INTRA-GENERATIONAL EXTERNALITIES AND INTER-GENERATIONAL TRANSFERS

MARTIN KOLMAR
VOLKER MEIER

CESIFO WORKING PAPER NO. 1437
CATEGORY 1: PUBLIC FINANCE
MARCH 2005

CESifo *Working Paper No. 1437*

INTRA-GENERATIONAL EXTERNALITIES AND INTER-GENERATIONAL TRANSFERS

Abstract

In an environment with asymmetric information the implementation of a first-best efficient Clarke-Groves-Vickrey (D'Aspremont-Gérard-Varet) mechanism may not be feasible if it has to be self-financing. By using intergenerational transfers, the arising budget deficit can generally be covered in every generation if the growth rate of the economy is positive. This result yields an alternative explanation for the existence of pay-as-you-go financed transfer mechanisms.

JEL Code: D82, H23, H55.

Keywords: pay-as-you-go, externalities, mechanism design, adverse selection.

Martin Kolmar
Department of Economics
University of Mainz
Welderweg 4
55128 Mainz
Germany
kolmar@uni-mainz.de

Volker Meier
Ifo Institute for Economic Research at the University of Munich
Poschingerstr. 5
81679 Munich
Germany
meier@ifo.de

1 Introduction

In this paper we show that making use of intergenerational transfers can be necessary and sufficient to achieve a Pareto improvement if otherwise non-internalizable intragenerational externalities exist. In order to generate intragenerational externalities that are not a consequence of an *ad-hoc* restriction of the set of admissible mechanisms, we use an environment with asymmetric information. For this class of problems the realization of intragenerational gains from trade – or, what is the same, the internalization of intragenerational externalities – is not trivial because mechanisms cannot be directly contingent on the information parameters of the problem. Our argument that intergenerational transfers can improve the allocation is based on the relaxation of participation constraints that hold if a generation tries to implement a potentially Pareto-improving mechanism. Although it is difficult to find externalities that have no intergenerational component in practice, a number of externalities in production and consumption mostly affect adults in their working age. It is therefore worthwhile to analyze the limiting case in which intergenerational components do not exist.

To be more specific, suppose that individuals can take actions that affect – through some arbitrary channel – the wellbeing of other individuals in the same generation. While the actions are observable, the types that may, for example, determine the psychic and monetary costs associated with these actions are private information. A government tries to implement a mechanism which induces every individual to take an action that yields in combination an efficient allocation. However, the implementation of a mechanism has to ensure that everybody is at least as well off as in a reference allocation without this mechanism. This requirement does not create a problem if individuals are sufficiently similar. With efficiency gains approximately equally distributed, everybody is willing to pay a lump sum that finances the incentive payments of a direct mechanism. Having a more differentiated population often implies a situation in which some individuals have a rather low willingness to pay for achieving a proposed efficient allocation. In the asymmetric information framework, these individuals cannot be identified *ex ante* and compensated accordingly. Consequently, some types earn information rents, and the maximum lump sum that can be collected may not cover the expenses for the incentive payments in full. As a result, the transfer mechanism is not feasible if it has to be self-financing.

Intergenerational transfers from the young to the old can close the gap between necessary expenses and the maximum revenue that can be collected without harming anyone in the old generation. This can take the form of a pay-as-you-go pension entitlement for the old being contingent on actions taken during their working life, a flat pension benefit, or public debt in general. However, the problem to finance the budget deficit of the mechanism arises again for the young who may face the same structure of intragenerational externalities as in the predecessor generation and who, in addition, have to be compensated for the transfer they have given to the old. It is shown that the resulting scheme of intra- and intergenerational transfers is sustainable if the economy exhibits a positive growth rate and if, in addition, this growth rate exceeds the growth rate of the minimum budget deficit necessary to achieve efficiency.

Our contribution adds a new argument to the literature dealing with the Pareto-improving role of intergenerational transfers. This literature has put forward four lines of argument to show that intergenerational transfers may be necessary to Pareto-improve the allocation of an intertemporal economy.

The first argument is based on the dynamic inefficiency of an overlapping-generations economy if individual preferences for old-age consumption are sufficiently strong. High rates of private savings may imply a capital stock that is too high. Channelling savings away from the capital market is thus a means to make every generation better off (Samuelson, 1958).

Second, in an economy with exogenous interest rate intergenerational transfers play the role of a chain letter. As long as some type of transversality condition is not violated and no last period exists, intergenerational transfers can make every generation better off (Spremann, 1984).

Third, Merton (1983) argues that if the risks on capital and labor markets are not perfectly and positively correlated, it may be useful to introduce some element of pay-as-you-go financed intergenerational redistribution in order to efficiently hedge risks.

Fourth, intergenerational externalities, for example in the form of human capital investments between parents and children (Peters, 1995; Kolmar, 1997; Sinn, 2000), in the form of technological externalities because of increasing returns to scale (Wigger, 2001), or in the form of the exploitation of a non-renewable resource create a sufficient argument in favor of intergenerational transfers. In each case intergenerational gains from trade exist. These gains can be captured by implementing a scheme in which the older generation receives a pay-as-you-go pension as a compensation for sacrificing consumption opportunities during the working period in favour of the younger generation. Intergenerational transfers are necessary to achieve a Pareto improvement because the generation that has to make the sacrifice would inevitably be worse off if it changed its incentive scheme as to internalize the externality without transfers.

Our contribution may be seen as turning around an argument from the debate on Pareto-improvements by abolishing a pay-as-you-go scheme being financed by distortionary taxation (Breyer, 1989; Homburg, 1990; Fenge, 1995; Brunner, 1996). Gains for each generation may be realized by getting rid of static inefficiencies that would not exist without the pay-as-you-go scheme. Conversely, in our framework it is the introduction of the pay-as-you-go scheme that enables the economy to remove externalities. Hence, abolishing it can create static inefficiencies that could otherwise be internalized.

The remainder of our paper is organized as follows. In the next section, we introduce the basic model of intragenerational externalities in a economy characterized by intertemporally segregated generations and a structure of asymmetric information. Section 3 describes the set of Pareto-efficient allocations and first-best mechanisms that induce one of these allocations. Subsequently, section 4 discusses participation constraints and presents a necessary and sufficient condition under which a self-financing first-best mechanism is no longer feasible. Section 5 analyzes the issue of sustainability when both intragenerational and intergenerational transfers are used to achieve a first-best allocation. After discussing an example in section 6, the final section 7 concludes.

