geq u_o(c_{y_2}^2) + v(\bar{l} - al_2^2). \quad (3.b)$$

The self-selection constraints prevent that a young individual 1 with a high labor productivity chooses a low labor supply to get the same income as a young individual 2 with a low labor productivity. The left-hand-side of the self-selection constraints gives the utility of individual 1 revealing his or her true labor productivity. The right-hand-side denotes the utility of individual 1 pooling with individual 2. In this case of pooling individual 1 would get the consumption levels $c_{y_t}^2$ and $c_{o_{t+1}}^2$ and would have to supply labor $\hat{l}_t \equiv al_t^2$ to receive the same labor income as individual 2.¹²

The solution of the second-best optimum can be characterized as follows:¹³ The labor supply of the young individuals is described by equations (4) and (5):

$$\frac{v'(\bar{l} - l_t^1)}{u_y'(c_{y_t}^1)} = a^1 F_{L_t}, \quad (4)$$

$$\frac{v'(\bar{l} - l_t^2)}{u_y'(c_{y_t}^2)} = a^2 F_{L_t} - \frac{\sigma [v'(\bar{l} - l_t^2) - av'(\bar{l} - al_t^2)]}{[1 - \sigma_t] u_y'(c_{y_t}^2)}. \quad (5)$$

The term σ_t denotes the non-discounted shadow price of the self-selection constraint ($\sigma_t < 1$). According to (4), labor supply of the high-productivity individual 1 is at the

¹² The self-selection constraint of individual 2 does not need to be considered explicitly, since it is not binding in the second-best optimum, if individuals 1 and 2 both have the same welfare weights in the social welfare function (see Stiglitz, 1987).

¹³ The following equations are derived from the first-order conditions, which are shown in appendix a. Both constraints (2) and (3) are binding in the second-best optimum. This follows immediately from the first-order conditions, so the proof is omitted here.

same level as in the first-best optimum without information constraints. Labor supply of the low-productivity individual 2 is below the first-best level.

Consumption is distributed within the generation of young individuals according to the following equation:

$$u'_y(c_{y1}^1)[1 + \sigma_1] = u'_y(c_{y1}^2)[1 - \sigma_1] \quad (6)$$

Individual 1 gets a higher consumption level during his or her working period than individual 2. Asymmetric information prevents an equal distribution of consumption – the individual with the higher productivity gets a higher consumption level to keep the self-selection constraint satisfied.

Both old individuals alive in period 1 receive the same level of consumption:

$$u'_o(c_{o1}^1) = u'_o(c_{o1}^2). \quad (7)$$

Neither the self-selection nor the budget constraints limit redistribution between individuals who are already retired in period 1, so that an equal distribution of consumption within this generation is optimal.

The intertemporal allocation of consumption and the optimal capital stock may be characterized as follows:

$$\frac{u'_y(c_{y1}^1)}{\beta u'_o(c_{o2}^1)} = \frac{u'_y(c_{y1}^2)}{\beta u'_o(c_{o2}^2)} = F_{K_1}. \quad (8)$$

According to (8), the marginal rate of intertemporal substitution has to be equal to the marginal rate of intertemporal transformation. This is also the condition for optimal savings in a first-best environment.¹⁴ Together with equation (6), equation (8) implies that individual 1 gets a higher level of consumption during retirement in period 2 than individual 2.

¹⁴ As Stiglitz (1985, 1987) shows, the marginal rate of intertemporal substitution differs from the marginal rate of transformation, if the relative wage a is not constant but changes with the capital stock. However, the result of an equal marginal rate of substitution for all individuals in the second-best optimum then still remains valid.

3. The Political Economy Equilibrium

In the political equilibrium the allocation is not determined by a social planner who sets all variables of the model at the beginning of period 1 but by two subsequent governments – the government in period 1 and the government in period 2 – each maximizing its own objective function. The government in period 2 decides about the consumption levels in period 2 and about labor supply (c'_{y_2} , c'_{o_2} and l'_2). The government in period 1 decides about c'_{y_1} , c'_{o_1} , l'_1 and about the capital stock K_2 . Assume the government in period t maximizes the aggregate non-weighted utility of all individuals alive in t . The objective functions of the governments are given by the following equations:

$$W_1 = \tilde{u}_{y_1}^1 + \tilde{u}_{y_1}^2 + \tilde{u}_{o_1}^1 + \tilde{u}_{o_1}^2, \quad (9.a)$$

$$W_2 = \tilde{u}_{y_2}^1 + \tilde{u}_{y_2}^2 + \tilde{u}_{o_2}^1 + \tilde{u}_{o_2}^2. \quad (9.b)$$

