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PARETO IMPROVEMENTS BY IN-KIND-TRANSFERS

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Abstract: This paper shows that in-kind-transfers are an effective instrument to stabilize agreements when compliance cannot be guaranteed. It demonstrates the weak superiority of in-kind-transfers for a unilateral relationship between two agents. In particular, it proves that, under conditions of perfect knowledge and necessary self-enforcement of contracts, both agents are at least not worse off by in-kind-transfers compared to monetary payments when no self-enforcing contract exists which is based on monetary payments. This result holds for finitely and for infinitely repeated games.

1. Introduction

Non-cooperative game theory has proved that finitely repeated games often result in inefficient outcomes under conditions of certainty and full rationality (Selten (1978)). The outcome of such games which can be developed by recursive induction exhibits the same properties which are observable for a one-shot-game. If commitments are not enforceable, the dominant strategies lead to a non-exploitation of possible gains as the prisoners' dilemma most dramatically illustrates. To my knowledge, the economic literature presents exclusively exemplifying numbers and corresponding utility functions to display the utilities which accrue to the agents. These numbers reflect the total utility which the involved agents assign to a specific outcome. It is therefore natural to focus on monetary payments which increase or decrease the real numbers if certain compensations are to be paid in a game of mutual exchange.

However, the assumption of transfers which are only variable with respect to their amount prevents further insights into stabilization policies. E.g., assume - as we will do in the remainder - a unilateral relationship in which the (consumption) activities of an agent B can concern an agent A harmfully but not vice versa. If the total gains of a restructuring of B's activities are positive, A could principally pay B for changing his plans. But if any commitment is not enforceable, B's dominant strategy is to take the money and breach the contract which induces A to refrain from any compensation.

But if A is alternatively able to deliver certain commodities to B which are known to decrease the harmful effect and can only be resold at a price which is lower than the market price, the lack of any self-enforcing transfer is not obvious. It is the purpose of this paper to discuss the potential stabilizing role of such in-kind-transfers which has - to my knowledge - been by and large unnoticed by the literature.[1] On the contrary, economic advisers often complain about in-kind-transfers and accuse them to represent an inefficient compensation instrument. Section 2 will outline the basic assumptions for a unilateral externality relationship between two agents. Section 3 will prove five propositions and a Theorem which demonstrates the relevance of in-kind-transfers for

1 Blackorby and Donaldson (1988) discuss the role of in-kind-transfers for discriminating between real and pretended claims of receivers and Bruce and Waldman (1991) demonstrate that in-kind-transfers are an efficient respond to an inefficient behaviour of recipients who attempt to manipulate the magnitude of transfers (see also the literature quoted there). Most of the economic literature dealing with transfers addresses transfer paradoxes, i.e. transfers which increase the

self-enforcement issues. Section 4 will deal with the impact of in-kind-transfers on infinitely repeated games and Section 5 will discuss several applications. Section 6 will address the limitations and possible extensions and will draw conclusions for a reassessment of in-kind-transfers.

2. The Nature of In-Kind-Transfers

Assume that time-invariant utility functions (1) and a by-product function (2) represent a unilateral relationship between an agent A and an agent B:

(1) $u^A = u^A (X_1^A, ..., X_n^A, b)$

$u^B = u^B (X_1^B, ..., X_n^B)$

with $\partial u^C/\partial X_i^C \geq 0, \quad \partial^2 u^C/\partial X_i^{C2} \leq 0$

for all C= A,B and all i=1,...,n

$\partial^2 u^C/\partial X_i^C \partial X_j^C = 0$

for all C= A,B and all $i \neq j \in \{1,...,n\}$

$\partial u^A/\partial b < 0, \quad \partial^2 u^A/\partial b^2 > 0$

(2) $b = b \ (X_1^B, ..., X_n^B)$

Agent C consumes the total amount of the commodity i which is denoted by X_i^C and directly enters his utility function. Two sets K and L distinguish the properties of the by-product function (2):

$$K \cup L = (X_1^B, ..., X_n^B), \ K \cap L = \emptyset, K,L \neq \emptyset$$

$$\forall X_k^B \in K: \ \partial b/\partial X_k^B \geq 0, \quad \partial^2 b/\partial X_k^{B2} \geq 0$$

$$\forall X_l^B \in L: \ \partial b/\partial X_l^B < 0, \quad \partial^2 b/\partial X_l^{B2} \geq 0$$

$$\partial^2 b/\partial X_i^B \partial X_j^B = 0 \text{ for all } i \neq j, \ i \neq j \in \{1,...,n\},$$

$$X_i^B, X_j^B \in K \cup L$$

utility of donors and decrease the utility of receivers (see Rao (1992) and the quoted literature there). In this paper, the assumption of constant prices will rule out any transfer paradoxes.