2 The model

We consider a discrete time model in which we have a sequence $t = 1, ...$ of periods. In every period of time there lives a number m^t of individuals, constituting generation t. Our assumption that generations do not overlap represents a reduced form of a standard overlapping-generations framework in which no intergenerational spillovers exist except for potential transfers. This convention is used in order to keep the notation as simple as possible. Focusing on intragenerational externalities, we stress that choices of individuals do not affect previous or succeeding generations. In an extension, we borrow from the standard overlapping-generations model the property of possible transfers from younger to older generations. In every period t, an individual $i = 1, ..., m^t$ is characterized by her type $\theta_i^t \in \Theta_i^t \subset \mathbb{R}$. This type is her private information. Denote by θ^t the vector of realized types $\{\theta_i^t, ..., \theta_m^t\}$, being an element of the set of potential type profiles $\Theta^t = \Theta_1^t \times ... \times \Theta_m^t$. For convenience we assume that the type determines the utility function of an individual, $U(., \theta_i^t)$. The probability distribution governing nature's choice of types is common knowledge.

Every individual can choose an action a_i^t from a set of possible actions A_i^t. The vector of actions is denoted by $a^t = \{a_1^t, ..., a_m^t\} = \{a_i^t, a_{-i}^t\}$, and $A^t = A_1^t \times ... \times A_m^t$ is the collection of action sets in period t. The utility of an individual depends both on the choices of all individuals in her generation, a^t, and on a transfer $b_i^t \in \mathbb{R}$, $b^t = \{b_1^t, ..., b_{m^t}^t\} \in B^t = \mathbb{R}^{m^t}$ of a storable private good. This formulation of an allocation problem allows for a very general structure of spillovers and types of goods that are traded within the economy. Virtually any type of intragenerational interdependency between individual actions and utilities can be interpreted as a special case of the above specification, ranging from perfectly rival to perfectly non-rival goods.

In our basic setup, we abstain from intergenerational transfers. This implies that the transfer budget must be balanced in every period:

$$\sum_{i=1}^{m^t} b_i^t = 0, \quad t = 1, ... \tag{1}$$

The utility function of an individual is given by

$$U(a^t, b_i^t, \theta_i^t) = v(a^t, \theta_i^t) + b_i^t, \quad i = 1, ..., m^t. \tag{2}$$

In accordance with the literature on mechanism design, the utility function is assumed to be additively separable between a^t and t_i^t and linear in the latter argument. The first component v will be called action utility. It fulfills the single-crossing property,

$$v(a_i^t, a_{-i}^t, \hat{\theta}_i^t) - v(\bar{a}_i^t, a_{-i}^t, \hat{\theta}_i^t) > v(a_i^t, a_{-i}^t, \tilde{\theta}_i^t) - v(\bar{a}_i^t, a_{-i}^t, \tilde{\theta}_i^t) \Leftrightarrow \quad \hat{\theta}_i^t > \tilde{\theta}_i^t \wedge a_i^t \neq \bar{a}_i^t, \tag{3}$$

which generates convenient monotonicity properties (Milgrom, 2004).

In the following we analyze the case that generations are intertemporally separated. This means that the choices made by members of generation t have no impact on the economic environment or the number of individuals in period $t+1$ or any other future period. In addition, we assume that intergenerational transfers are absent in the initial situation prior to the implementation of an efficient mechanism. In this reference allocation individual i in period t achieves a utility level of $U_i^M(\theta^t)$, where the vector of reservation utilities in period t is denoted by $U^M(\theta^t) = \{U_1^M(\theta^t), ..., U_{m^t}^M(\theta^t)\}$. This initial situation can have various interpretations. In a positive interpretation of the model it can range from anarchy to a private-property economy, or any form of a more explicit institutional structure that generates a potentially inefficient outcome. In a normative contractarian interpretation of the model, it can be a situation of ideal equality under a veil of ignorance (Rawls, 1971). Irrespective of the precise interpretation of this initial situation, it leads to a vector of reservation utilities for every individual in each generation. This vector specifies a minimum acceptance point for every individual in the sense that every allocation that generates a lower level of utility can be blocked.

To summarize, an economy is characterized by $\{m^t, U, U^M, \Theta^t, A^t, B^t\}_{t=1,...}$.

3 Pareto-efficient allocations and direct mechanisms

We start by a characterization of Pareto-efficient allocations. First note that the set of Pareto-efficient allocations can be found by the maximization of the unweighted sum of utilities because of the assumption of quasi-linear utilities. The case of intertemporally separated generations is particularly easy to solve because the intertemporal optimum $\{a^t, b^t\}_{t=1,...}$ can be derived by the separate solution of each period's optimal policy $\{a^t, b^t\}$ for the case of symmetric information.

Recalling the budget equation (1), the first-best efficient allocation for every period t can be characterized as follows:

$$\max_{a(\theta^t),\ t(\theta^t)} \sum_{i=1}^{m^t} \left(v(a(\theta^t), \theta_i^t) + b_i^t(\theta^t)\right) = \max_{a(\theta^t)} \sum_{i=1}^{m^t} v(a(\theta^t), \theta_i^t). \tag{4}$$

In general, the optimal choice of a^t will be a function of θ^t because otherwise the type would be irrelevant. Denote by $a^{t*} = a^{t*}(\theta^t)$ such an optimal solution and by $P(\theta^t)$ the maximum sum of utilities. The linear terms $b^*(\theta^t)$ are indeterminate within a certain range and will be used to control incentives.

We are looking for conditions under which intergenerational redistribution is necessary and sufficient for a Pareto improvement. It is therefore necessary to assume that every generation chooses an institutional structure that is as efficient as possible, given that no transfers between generations occur. Any argument in favor of intergenerational redistribution that is not based on an inevitable friction of the intratemporal problem is *ad hoc* in the sense that a better organization of the intratemporal allocation problem would be an alternative to intertemporal redistribution.

In order to implement a^{t*} the society can use a period-t mechanism $M^t = \{S^t, f\}$ that assigns strategy sets $S^t = \{S_1^t, ..., S_{m^t}^t\}$ to every individual $i = 1, ..., m^t$ in period t and a mapping $f : S^t \to (a^t, b^t)$ that selects a choice vector a^t for any given vector of strategies s^t. We call an allocation (a^t, b^t) Bayesian implementable if it is a Bayesian-Nash equilibrium of the game induced by mechanism M^t.

We know from standard implementation theory that every choice vector a^t that can be implemented by an arbitrary mechanism can also be implemented by a direct mechanism $M_d^t = \{\Theta^t, (a^t, b^t)\}$ (Mas Colell, Whinston and Green, 1995). Because we want to focus on the role of intergenerational transfers under ideal institutional structures we will therefore restrict attention to optimal direct mechanisms in the following.