The model is solved by backward induction. The government in period 2 maximizes W_2 subject to the budget constraint (2.b) and the self-selection constraint (3.b). The solution with respect to labor supply can be characterized by the same equations (4) and (5) as in the second-best optimum.¹⁵ Also the conditions determining consumption of the young in period 2 are the same as in the second-best optimum and can be characterized by equation (6). There is, however, a difference to the second-best optimum with respect to consumption of the old in period 2. In the political equilibrium, both retired individuals in period 2 get the same level of consumption:

$$u'_o(c_{o_2}^1) = u'_o(c_{o_2}^2). \quad (10)$$

This result differs from the second-best optimum according to which consumption of the high-productivity individual during retirement in period 2 has to exceed consumption of the low-productivity individual.

The government in the first period maximizes W_1 subject to the budget constraint (2.a) and the self-selection constraint (3.a). In addition, the government in the first period

¹⁵ The first-order conditions of the political equilibrium are shown in appendix b.

takes into account that the capital stock K_2 may influence retirement consumption c_{o2}^t in the following period, i.e. $c_{o2}^t = c_{o2}^t(K_2)$. Equilibrium labor supply l_1^t , consumption of the young c_{y1}^t and consumption of the old c_{o1}^t in the first period can be characterized by the same equations (4) – (7) as in the second-best optimum. Dividing (6) by (10) gives the following equation:

$$\frac{u_y'(c_{y1}^1)}{\beta u_o'(c_{o2}^1)} [1 + \sigma_1] = \frac{u_y'(c_{y1}^2)}{\beta u_o'(c_{o2}^2)} [1 - \sigma_1]. \quad (11)$$

Compared to the second-best optimum, the intertemporal allocation of consumption is distorted for both individual types: the marginal rate of intertemporal substitution for individual 2 exceeds the marginal rate of substitution for individual 1. Welfare could be improved, if consumption of individual 2 is shifted towards period 1 and consumption of individual 1 is shifted towards period 2. This result is shown in more detail in the following proposition:

Proposition: *The political economy equilibrium is not Pareto-efficient. For a given level of K_2 the utility of both young individuals of period 1 could be increased without reducing the utility of any other individual. The high-productivity individual then had to consume less during the working period and more during retirement, whereas the low-productivity individual had to consume more during the working period and less during retirement.*

Proof: The following policy experiment shows the potential for a Pareto-improvement of the political economy equilibrium: Let labor supply l_1^t , consumption of the old in the first period c_{o1}^t , consumption of the young in the second period c_{y2}^t and the capital stock K_2 be constant. Reduce c_{y1}^1 by Δc_{y1}^1 ($\Delta c_{y1}^1 \rightarrow 0$) and increase c_{y1}^2 , such that the budget constraint (2.a) remains satisfied as an equality ($\Delta c_{y1}^2 = -\Delta c_{y1}^1$). In addition, increase c_{o2}^1 and reduce c_{o2}^2 , such that the self-selection constraint in the first period (3.a) and the budget constraint (2.b) in the second period remain satisfied as equalities. The budget constraint (2.b) implies $\Delta c_{o2}^2 = -\Delta c_{o2}^1$. Totally differentiating the self-selection constraint (3.a) gives:

$$u'_y(c_{y_1}^1)dc_{y_1}^1 + \beta u'_o(c_{o_2}^1)dc_{o_2}^1 = u'_y(c_{y_1}^2)dc_{y_1}^2 + \beta u'_o(c_{o_2}^2)dc_{o_2}^2. \quad (12)$$

Inserting $\Delta c_{y_1}^2 = -\Delta c_{y_1}^1$, $\Delta c_{o_2}^2 = -\Delta c_{o_2}^1$, using (6) and (10) and rearranging gives:

$$\Delta c_{o_2}^1 = -\frac{u'_y(c_{y_1}^1)}{\beta[1-\sigma_1]u'_o(c_{o_2}^1)}\Delta c_{y_1}^1. \quad (13)$$

The impact of this policy experiment on the utility of individual 1 is given by the following equation:

$$\Delta \bar{u}_{y_1}^1 = u'_y(c_{y_1}^1)\Delta c_{y_1}^1 + \beta u'_o(c_{o_2}^1)\Delta c_{o_2}^1. \quad (14)$$