The utilities of both agents and the by-product are a function of the *total sum* of commodities. The utility functions exhibit the usual properties[2] and rule out any scope effects which are surpressed for the by-product function, too.[3] A non-empty set L assumes at least one commodity to exist for B which lowers the by-product by an increase in consumption. Otherwise, mutual improvements conflict with an increase of total benefits because every restructuring of B's activities which induces a lower by-product would make B worse off. Because non-enforcement is at the heart of this paper, it rules any coercive measures out.

This paper assumes that agent A is a Stackelberg leader and agent B a follower. Hence, A anticipates the reaction of B but B does not anticipate the compensation policy of A. This assumption conceives A as an agent who is fully aware of by-products which originate from B's activities and B as an agent who is totally ignorant with respect to the influence of his consumption plans on A.[4] Both agents are facing constraints which are composed of their constant individual incomes, the compensations paid and received, respectively, and the expenses for commodities. In a cooperative setting which ensures compliance, B would adjust his output according to

$$(3) \qquad \frac{\partial u^B}{\partial X_i^B} = \lambda\, q_i - \frac{\partial u^A}{\partial b} \frac{\partial b}{\partial X_i^B} \quad \forall\, i$$

with λ as the shadow price of the total budget constraint and q_i as the price of commodity i.

This outcome could be guaranteed by a (C^*,b^*)-contract which specifies the optimal level of by-products b^* according to (3) and the compensations C^* which must at least make B not worse off. To ensure that this paper discusses a real problem, b^* must fall short from the outcome of the isolated utility maximization of B.

If any enforcement possibilities are absent, any compensation will only increase B's budget at first glance. But even in such a case, mutual improvements are possible if B's marginal utility for harmful commodities "immediately" approaches zero whereas it is

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2 The utility functions assume also that the inequality for the first derivative induces an inequality for the second one. The same applies to the $X_k^B \in K$ with respect to the by-product function.

3 The appendix addresses scope effects and deals with the general second-order-conditions.

4 Basically, this assumption originates from better tractability. Except concerning Proposition 4, the reader will be able to verify that the salient results do not change if B is able to anticipate the policy of A.

still sufficiently positive for commodities belonging to L. Then, it can even pay for A to support a non-compliant B when the disutility of compensations is at least outweighted by the utility which originates from the increased consumption of commodities belonging to L. Generally, a non-compliant B will adjust his consumption in the case of monetary compensations, C_M, according to

$$(4) \qquad \frac{\partial u^B}{\partial X_i^B} = \lambda^* q_i$$

with λ^* as the changed (at least lower) shadow price which represents B's marginal utility of income.

Alternatively, A is able to deliver certain goods to B and to bear the corresponding costs $C_I = \Sigma\, q_i\, z_i$. z_i represents the specific amount of in-kind-transfers. Contrary to financial compensations, any retrading of received commodities incurs certain costs which originate from change costs, irreversibilities, discounts for used commodities, etc. I assume that these costs, c_i, are constant (i.e. independent of the retrading degree) and to be borne by agent B. Hence, (5) gives the maximization problem of B when he receives in-kind-transfers

$$(5) \qquad \max_{x,y}\ u^B (X_1^B, ..., X_n^B) \text{ s.t.}$$

$$\forall\, i: \quad X_i^B = x_i^B + z_i - y_i$$

$$z_i - y_i \geq 0$$

$$Y^B + \sum_i (q_i - c_i)\, y_i - \sum_i q_i\, x_i = 0$$

If a certain amount of in-kind-transfers, z_i, endows B, B has to decide on how many of these commodities he wants to retrade, i.e. y_i. The retraded commodities yield a price of $q_i - c_i$ per unit. The commodities spent by B, i.e. X_i^B, sum up to the self-bought ones, i.e. x_i^B, plus the remaining in-kind-transfers. According to the Kuhn-Tucker-Theorem with L as the Lagrangian function, (6) indicates the optimality conditions:

(6) $\forall i \in K \cup L$:

$$\frac{\partial L}{\partial x_i^B} = \frac{\partial u^B}{\partial X_i^B} - \lambda' q_i \leq 0, \quad x_i^B \geq 0, \quad x_i^B \quad \frac{\partial L}{\partial X_i^B} = 0$$

$$\frac{\partial L}{\partial y_i} = - \frac{\partial u^B}{\partial X_i^B} + \lambda'(q_i - c_i) \leq 0, \qquad y_i \geq 0,$$

$$y_i \quad \frac{\partial L}{\partial y_i} = 0$$

$$\rho_i = 0, \ z_i - y_i \geq 0$$

ρ_i is the shadow price of the condition that agent B cannot retrade more in-kind-transfers than he has received from A. $\rho_i = 0$ is a direct consequence of the utility function's curvature. If an agent preferred a redevotion of in-kind-transfers above the actual non-negative level, he must have allocated his commodities inefficiently before compensations were given. The non-negative marginal utility with respect to all commodities ensures that there is never a positive shadow price of the endowment constraint.

The assumption of positive levels x_i^B and y_j is convenient to show that according to a reformulation of (6)

$$(7) \qquad \frac{\partial u^B}{\partial X_i^B} = \lambda' q_i \text{ and } \frac{\partial u^B}{\partial X_j^B} = \lambda' (q_j - c_j)$$

cannot hold for i = j. That means that either x_i^B is positive and y_i zero or x_i^B is zero and y_i is positive or both are zero. Without lack of generality, we will omit the last case because it does not add any new information to the economics of in-kind-transfers.

(7) indicates that in-kind-transfers drive a wedge between the marginal utilities of the *total amount* of commodities which receive in-kind-transfers and those which do not. The propositions of Chapter 3 will reveal that this wedge is apt to improve the performance of self-enforcing agreements because in-kind-transfers can enforce a certain consumption pattern which monetary transfers are likely to fail.

3. Pareto Improvements by In-Kind-Transfers

Any positive compensation improves B's situation. (8) displays A's marginal utility with respect to a change in compensations:

$$(8)\qquad \frac{du^A}{dC} = \sum_i \frac{\partial u^A}{\partial X_i^A}\,\frac{dX_i^A}{dC} + \frac{\partial u^A}{\partial b}\,\sum_j \frac{\partial b}{\partial X_j^B}\,\frac{dX_j^B}{dC}$$

which can be negative for any given C or reach a maximum for some positive C's. Note that - for a positive C - dX_i^A/dC, i.e. the *change in A's consumption* which originates from given transfers, is non-positive and negative for at least one commodity because A has to sacrifice a part of his consumption bundle to pay the transfers given to B. The maximizing conditions are

$$(9)\qquad \frac{du^A}{dC} \leq 0 \quad , C \geq 0, \qquad C\,\frac{du^A}{dC} = 0$$

As mentioned above, even monetary compensations can improve A's welfare.[5] But in-kind-transfers can improve on an outcome that attributes zero monetary compensations to the optimal policy of A.

Proposition 1: *An empty set of monetary transfers which improve A's welfare does not necessarily imply a corresponding empty set of in-kind-transfers.*

Proof: An empty set of monetary payments directly translates into $du^A/dC\ (C_M=0) \leq 0$. Without lack of generality, suppose that $L = \{X_l\}$, i.e. the improving compensation is concentrated on only one commodity. Total differentiation of B's *optimal compensation-dependent utility* gives

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[5] Note that an interior solution, i.e. C > 0, fulfills the sufficient condition of standard maximization, i.e.

$$du^{A2} = \sum_i \frac{\partial^2 u^A}{\partial X_i^{A2}}\, dX_i^{A2} + \frac{\partial^2 u^A}{\partial b^2} \sum_j \frac{\partial^2 b}{\partial X_j^{B2}}\, dX_j^{B2} < 0$$

Hence, the employed functions always guarantee the second-order-conditions to be fulfilled for an interior solution. The appendix addresses the question of sufficient conditions for more general functions.

$$\frac{du^B}{dC} = \sum_{j \neq l} \frac{\partial u^B}{\partial X_j^B} \frac{dX_j^B}{dC} + \frac{\partial u^B}{\partial X_l^B} \frac{dX_l^B}{dC} \quad \text{or}$$

$$\frac{dX_l^B}{dC} = \frac{\dfrac{du^B}{dC} - \sum_{j \neq l} \dfrac{\partial u^B}{\partial X_j^B} \dfrac{dX_j^B}{dC}}{\dfrac{\partial u^B}{\partial X_l^B}}$$