Our analysis follows the approach of Makowski and Mezzetti (1994) who contrary to most of their predecessors first look at conditions under which the incentive compatibility constraints are fulfilled and then analyze the participation constraints. This way of dealing with the problem is analytically easy to handle and is more adequate to our problem than the alternative approach to assume that the participation constraints are fulfilled and then check for the incentive compatibility constraints. We will first characterize the first-best efficient direct mechanism. In the next section we investigate the conditions under which a Pareto-improving implementation of this mechanism is or is not possible. The latter case defines necessary conditions for the Pareto-improving role of intergenerational transfers. In order to complete our argument in favor of intergenerational transfers we finally have to characterize conditions under which a scheme of intra- and intergenerational transfers is also sustainable.

Denote by $E^t[.]$ the non-contingent expected value and by $E_i^t[.]$ the contingent expected value of [.] for a given type θ_i^t, $i = 1, ..., m^t$. A Bayesian-Nash equilibrium of the direct mechanism M_d^t is a vector of strategies θ^t such that

$$\begin{aligned} E_i^t[U(a^t(\theta^t), b_i^t(\theta^t), \theta_i^t)] &\geq E_i^t[U(a^t(\hat{\theta}_i^t, \theta_{-i}^t), b_i^t(\hat{\theta}_i^t, \theta_{-i}^t), \theta_i^t)] \\ \forall\, \hat{\theta}_i^t &\in \Theta_i^t \; \forall\, i = 1, ..., m^t. \end{aligned} \tag{5}$$

It is now straightforward to characterize the properties of an efficient direct mechanism. In order to implement $a^{t*}(\theta^t)$, individuals need to have an incentive to reveal their true type θ_i^t.

Lemma 1: *Any efficient direct mechanism involves a transfer rule obeying*

$$b_i^t(\hat{\theta}^t{}_i, \theta_{-i}^t) = E^t \left[\sum_{j \neq i} v(a^{t*}(\hat{\theta}_i^t, \theta_{-i}^t), \theta_j^t) \right] + \gamma_i^t, \quad i = 1, ...m^t, \tag{6}$$

where γ_i^t is a constant.

Proof. Compare the condition for an efficient allocation (4) with the individual condition for rational behavior in a Bayesian-Nash equilibrium, (5). Recalling the utility function (2) then shows that both problems coincide if and only if b^t fulfills (6). With this transfer the individual maximization problem reads:

$$\max_{\hat{\theta}_i^t \in \Theta_i^t} E_i^t \left[v(a^{t*}(\hat{\theta}_i^t, \theta_{-i}^t), \theta_i^t) + \sum_{j \neq i} v(a^t(\hat{\theta}_i^t, \theta_{-i}^t), \theta_j^t) \right] + \gamma_i^t, \quad i = 1, ..., m^t. \tag{7}$$

For every individual $i = 1, ..., m^t$, the maximum of this function is at $\hat{\theta}_i^t = \theta_i^t$ by construction. It can easily be verified that the class of efficient mechanisms is unambiguously determined except for the constant terms γ_i^t (see D'Aspremont and Gérard-Varet, 1979). □

Lemma 1 states that the transfer is equal to the sum of the expected action utilities of all other individuals plus a constant. This rule ensures that everybody acts so as to maximize the sum of all expected utilities.

4 Feasibility without intergenerational transfers

Without intergenerational transfers the budget constraint $\sum_{i=1}^{m^t} b_i^t = 0$ has to be fulfilled. In order to find out whether the first-best mechanism is feasible without relying on external resources, we have to check if the constant terms γ^t can be chosen so as to balance the budget. Denote by $D^t(\gamma^t)$ the expected deficit of the efficient mechanism with constant terms γ^t. If $\gamma_1^t = ... = \gamma_{m^t}^t = 0$, the expected deficit is equal to

$$D(0) := (m^t - 1)E^t[P(\theta^t)] = (m^t - 1)\ E^t\left[\sum_{i=1}^{m^t} v(a^{t*}(\theta^t), \theta_i^t)\right]. \tag{8}$$

Hence, an efficient mechanism can be implemented without intergenerational transfers if and only if the sum of constant terms γ^t, multiplied by -1, is not smaller than $D(0)$, where the boundary is determined by

$$\begin{aligned}\sum_{i=1}^{m^t} b_i &= \sum_{i=1}^{m^t}\left(E^t\left[\sum_{j\neq i} v(a^{t*}(\hat{\theta}_i^t, \theta_{-i}^t), \theta_j^t)\right] + \gamma_i^t\right) \\ &= (m^t - 1)E^t\left[\sum_{i=1}^{m^t} v(a^{t*}(\theta^t), \theta_i^t)\right] + \sum_{i=1}^{m^t}\gamma_i^t = 0. \end{aligned} \tag{9}$$

Assume that the reservation utility of individual i in the case that the mechanism is not implemented is equal to $U_i^M(\theta^t)$. The precise specification of this reservation utility depends on the *status quo* alternative that is used as a benchmark for the evaluation of the implementation of an efficient mechanism, as being discussed in section 2. Since the qualitative nature of our argument does not rely on the numerical values of the $U_i^M(\theta^t)$, we do not have to specify the economic environment that generates them. However, we will analyze the allocation of a private good in a private-property economy as an example in section 6. The assumption of private property will then generate an explicit value of the reservation utilities.

Given this framework, Proposition 1 describes the necessary and sufficient condition for being able to implement a first-best allocation without intergenerational transfers.

Proposition 1: *If and only if* $D(0) \leq -\sum_{i=1}^{m^t} M_i^t$ *with*

$$M_i^t := \max_{\theta_i^t \in \Theta_i^t}\left\{E_i^t[U_i^M(\theta^t)] - E_i^t\left[\sum_{j=1}^{m^t} v(a^{t*}(\hat{\theta}_j^t, \theta_{-j}^t), \theta_j^t)\right]\right\}$$

holds in every period, it is possible to implement an intertemporally efficient allocation without intergenerational transfers.