Inserting (13) gives:

$$\Delta \bar{u}_{y_1}^1 = -\frac{\sigma_1}{1-\sigma_1}\Delta c_{y_1}^1. \quad (15)$$

The lifetime utility of individual 1 increases ($\Delta \bar{u}_{y_1}^1 > 0$ for $\Delta c_{y_1}^1 < 0$). The same procedure for individual 2 gives $\Delta \bar{u}_{y_1}^2 = \Delta \bar{u}_{y_1}^1$. The utility of the old generation in period 1 and the young generation in period 2 is not influenced by the policy experiment. The utility of both young individuals can be increased without utility loss for any other individual. The political economy equilibrium is not Pareto-efficient.

Q.e.d.

This result can be explained with the fact that the government in period 1 cannot bind the subsequent government in period 2 in its actions. In period 1, the government has to give individual 1 a higher utility from consumption than individual 2 in order to satisfy the self-selection constraint. In the second-best optimum, this can be done without distorting the intertemporal allocation of consumption. Individual 1 then receives a higher consumption level during the working period as well as during retirement. This second-best allocation is not feasible in the political equilibrium, since the government in period 2 distributes consumption equally within the generation of retirees. A higher working period consumption of individual 1 then necessarily implies a lower marginal rate of intertemporal substitution for individual 1 compared to individual 2.

Underlying this conflict between the governments in period 1 and 2 is a time-consistency problem: The government in period 1 prefers an unequal distribution within the generation of retirees in period 2 to satisfy the self-selection constraint (3.a) with the lowest possible distortions. For the government in period 2, the self-selection constraint (3.a) is no longer binding, so that an unequal distribution within the generation of retirees is no longer optimal. This time-consistency problem differs from the one derived in models of optimal capital and labor taxation with restricted lump-sum taxes.¹⁶ In these models, savings and labor supply are determined by the individuals. The government decides about the tax rates of a proportional capital and labor income tax. The government then imposes a higher tax rate on capital *ex-post* compared to the capital tax rate that is optimal *ex-ante* before individuals decide about savings. Households anticipate the high *ex-post* capital tax rate, and the equilibrium capital stock in the economy is inefficiently low. In the political economy model of this paper, the government determines aggregate savings, and the inefficiency arises even for a given capital stock.

4. Equilibrium Capital Stock

The previous section has shown that the political equilibrium is Pareto-inefficient for a given capital stock K_2 . In addition, the capital stock might also be chosen on an inefficient level in equilibrium. As mentioned in the introduction, it has been shown in a model without intra-generational heterogeneity that the capital stock is inefficiently low in the political equilibrium (Lang, 1996, Hori, 1997). In this section, it is analyzed, whether this result can be extended to the case of heterogeneous individuals and asymmetric information.

The capital stock in the political equilibrium is determined by the following equation:

$$\frac{\lambda_1}{\beta \lambda_2} = 2 \frac{dc_{22}^1}{dK_2}. \quad (16)$$

¹⁶ See, for example, Kydland, Prescott (1980), Fischer (1980) or for a general discussion Persson, Tabellini (1990).

The term λ_t denotes the shadow price of the budget constraint in t . In the second-best optimum, the equilibrium capital stock is determined by $\lambda_1 / \beta \lambda_2 = F_{K_2}$. For $dc_{o_2}^1 / dK_2 \neq F_{K_2} / 2$ equation (16) differs from the condition of the second-best optimum. For a given λ_1 and λ_2 the capital stock in the political equilibrium then differs from the capital stock in the second-best optimum. The term $dc_{o_2}^1 / dK_2$ is determined by the solution of the political equilibrium in the second period.¹⁷ It can be derived explicitly for a simplifying specification of the utility functions and technology. With this specification it can then be shown that the capital stock is inefficiently low in equilibrium.

Assume the following utility functions: $\tilde{u}_{y_1}^t = \ln(c_{y_1}^t) + \beta \ln(c_{o_1}^t) - v l_1^t$, $\tilde{u}_{y_2}^t = \ln(c_{y_2}^t) - v l_2^t$ and $\tilde{u}_{o_1}^t = \ln(c_{o_1}^t)$. In addition, assume a Cobb-Douglas technology $F(K_t, L_t) = K_t^\alpha L_t^{1-\alpha}$ and $\alpha^1 < 3\alpha^2$. With this specification, equilibrium labor supply in the political equilibrium in period 2 is given by the following two equations (see appendix c):¹⁸

$$l_2^1 = \frac{4a[1-\alpha]}{[1+a]v} - \frac{1}{2v} \ln\left(\frac{3a-1}{1+a}\right), \quad (17)$$

$$l_2^2 = \frac{4[1-\alpha]}{[1+a]v} + \frac{1}{2va} \ln\left(\frac{3a-1}{1+a}\right). \quad (18)$$

These equations also determine labor supply in the second-best optimum. As shown by (17) and (18), labor supply in period 2 is not affected by the capital stock K_2 . The consumption levels in the political equilibrium are given by the following equations:

$$c_{y_1}^1 = \frac{\alpha^1}{v} F_{L_1}, \quad (19)$$

$$c_{y_1}^2 = \frac{[3a-1]\alpha^1}{[1+a]v} F_{L_1}, \quad (20)$$

¹⁷ This equilibrium is given by the first-order conditions (b.1)-(b.8) of appendix b.

¹⁸ The parameters a and α of the model are assumed to be compatible with a strictly positive labor supply of both households.

$$c'_{o1} = \frac{2a^2}{[1+a]^\nu} F_{L1}. \quad (21)$$

From (21) the following expression can be derived for dc'_{o2} / dK_2 :

$$\frac{dc'_{o2}}{dK_2} = \frac{2a^2}{[1+a]^\nu} F_{LK2}. \quad (22)$$

With equation (22) it can be shown that $2dc'_{o2} / dK_2 < F_{K2}$ in equilibrium: Using the equation $L_2 F_{LK2} = [1-\alpha] F_{K2}$, which holds for a Cobb-Douglas function, and inserting from (17) and (18) for L_2 , equation (22) implies $2dc'_{o2} / dK_2 = F_{K2} / 2$. The old generation thus gets only half of the additional income that is created in period 2 from an increase in the capital stock. The other half goes to the young generation in period 2. This lowers the incentives for the government in period 1 to accumulate capital.

As a result, the equilibrium capital stock is inefficiently low in equilibrium. This can be shown as follows: Suppose the aggregate capital stock is increased by ΔK_2 ($\Delta K_2 \rightarrow 0$). This gives an additional income in period 2 of $F_{K2} \Delta K_2$. This additional income is shared equally between both retired households in period 2, such that $\Delta c'_{o2} = \Delta c^2_{o2} = F_{K2} \Delta K_2 / 2$. To keep lifetime utility of these individuals constant, their consumption levels in period 1 are reduced according to the following equation:

$$\Delta c'_{y1} = - \frac{\beta u'_o(c'_{o2})}{u'_y(c'_{y1})} \Delta c'_{o2}. \quad (23)$$

Inserting from (b.3), (b.8), (b.9) and (16) gives:¹⁹

$$\Delta c'_{y1} = - \frac{1 + \sigma_1}{2dc'_{o2} / dK_2} \Delta c'_{o2}, \quad (24)$$

$$\Delta c^2_{y1} = - \frac{1 - \sigma_1}{2dc'_{o2} / dK_2} \Delta c^2_{o2}, \quad (25)$$

¹⁹ Equations (b.3), (b.8) and (b.9) are given in appendix b.

The budget constraint (2.a) in period 1 implies $\Delta c_{y_1}^1 + \Delta c_{y_1}^2 + \Delta c_{o_1}^1 + \Delta c_{o_1}^2 + \Delta K_2 = 0$.

Inserting (24), (25) and $dc_{o_2}^1 / dK_2 = F_{K_2} / 4$ in the budget constraint gives:

$$\Delta c_{o_1}^1 + \Delta c_{o_1}^2 = \Delta K_2 \quad (26)$$

With an increase in the capital stock, consumption of both retired individuals in period 1 can be increased without reducing the utility of any other individual.

5. Concluding Remarks

In this paper the allocation of consumption, capital and labor in the political equilibrium has been characterized. It has not been analyzed so far how the governments may achieve this allocation. In the reference framework of the second-best optimum, the social planner may delegate the savings decision as well as the decision on labor supply to the private sector. Lump-sum transfers can bring about the optimal distribution of consumption between and within generations. In addition, labor supply of the low-productivity individuals has to be lowered to the second-best optimal level, for example by using taxes on low labor incomes.