Proof. The implementation of an efficient mechanism M_d^t is Pareto-improving if and only if

$$E_i^t\left[\sum_{j=1}^{m^t} v(a^{t*}(\hat{\theta}_j^t, \theta_j^t), \theta_j^t)\right] + \gamma_i^t \geq E_i^t[U_i^M(\theta^t)], \quad i = 1, ..., m^t. \tag{10}$$

Noting that γ_i^t cannot be contingent on θ_i^t because of the asymmetry of information, (10) has to be fulfilled for all possible realizations of the type, implying that:

$$\gamma_i^t \geq M_i^t := \max_{\theta_i^t \in \Theta_i^t} \left\{ E_i^t[U_i^M(\theta^t)] - E_i^t\left[\sum_{j=1}^{m^t} v(a^{t*}(\hat{\theta}_j^t, \theta_{-j}^t), \theta_j^t)\right]\right\}, \tag{11}$$

which defines a participation constraint for individual i in period t. Hence, only if

$$D(\gamma^t) = D(0) + \sum_{i=1}^{m^t} \gamma_i^t \leq 0 \;\Leftrightarrow\; D(0) \leq -\sum_{i=1}^{m^t} \gamma_i^t \leq -\sum_{i=1}^{m^t} M_i^t \tag{12}$$

holds, it is possible to implement an efficient mechanism without intergenerational transfers. □

Proposition 1 indicates under which condition intergenerational transfers may be useful to achieve a Pareto improvement. Notice that the threshold values M_i^t will typically be negative if the sum of the expected action utilities is positive, and vice versa.

Condition (11) restricts the lump-sum payments that can be imposed on an individual from above. If the condition stated in Proposition 1 is violated, it is no longer possible to arrive at a first-best allocation by means of a self-financing mechanism. Of course, this does not exclude a Pareto-improvement compared to the reference allocation through some other self-financing mechanism.

The feasibility problem is in fact a result of asymmetric information. The next proposition demonstrates that in a world with symmetric information the first-best allocation can be achieved without intergenerational transfers.

Proposition 2: *With symmetric information implementing a first-best allocation is feasible without relying on intergenerational transfers.*

Proof. With symmetric information, type-contingent transfers γ_i^t can be used. The threshold levels are given by

$$\gamma_i^t \geq M_i^t := E_i^t \left[U_i^M(\theta^t)\right] - E_i^t \left[\sum_{j=1}^{m^t} v(a^{t*}(\hat{\theta}_j^t, \theta_{-j}^t), \theta_j^t)\right]. \tag{13}$$

Implementing a first-best allocation without intergenerational transfers is feasible if

$$\begin{aligned} D(0) = (m^t - 1)E^t \left[\sum_{j=1}^{m^t} v(a^{t*}(\hat{\theta}_j^t, \theta_{-j}^t), \theta_j^t)\right] \quad &\leq \\ \sum_{j=1}^{m^t} E_i^t \Big(U_i^M(\theta^t) - \sum_{j=1}^{m^t} v(a^{t*}(\hat{\theta}_j^t, \theta_{-j}^t), \theta_j^t)\Big) \quad &= \quad -\sum_{i=1}^{m^t} M_i^t, \end{aligned}$$

which is equivalent to

$$\sum_{j=1}^{m^t} E_t^i \left[v(a^{t*}(\hat{\theta}_j^t, \theta_{-j}^t), \theta_j^t)\right] \geq \sum_{j=1}^{m^t} E_t^i \left[U_i^M(\theta^t)\right].$$

This latter condition is always satisfied with strict inequality because gains from the coordination of actions exist. $\square$

Proposition 2 is easily understood. If information about the individuals' types is symmetrically distributed, differentiated lump-sum payments can be used. It is then possible to design the transfer structure such that everybody gets exactly her reservation utility while the first-best action vector is induced. Such a scheme will be associated with a budget surplus because internalizing the externalities at a balanced budget must lead to a higher sum of expected utilities. The arising budget surplus can then be distributed to make everybody better off. With asymmetric information, many individuals may receive unavoidable information rents if a mechanism is implemented in order to achieve a first-best allocation. As a result, the gain in aggregate utility may not be sufficient to finance these rents.

5 Sustainability with intergenerational transfers

We know from the above analysis that a first-best efficient allocation can be reached only if the transfer rule (6) is fulfilled in all periods. Recalling that Lemma 1 describes the set of efficient direct mechanisms, the question as to whether it is actually possible to implement a first-best efficient allocation is answered by finding out if

γ^t can be set such that (12) is fulfilled. Depending on the structure of the intragenerational allocation problem, (12) may or may not be fulfilled if information is asymmetrically distributed. If the gains from trade from the implementation of an efficient mechanism are sufficiently large for all realizations of types θ^t, we can expect that the implementation of an efficient mechanism is in fact a Pareto-improvement. However, it is easy to construct examples where this condition is not satisfied. For example, Myerson and Satterthwaite (1983) have shown that it is impossible to reach efficiency in a situation of bilateral trade with private property rights if gains from trade exist in expectation, but not for every realization of types. If such a situation occurs, intergenerational transfers may play a Pareto-improving role. In order to demonstrate this, let

$$\bar{W}(\theta^t, m^t, a^t, U^M) = D(0) + \sum_{i=1}^{m^t} M_i^t \tag{14}$$

be the minimum external amount of resources that would be necessary to create a Pareto-improvement by implementing an efficient mechanism in generation t. In general, $\bar{W}^t$ depends on the nature of the allocation problem, the preferences of the individuals, and the size of the population. In the following we extend our basic model of intertemporally separated generations by allowing for transfers from any younger generation $t+1$ to its predecessor generation t. This can be done by simply reinterpreting (2) as representing the indirect utility function of the standard overlapping generations model where the individual has already optimized her savings behavior.

Given that every generation $t+1$ pays a transfer $W\left(\theta^t\right)$ to its predecessor generation, the budget constraint (1) of a generation t becomes

$$\sum_{i=1}^{m^t} t_i^t + W(\theta^{t-1}) - W(\theta^t) = 0. \tag{15}$$

Intergenerational transfers can hence make it possible to implement an efficient allocation for all generations t if and only if

$$\bar{W}(\theta^t) \leq W(\theta^t) - W(\theta^{t-1}), \quad t = 1, ... \tag{16}$$

Neglecting the asymptotic behavior of $W(.)$ such a transfer scheme is possible to implement in principle (see Spremann, 1984). The problem is to construct a scheme which is sustainable. For a finite time horizon, a first-best mechanism is called sustainable if it is possible to cover all budget deficits. If we have an infinite time horizon, the corresponding condition is that public debt per capita converges to zero. Our notion of sustainability is of course very narrow. It is also conveivable to call a scheme sustainable if debt per capita does not exceed a finite threshold or even if the ratio between public debt and GDP does not exceed some finite number. However, neither alternative is a generalization of the requirement in the finite horizon framework that all debt has to be repaid.