The situation differs in the political economy equilibrium: no individual has an incentive to save voluntarily, since the level of consumption during retirement is predetermined by the political equilibrium in period 2. Without government intervention in period 1, the aggregate level of savings would be zero. All savings have to be done in the form of forced savings, for example by introducing a mandatory funded pension system. This feature of the political economy model may appear to be quite extreme, if compared to reality. Voluntary savings for retirement may be depressed by the anticipation of redistribution policy but do not seem to be brought down completely to zero. The simple model of this paper sets a theoretical benchmark, in which the effects endogenous redistribution policy come out most clearly. Empirically more reasonable predictions may be derived from the paper, if it is extended to include additional factors.

A promising way to extend the model in this respect seems to be to endogenize the political power of the individuals. Retired individuals with a high capital income may possess a higher political power than those with a low capital income, for example,

because a high income improves the value of outside options of the individuals. To illustrate this point, assume retired individuals have the option to leave the country at a certain cost. A high capital income then may improve the utility received after choosing this option and thereby may also improve the power of the respective individual in the process of political decision-making. This effect may give the individuals an incentive to save voluntarily.

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Appendix a: Second-best Optimum

The social planner maximizes the Lagrange-function $L = \bar{W} + \lambda_1 [bc_1] + \beta \lambda_2 [bc_2] + \sigma_1 [ssc_1] + \beta \sigma_2 [ssc_2]$, with bc_t given by the budget constraint and ssc_t by the self-selection constraint in period t .

This gives the following first order conditions:

$$u'_y(c^1_y) [1 + \sigma_1] = \lambda_1, \quad (\text{a.1})$$

$$u'_y(c^2_y) [1 - \sigma_1] = \lambda_1, \quad (\text{a.2})$$

$$u'_o(c^1_o) = \lambda_1, \quad (\text{a.3})$$

$$u'_o(c^1_o) [1 + \sigma_1] = \lambda_2, \quad (\text{a.4})$$

$$u'_o(c^2_o) [1 - \sigma_1] = \lambda_2, \quad (\text{a.5})$$

$$v'(\bar{l} - l_t^1)[1 + \sigma_1] = \lambda_1 a^1 F_{L_1}, \quad (\text{a.6})$$

$$v'(\bar{l} - l_t^2) - \sigma_1 v'(\bar{l} - al_t^2) a = \lambda_1 a^2 F_{L_1}, \quad (\text{a.7})$$

$$\lambda_1 = \beta \lambda_2 F_{K_2}, \quad (\text{a.8})$$

$$c_{y_1}^1 + c_{y_1}^2 + c_{o_1}^1 + c_{o_1}^2 + K_2 = F(\bar{K}_1, a^1 l_1^1 + a^2 l_1^2), \quad (\text{a.9})$$

$$c_{y_2}^1 + c_{y_2}^2 + c_{o_2}^1 + c_{o_2}^2 = F(K_2, a^1 l_2^1 + a^2 l_2^2), \quad (\text{a.10})$$

$$u_y(c_{y_1}^1) + \beta u_o(c_{o_2}^1) + v(\bar{l} - l_1^1) = u_y(c_{y_1}^2) + \beta u_o(c_{o_2}^2) + v(\bar{l} - al_1^2). \quad (\text{a.11})$$

$$u_y(c_{y_2}^1) + v(\bar{l} - l_2^1) = u_o(c_{y_2}^2) + v(\bar{l} - al_2^2). \quad (\text{a.12})$$

Appendix b: First Order Conditions of the Political Equilibrium

Period 2:

$$u_y'(c_{y_2}^1)[1 + \sigma_2] = \lambda_2, \quad (\text{b.1})$$

$$u_y'(c_{y_2}^2)[1 - \sigma_2] = \lambda_2, \quad (\text{b.2})$$

$$u_o'(c_{o_2}^i) = \lambda_2, \quad (\text{b.3})$$

$$v'(\bar{l} - l_t^1)[1 + \sigma_2] = \lambda_2 a^1 F_{L_2}, \quad (\text{b.4})$$

$$v'(\bar{l} - l_t^2) - \sigma_2 v'(\bar{l} - al_t^2) a = \lambda_2 a^2 F_{L_2}, \quad (\text{b.5})$$

$$c_{y_2}^1 + c_{y_2}^2 + c_{o_2}^1 + c_{o_2}^2 = F(K_2, a^1 l_2^1 + a^2 l_2^2), \quad (\text{b.6})$$

$$u_y(c_{y_2}^1) + v(\bar{l} - l_2^1) = u_y(c_{y_2}^2) + v(\bar{l} - al_2^2). \quad (\text{b.7})$$