In the following, we implicitly assume that transfers do not alter production in the economy. Thus, a budget surplus can only be stored. In order to keep the analysis as simple as possible, we exclude the option to invest such surpluses in order to generate some additional output in the next period. This amounts to setting the interest rate to zero.

Assume that the intergenerational transfer mechanism is first to be implemented in period $t = 1$ and that a transfer $\bar{W}^1$ is first paid to generation 1 by generation 2. We can easily derive the necessary and sufficient condition for being able to implement a first-best mechanism when the economy ceases to exist at the end of period T.

> **Proposition 3:** *For every finite time horizon T a necessary and sufficient condition for the implementation of a first-best mechanism in every period is that the sequence of transfers $\{W^t\}_{t=1,...,T} = \{\sum_{i=1}^{t} \bar{W}^i\}_{t=1,...,T}$ satisfies $\sum_{i=1}^{T} \bar{W}^i \leq 0$.*

Proof. According to (16), the minimum intergenerational transfer sufficient to implement an efficient mechanism for all generations $1, ..., t$ is equal to

$$W^t = \sum_{i=1}^{t} \bar{W}^i.$$

Noticing this condition, the claim is an immediate consequence of the definition of a sustainable scheme. □

Proposition 3 states that deficits in some periods have to be at least compensated by surpluses in other periods. Otherwise, it is impossible to cover every budget deficit that arises between the first period $t = 1$ and the last period T. Given that the nature of the allocation problem and the preferences of the individuals do not change over time, this condition can only be fulfilled if there is either positive or negative population growth. With a constant population size and $\bar{W}^t > 0$ for some t, the deficit $\bar{W}^t$ is constant and positive in all periods. In the next section we will present an example of an economy with only private goods in which $\bar{W}^t$ decreases in m^t. The following corollary is an immediate implication of Proposition 3.

> **Corollary:** *There exists no Pareto-improving introduction of a sequence of transfers* $\{W^t\}_{t=1,...,T} = \{\sum_{i=1}^{t} \bar{W}^i\}_{t=1,...,T}$ *with* $\bar{W}^t \neq 0$ *for at least one t that implements a first-best mechanism in every period.*

Proof. Every minimum deficit $\bar{W}^t > 0$ in an arbitrary period t has to covered by a subsequence of surpluses $\bar{W}^\tau < 0$, $\tau \subset \{1, ..., T\}$. In these periods τ it would have been possible to implement an efficient mechanism without any transfers. Hence, any transfer $\bar{W}^\tau < 0$ reduces consumption in period τ, which implies that at least one individual is worse off compared to the *status quo*. □

Hence, with a finite time horizon, it is impossible to make every individual in each generation better off by introducing intergenerational transfers. While a Pareto-efficient allocation may be achieved by implementing the scheme of intra- and intergenerational transfers, a generation that is a net payer can even do better in the absence of the intergenerational transfer scheme. In that case it can implement a first-best allocation for its members and leave the full period budget surplus for their consumption.

Next we focus on an infinite time horizon. The gross intergenerational transfer in the receiving generation is $w(\theta^t) = W(\theta^t)/m^t$ *per capita*. We start by considering the situation in which the population grows at a constant rate $\mu = m^{t+1}/m^t - 1 \ \forall \ t$ and the minimum deficit $\bar{W}$ grows at a constant rate $\eta \ \forall \ t$. Proposition 4 collects the conditions under which debt per capita converges to zero.

> **Proposition 4:** *With an infinite time horizon and constant growth rates of the population and the period budget deficit, implementing a first-best mechanism in every period is sustainable if and only if the rate of population growth,* μ*, is both positive and higher than the growth rate of the deficit,* η*, that is,* $\mu > 0$ *and* $\mu > \eta$*.*

Proof. With a constant population growth rate and a constant minimum-deficit growth rate, population at time t is equal to $m^t = (1 + \mu)^{t-1} m^1$, and the aggregate minimum deficit at time t can be expressed as $W^t = \sum_{i=1}^{t} \bar{W}^i = \bar{W}^1((1+\eta)^t - 1)/\eta$. Hence, debt per capita in period t can be expressed as

$$w^t = \frac{\bar{W}^1}{m^1} \frac{(1+\eta)^t - 1}{\eta(1+\mu)^{t-1}} \tag{17}$$

if $\eta \neq 0$, and $w^t = (t\bar{W}^1)/(m^1(1+\mu)^{t-1})$ if $\eta = 0$. The claim then follows immediately from considering $\lim_{t\to\infty} w_t$. □

Since aggregate debt increases steadily irrespective of the growth rate of the deficit, a positive rate of population growth is necessary for having a debt per capita that converges to zero. Should the growth rate of the budget deficit be positive, an even higher growth rate of the population is necessary and sufficient for reducing debt per capita period per period.

Propositions 3 and 4 have some obvious implications for the more general scenarios without constant growth rates. For example, if the growth rate of the population is always positive and higher than the growth rate of the deficit, debt *per capita* will converge to zero. In contrast, if the population does never increase and the budget deficit is always positive, the intergenerational transfer scheme is not sustainable.

Of course, as it will also turn out in the example in the next section, $\bar{W}^t$ is in general a function of the population size, $\bar{W}^t = \bar{W}(m^t)$. Again, we can draw some obvious conclusions by recalling Propositions 3 and 4. Debt *per capita* will converge to zero if population increases at a minimum growth rate $\mu_{\min} > 0$ while at the same time the function $\bar{W}$ is non-increasing. With an increasing function $\bar{W}$, the intergenerational transfer scheme is sustainable if in every period the rate of population growth exceeds the growth rate of the deficit. Further, a shrinking population may go along with a sustainable scheme if we have budget surpluses for small populations and budget deficits for large populations. If the deficit is positive for all population sizes, a constant or shrinking population can never imply that debt per capita converges to zero.

6 Example with private goods

In this section we illustrate the above argument by means of an example. We assume that a private (that means rival and excludable) good is traded and that private property exists, which determines the reservation utility of each individual.

Assume that at every point of time t there is a potential seller of an indivisible unit of a private good, called individual 1. This individual has with probability 1/2 a utility of consuming her good that is equal to 1, and with probability 1/2 a utility of consuming her good that is equal to 0. There are $m^t - 1 \geq 1$ potential buyers of the good with utilities of a or $(1+a)$, $a \in (0,1)$, and probabilities 1/2, 1/2 respectively. The utilities represent types, and the random draws are independent of each other. Each individual learns her type before trade takes place, but not the types of the other individuals. Denote by $a_i^t \in \{0,1\}$, $\sum_{i=2,\dots,m^t} a_i^t \leq 1$, the act of trading the good with individual i at t. Normalizing the utility in case of no consumption to zero, this implies a utility before transfers of

$$v(a^t, \theta_1^t) = (1 - \sum_{i=2,\dots,m^t} a_i^t)\theta_1^t \tag{18}$$

for individual 1, and

$$v(a^t, \theta_i^t) = a_i^t \theta_i^t \tag{19}$$

for individuals $i = 2, \dots, m^t$.

As in Myerson and Satterthwaite (1983), the problem is to implement a mechanism that induces every individual to reveal her type and at the same time satisfy the governments' budget constraint. Intuitively, the mechanism has to avoid a scenario in which agents are not willing to engage in mutually beneficial trade. This may happen if they can rationally expect to get better terms by not agreeing to the proposed price and continuing the bargaining process. An efficient mechanism implies an ex-post surplus of $\max\{\theta_1^t, \dots, \theta_m^t\}$. Given this surplus the expected deficit of an uncompensated CGV-mechanism is equal to

$$\begin{aligned} D^t(0) &= (m^t - 1)E[\max\{\theta_1, \dots, \theta_m^t\}] = (m^t - 1)\frac{\left(2^{m^t} - 2\right)(1+a) + 1 + a}{2^{m^t}} \\ &= (m^t - 1)\frac{\left(2^{m^t} - 1\right)(1+a)}{2^{m^t}}. \end{aligned} \tag{20}$$

The maximum transfer M_i^t that individual i is willing to accept without generating a conflict with its participation constraint is equal to

$$\begin{aligned} M_1^t &= \max_{\theta_1 \in \{0,1\}} \left\{\theta_1^t - E_1^t[\max\{\theta_1^t, \theta_2^t, \dots, \theta_m^t\}]\right\} \\ &= 1 - E_1^t[\max\{1, \theta_2^t \dots, \theta_m^t\}] \\ &= 1 - \frac{1}{2^{m^t-1}} - \frac{2^{m^t-1} - 1}{2^{m^t-1}}(1+a) \end{aligned} \tag{21}$$

for individual 1, and

$$
\begin{aligned}
M_i^t &= \max_{\theta_i \in \{a,1+a\}} \left\{0 - E_i^t[\max\{\theta_1^t, ..., \theta_m^t\}]\right\} \\
&= -E_i^t[\max\{\theta_1^t, ..., a, ..., \theta_m^t\}] \\
&= -\frac{\left(2^{m^t-1} - 2\right)(1+a) + 1 + a}{2^{m^t-1}} = -\frac{2^{m^t-1} - 1}{2^{m^t-1}}(1+a) \qquad (22)
\end{aligned}
$$

for individuals $i = 2, ..., m^t$. Hence, the intergenerational net transfer that is necessary to balance the budget is equal to

$$
\begin{aligned}
\bar{W}(\theta^t) &= D^t(0) + \sum_{i=1}^{m^t} M_i^t \\
&= (m^t - 1)\frac{2^{m^t} - 1}{2^{m^t}}(1+a) + \left(1 - \frac{1}{2^{m^t-1}} - \frac{2^{m^t-1} - 1}{2^{m^t-1}}(1+a)\right) \\
&\quad -(m^t - 1)\left(\frac{2^{m^t-1} - 1}{2^{m^t-1}}(1+a)\right) \\
&= 1 - 2^{1-m^t} + 2^{-m^t}(2^{m^t} - 1)(1+a)(m^t - 1) \\
&\quad -2^{1-m^t}(2^{-1+m^t} - 1)(1+a)m^t. \qquad (23)
\end{aligned}
$$

It is straightforward to check that the sign of this condition depends on a as well as on m^t. The locus $\bar{W}(\theta^t) = 0$ is given by a monotonically decreasing and convex function $a(m^t)$, with $a < a(m^t)$ implying that $\bar{W}(\theta^t) > 0$. Two results from the literature emerge as special cases. First, for $m^t = 2$ we get $\bar{W}(\theta^t) = (1-a)/4 > 0$. This is the famous impossibility result by Myerson and Satterthwaite (1983) who were the first who have shown that bilateral trade is necessarily inefficient for small groups of traders. Second, for $m^t \to \infty$ we get $\lim_{m^t \to \infty} \bar{W}(\theta^t) = -a < 0$, which replicates the result by Gresik and Sattherthwaite (1989) who have shown that the inefficiency vanishes if the number of potential traders increases. Hence, there is no need for intergenerational transfers in our example if the economy is sufficiently large.

On the other hand, if $a < a(m^t)$ holds, balancing the budget is only possible by means of intergenerational transfers. However, in a growing economy, $m^{t+1} > m^t \; \forall t$ it is always possible to find a non-exploding scheme. Noting that $m^{t+1} \geq m^t + 1$ in this case, the range in which $a > a(m^t)$ is valid will be reached in finite time. Therefore, there exists an intergenerational transfer scheme from the young to the old that allows the implementation of a Pareto-efficient mechanism in every period

t if T is sufficiently large. If $T \rightarrow \infty$ a Pareto-improving transfer scheme always exists.

7 Concluding discussion

We have demonstrated that implementing a first-best allocation in an environment with asymmetric information and only intragenerational externalities can require the use of intergenerational transfers. Since the self-financing constraint of the mechanism cannot be satisfied, additional funds are needed. These funds are provided by the succeeding generation, which can be achieved by setting up a pay-as-you-go pension scheme. Of course, if an alternative source for receiving the additional government revenue is available as, for example, borrowing from abroad, the problem may also be solved without making use of pay-as-you-go pensions or some similar arrangement. However, if government borrowing on a perfect capital market is considered, it should be noted that the debt will never be repaid by the generation that receives the benefits. Otherwise, future tax payments will be taken into account such that the additional funds today do not contribute to relax the participation constraints. If future generations have to pay back the internal or external public debt, the transfer scheme is virtually identical to a pay-as-you-go pension scheme. A sustainable scheme with a *per-capita* debt converging to zero requires a growing population if a budget deficit arises in every period.

The proposed scheme can also work in a shrinking economy, which may be characterized by a negative population growth rate. An efficient allocation in all periods can, for example, be achieved when we have budget surpluses in smaller economies. With budget surpluses in some periods, at least one generation of net contributors can improve its position by abolishing the transfer scheme. When the notion of sustainability is relaxed by allowing for some finite *per-capita* debt in the limit or a positive maximum debt-output ratio, a growing population may no longer be necessary for a sustainable scheme with budget deficits in every period. If we allowed for growing labor productivity, a constant or even declining population can go along with an increasing aggregate output over time.