Period 1:

$$u_y'(c_{y_1}^1)[1 + \sigma_1] = \lambda_1, \quad (\text{b.8})$$

$$u_y'(c_{y_1}^2)[1 - \sigma_1] = \lambda_1, \quad (\text{b.9})$$

$$u'_o(c'_{o1}) = \lambda_1, \quad (\text{b.10})$$

$$v'(\bar{l} - l^1_t)[1 + \sigma_1] = \lambda_1 a^1 F_{L1}, \quad (\text{b.11})$$

$$v'(\bar{l} - l^2_t) - \sigma_1 v'(\bar{l} - a l^1_t) = \lambda_1 a^2 F_{L1}, \quad (\text{b.12})$$

$$c_{y1}^1 + c_{y1}^2 + c_{o1}^1 + c_{o1}^2 + K_2 = F(\bar{K}_1, a^1 l^1_t + a^2 l^2_t), \quad (\text{b.13})$$

$$u_y(c_{y1}^1) + v(\bar{l} - l^1_t) = u_y(c_{y1}^2) + v(\bar{l} - a l^1_t),^{20} \quad (\text{b.14})$$

$$\lambda_1 = 2\beta\lambda_2 \frac{dc_{o2}^1}{dK_2}.^{21} \quad (\text{b.15})$$

Appendix c: A Specific Example

Given the utility functions as specified in section 5, equations (4), (5) and (6) can be written as follows:

$$vc_{y_t}^1 = a^1 F_{L_t}, \quad (\text{c.1})$$

$$vc_{y_t}^2 = a^2 F_{L_t} - \frac{\sigma_t v[1-a]}{[1-\sigma_t]} c_{y_t}^2, \quad (\text{c.2})$$

$$[1 + \sigma_t] c_{y_t}^2 = [1 - \sigma_t] c_{y_t}^1. \quad (\text{c.3})$$

Rearranging (c.1) and (c.2) and inserting in (c.3) gives:

$$c_{y_t}^1 = \frac{a^1}{v} F_{L_t}, \quad (\text{c.4})$$

²⁰ The utility of consumption during retirement does not need to be considered in the self-selection constraint, because both retirees receive the same consumption level in period 2.

²¹ Equation (b.15) is derived from $\beta u'_o(c'_{o2})[1 + \sigma_1] \frac{dc_{o2}^1}{dK_2} + \beta u'_o(c'_{o2})[1 - \sigma_1] \frac{dc_{o2}^2}{dK_2} = \lambda_1$, given

$$u'_o(c'_{o2}) = u'_o(c'_{o2}) \text{ which implies } \frac{dc_{o2}^1}{dK_2} = \frac{dc_{o2}^2}{dK_2}.$$

$$c_{v_t}^2 = \frac{[3a-1]a^1}{[1+a]v} F_{L_t}, \quad (c.5)$$

$$\sigma_t = \frac{1-a}{2a}. \quad (c.6)$$

Equations (b.1), (b.3), (b.8), (b.10), (c.4) and (c.6) give:

$$c_{o_t}^1 = \frac{2a^2}{[1+a]v} F_{L_t}. \quad (c.7)$$

Inserting (c.4), (c.5), (c.8) and the Cobb-Douglas production function in (b.6) gives:

$$\frac{8a^2}{[1+a]v} [1-\alpha] = L_2. \quad (c.8)$$

This gives:

$$l_2^2 = \frac{8[1-\alpha]}{[1+a]v} - \frac{l_2^1}{a}. \quad (c.9)$$

Inserting (c.4), (c.5) and (c.7) into (b.7) gives:

$$\ln\left(\frac{a^1}{v} F_{L_2}\right) - \ln\left(\frac{[3a-1]a^1}{[1+a]v} F_{L_2}\right) = vl_2^1 - avl_2^2. \quad (c.10)$$

Inserting (c.9) and rearranging finally gives:

$$l_2^1 = \frac{4a[1-\alpha]}{[1+a]v} - \frac{1}{2v} \ln\left(\frac{3a-1}{1+a}\right), \quad (c.11)$$

$$l_2^2 = \frac{4[1-\alpha]}{[1+a]v} + \frac{1}{2va} \ln\left(\frac{3a-1}{1+a}\right). \quad (c.12)$$