If the proposed scheme is not sustainable, using some resources from intergenerational transfers will generally harm at least one of the succeeding generations. However, the typical situation in practice will be that achieving a first-best allocation in one generation involves some elements of intergenerational spillover in the sense that it enlarges the production capacities in the next generation. As already stated at the outset, such a component of intergenerational spillover would already necessitate intergenerational transfers.

References

AARON, H. J. (1966), "The Social Insurance Paradox", *Canadian Journal of Economics and Political Science*, **32**, 371-374.

ARROW, K. (1979), "The Property Rights Doctrine and Demand Revelation under Incomplete Information", in M. Boskin (ed.), *Economics and Human Welfare* (New York: Academic Press), 23-39.

BREYER, F. (1989), "On the Intergenerational Pareto Efficiency of Pay-As-You-Go Financed Pension Systems", *Journal of Institutional and Theoretical Economics*, **145**, 643-658.

BRUNNER, J. K. (1996), "Transition from a Pay-As-You-Go to a Fully Funded Pension System: The Case of Differing Individuals and Intragenerational Fairness", *Journal of Public Economics*, **60**, 131-146.

D'ASPREMONT, C. and GÉRARD-VARET, L. A. (1979), "Incentives and Incomplete Information", *Journal of Public Economics*, **11**, 25-45.

FENGE, R. (1995), "Pareto Efficiency of the Pay-As-You-Go Pension System with Intragenerational Fairness", *Finanzarchiv*, **52**, 357-363.

GREEN, J. and LAFFONT, J. J. (1979), *Incentives in Public Decision Making* (Amsterdam: North-Holland).

GRESIK, T. A. and SATTERTHWAITE, M. A. (1989), "The Rate at Which a Simple Market Converges to Efficiency as the Number of Traders Increases: An Asymptotic Result for Optimal Trading Mechanisms", *Journal of Economic Theory*, **48**, 304-332.

GROVES, T. (1973), "Incentives in Teams", *Econometrica*, **41**, 617-631.

HOMBURG, S. (1990), "The Efficiency of Unfunded Pension Schemes", *Journal of Institutional and Theoretical Economics*, **146**, 640-647.

KOLMAR, M. (1997), "Intergenerational Redistribution in a Small Open Economy with Endogenous Fertility", *Journal of Population Economics*, **10**, 335-356.

MAKOWSKI, L. and MEZZETTI, C. (1994), "Bayesian and Weakly Robust First Best Mechanisms: Characterizations", *Journal of Economic Theory*, **64**, 500-519.

MAS-COLELL, A., WHINSTON, M. D. and GREEN, J. R. (1995), *Microeconomic Theory* (New York: Oxford University Press).

MERTON, R.C. (1983), "On the Role of Social Security as a Means for Efficient Risk Sharing in an Economy where Human Capital is not Tradable" in Z. Bodie and J. Shoven (eds.), *Financial Aspects of the United States Pension System* (Chicago and London: University of Chicago Press), 325-358.

MILGROM, P. (2004), *Putting Auction Theory to Work*, (Cambridge, MA: Cambridge University Press).

MYERSON, R. B. and SATTERTHWAITE, M. A. (1983), "Efficient Mechanisms for Bilateral Trading", *Journal of Economic Theory*, **28**, 265-281.

PETERS, W. (1995), "Public Pensions, Family Allowances and Endogenous Demographic Change", *Journal of Population Economics*, **8**, 161-183.

RAWLS, J. (1971), *A Theory of Justice* (Cambridge, MA: Harvard University Press).

SAMUELSON, P. A. (1958), "An Exact Consumption-Loan Model of Interest with or without the Social Contrivance of Money", *Journal of Political Economy*, **66**, 467-482.

SINN, H.-W. (2000), "Why a Funded Pension System is Useful and Why It Is Not Useful", *International Tax and Public Finance*, **7**, 389-410.

SPREMANN, K. (1984), "Intergenerational Contracts and their Decomposition", *Journal of Economics*, **44**, 237-253.

WIGGER, B. U. (2001), "Pareto-Improving Intergenerational Transfers", *Oxford Economic Papers*, **53**, 260-280.

CESifo Working Paper Series

(for full list see www.cesifo.de)

1374 Sascha O. Becker, Karolina Ekholm, Robert Jäckle and Marc-Andreas Mündler, Location Choice and Employment Decisions: A Comparison of German and Swedish Multinationals, January 2005

1375 Christian Gollier, The Consumption-Based Determinants of the Term Structure of Discount Rates, January 2005

1376 Giovanni Di Bartolomeo, Jacob Engwerda, Joseph Plasmans, Bas van Aarle and Tomasz Michalak, Macroeconomic Stabilization Policies in the EMU: Spillovers, Asymmetries, and Institutions, January 2005

1377 Luis H. R. Alvarez and Erkki Koskela, Progressive Taxation and Irreversible Investment under Uncertainty, January 2005

1378 Theodore C. Bergstrom and John L. Hartman, Demographics and the Political Sustainability of Pay-as-you-go Social Security, January 2005

1379 Bruno S. Frey and Margit Osterloh, Yes, Managers Should Be Paid Like Bureaucrats, January 2005

1380 Oliver Hülsewig, Eric Mayer and Timo Wollmershäuser, Bank Loan Supply and Monetary Policy Transmission in Germany: An Assessment Based on Matching Impulse Responses, January 2005

1381 Alessandro Balestrino and Umberto Galmarini, On the Redistributive Properties of Presumptive Taxation, January 2005

1382 Christian Gollier, Optimal Illusions and Decisions under Risk, January 2005

1383 Daniel Mejía and Marc St-Pierre, Unequal Opportunities and Human Capital Formation, January 2005

1384 Luis H. R. Alvarez and Erkki Koskela, Optimal Harvesting under Resource Stock and Price Uncertainty, January 2005

1385 Ruslan Lukach, Peter M. Kort and Joseph Plasmans, Optimal R&D Investment Strategies with Quantity Competition under the Threat of Superior Entry, January 2005

1386 Alfred Greiner, Uwe Koeller and Willi Semmler, Testing Sustainability of German Fiscal Policy. Evidence for the Period 1960 – 2003, January 2005

1387 Gebhard Kirchgässner and Tobias Schulz, Expected Closeness or Mobilisation: Why Do Voters Go to the Polls? Empirical Results for Switzerland, 1981 – 1999, January 2005

1388 Emanuele Bacchiocchi and Alessandro Missale, Managing Debt Stability, January 2005

1389 Assar Lindbeck and Dirk Niepelt, Improving the SGP: Taxes and Delegation rather than Fines, January 2005

1390 James J. Heckman and Dimitriy V. Masterov, Skill Policies for Scotland, January 2005

1391 Emma Galli & Fabio Padovano, Sustainability and Determinants of Italian Public Deficits before and after Maastricht, January 2005

1392 Angel de la Fuente and Juan Francisco Jimeno, The Private and Fiscal Returns to Schooling and the Effect of Public Policies on Private Incentives to Invest in Education: A General Framework and Some Results for the EU, January 2005

1393 Juan C. Conesa and Carlos Garriga, Optimal Response to a Demographic Shock, January 2005

1394 Christian Gollier, Optimal Portfolio Management for Individual Pension Plans, February 2005

1395 Ruslan Lukach, Joseph Plasmans and Peter M. Kort, Innovation Strategies in a Competitive Dynamic Setting, February 2005

1396 Gebhard Kirchgässner, (Why) Are Economists Different?, February 2005

1397 Marko Köthenbürger, Panu Poutvaara and Paola Profeta, Why are More Redistributive Social Security Systems Smaller? A Median Voter Approach, February 2005

1398 Gabrielle Demange, Free Choice of Unfunded Systems: A First Assessment, February 2005

1399 Carlos Fonseca Marinheiro, Sustainability of Portuguese Fiscal Policy in Historical Perspective, February 2005

1400 Roel M. W. J. Beetsma and Koen Vermeylen, The Effect of Monetary Unification on Public Debt and its Real Return, February 2005

1401 Frank Asche, Petter Osmundsen and Maria Sandsmark, Is It All Oil?, February 2005

1402 Giacomo Corneo, Media Capture in a Democracy: The Role of Wealth Concentration, February 2005

1403 A. Lans Bovenberg and Thijs Knaap, Ageing, Funded Pensions and the Dutch Economy, February 2005

1404 Thiess Büttner, The Incentive Effect of Fiscal Equalization Transfers on Tax Policy, February 2005

1405 Luisa Fuster, Ayşe İmrohoroğlu and Selahattin İmrohoroğlu, Personal Security Accounts and Mandatory Annuitization in a Dynastic Framework, February 2005

1406 Peter Claeys, Policy Mix and Debt Sustainability: Evidence from Fiscal Policy Rules, February 2005

1407 James M. Malcomson, Supplier Discretion over Provision: Theory and an Application to Medical Care, February 2005

1408 Thorvaldur Gylfason, Interview with Assar Lindbeck, February 2005

1409 Christian Gollier, Some Aspects of the Economics of Catastrophe Risk Insurance, February 2005

1410 Gebhard Kirchgässner, The Weak Rationality Principle in Economics, February 2005

1411 Carlos José Fonseca Marinheiro, Has the Stability and Growth Pact Stabilised? Evidence from a Panel of 12 European Countries and Some Implications for the Reform of the Pact, February 2005

1412 Petter Osmundsen, Frank Asche, Bård Misund and Klaus Mohn, Valuation of International Oil Companies –The RoACE Era, February 2005

1413 Gil S. Epstein and Shmuel Nitzan, Lobbying and Compromise, February 2005

1414 Marcel F. M. Canoy, Jan C. van Ours and Frederick van der Ploeg, The Economics of Books, February 2005

1415 Eric A. Hanushek and Ludger Wößmann, Does Educational Tracking Affect Performance and Inequality? Differences-in-Differences Evidence across Countries, February 2005

1416 George Kapetanios and M. Hashem Pesaran, Alternative Approaches to Estimation and Inference in Large Multifactor Panels: Small Sample Results with an Application to Modelling of Asset Returns, February 2005

1417 Samuel Mühlemann, Jürg Schweri, Rainer Winkelmann and Stefan C. Wolter, A Structural Model of Demand for Apprentices. February 2005

1418 Giorgio Brunello and Lorenzo Rocco, Educational Standards in Private and Public Schools, February 2005

1419 Alex Bryson, Lorenzo Cappellari and Claudio Lucifora, Why so Unhappy? The Effects of Unionisation on Job Satisfaction, March 2005

1420 Annalisa Luporini, Relative Performance Evaluation in a Multi-Plant Firm, March 2005

1421 Giorgio Bellettini and Carlotta Berti Ceroni, When the Union Hurts the Workers: A Positive Analysis of Immigration Policy, March 2005

1422 Pieter Gautier, Michael Svarer and Coen Teulings, Marriage and the City, March 2005

1423 Ingrid Ott and Stephen J. Turnovsky, Excludable and Non-Excludable Public Inputs: Consequences for Economic Growth, March 2005

1424 Frederick van der Ploeg, Back to Keynes?, March 2005

1425 Stephane Dees, Filippo di Mauro, M. Hashem Pesaran and L. Vanessa Smith, Exploring the International Linkages of the Euro Area: a Global VAR Analysis, March 2005

1426 Hans Pitlik, Friedrich Schneider and Harald Strotmann, Legislative Malapportionment and the Politicization of Germany's Intergovernmental Transfer System, March 2005

1427 Konstantinos Angelopoulos and Apostolis Philippopoulos, The Role of Government in Anti-Social Redistributive Activities, March 2005

1428 Ansgar Belke and Daniel Gros, Asymmetries in the Trans-Atlantic Monetary Policy Relationship: Does the ECB follow the Fed?, March 2005

1429 Sören Blomquist and Luca Micheletto, Optimal Redistributive Taxation when Government's and Agents' Preferences Differ, March 2005

1430 Olof Åslund and Peter Fredriksson, Ethnic Enclaves and Welfare Cultures – Quasi-Experimental Evidence, March 2005

1431 Paul De Grauwe, Roberto Dieci and Marianna Grimaldi, Fundamental and Non-Fundamental Equilibria in the Foreign Exchange Market. A Behavioural Finance Framework, March 2005

1432 Peter Egger, Stefan Gruber, Mario Larch and Michael Pfaffermayr, Knowledge-Capital Meets New Economic Geography, March 2005

1433 George Economides and Apostolis Philippopoulos, Should Green Governments Give Priority to Environmental Policies over Growth-Enhancing Policies?, March 2005

1434 George W. Evans and Seppo Honkapohja, An Interview with Thomas J. Sargent, March 2005

1435 Helge Berger and Volker Nitsch, Zooming Out: The Trade Effect of the Euro in Historical Perspective, March 2005

1436 Marc-Andreas Muendler, Rational Information Choice in Financial Market Equilibrium, March 2005

1437 Martin Kolmar and Volker Meier, Intra-Generational Externalities and Inter-Generational Transfers, March 2005