Keep in mind that this formula displays a change in the optimal non-compliance utility. This change originates from a change of the degree of compensations. At point $C = 0$, all terms in the numerator are identical for monetary and in-kind-transfers. Furthermore, at $C = 0$ the shadow price of the budget constraint is λ' (see (6)). The denominator, however, differs dependent on the mode of compensations. According to (4) and (7) with M and I denoting monetary and in-kind-transfers, it turns out for positive costs c_l that

(10) $$[\partial u^B/\partial X_l^B]_M = \lambda' q_l > [\partial u^B/\partial X_l^B]_I = \lambda' (q_l - c_l)$$

which is equivalent to

(11) $$[dX_l^B/dC]_I > [dX_l^B/dC]_M \text{ and}$$

$$du^A/dC\ (C_I{=}0) > du^A/dC\ (C_M{=}0), \text{ q.e.d.}$$

Hence, there may exist situations in which in-kind-transfers are able to improve A's welfare whereas monetary ones do not. Proposition 2 restricts the respective instrumental set of agent A.

Proposition 2: *If only in-kind-transfers can maximize the welfare of agent A, the set of efficient in-kind-transfers is a subset of L.*

Proof: The condition $Y^A - \Sigma q_i z_i - \Sigma q_i X_i^A = 0$ constrains A's utility maximization which yields the optimality conditions for all z as

(12) $\forall$ i,j $\in K \cup L$:

$$\frac{\partial u^A}{\partial b} \sum_j \frac{\partial b}{\partial X_j^B} \frac{\partial X_j^B}{\partial z_i} - \lambda^A q_i \leq 0,$$

$$z_i \geq 0,$$

$$z_i \left\{\frac{\partial u^A}{\partial b} \sum_j \frac{\partial b}{\partial X_j^B} \frac{\partial X_j^B}{\partial z_i} - \lambda^A q_i \right\} = 0.$$

The optimal partial derivatives of the total consumption of X_j^B with respect to the in-kind-transfer are a result of the utility maximization of B according to (7). Additionally, $\partial u^B/\partial z_i$ is given by the net price of retrading times the shadow price λ^*:

$$\frac{\partial X_j^B}{\partial z_i} = \frac{\partial u^B/\partial z_i}{\partial u^B/\partial X_j^B} \quad \text{with} \quad \frac{\partial u^B}{\partial z_i} = \lambda^* (q_i - c_i)$$

$$\frac{\partial u^B}{\partial X_i^B} = \lambda^* (q_i - c_i) \quad \text{for the in-kind-transfer itself}$$

$$\frac{\partial u^B}{\partial X_j^B} = \lambda^* q_j \quad \text{for all } j \neq i \text{, i.e. for all other commodities}$$

Thus,

$$\frac{\partial X_i^B}{\partial z_i} = 1 \quad \text{and} \quad \frac{\partial X_j^B}{\partial z_i} = \frac{q_i - c_i}{q_j} = \omega_{ij} \quad \text{for all } j \neq i,$$

$$0 \leq \omega_{ij} < q_i/q_j$$

Hence, the optimality condition is given by

(13) $\forall$ i,j $\in K \cup L$:

$$\frac{\partial u^A}{\partial b} \frac{\partial b}{\partial X_i^B} + \frac{\partial u^A}{\partial b} \sum_{j \neq i} \frac{\partial b}{\partial X_j^B} \omega_{ij} \leq \lambda^A q_i$$

If $i \in K$, A can easily be better off by changing to monetary transfers because the beneficial effects are lower in the case of in-kind-transfers. The factor for harmful consumption is unity whereas the factors for beneficial consumption, ω_{il}, are lower than q_l/q_i which would be valid for monetary transfers. Hence, because the superiority of monetary compensations was ruled out, the set of employed z_i is a subset of L. Q.e.d.

A salient conclusion is given in

Proposition 3: *For any degree C of compensations, agent A is at least not better off by substituting in-kind-transfers $l \in L$ developed according to (13) by monetary transfers.*

Proof: Note that (10) and (11) are also fulfilled for a given arbitrary C (change λ' by λ^*). Proposition 2 restricts the set of efficient options to a subset of L as it was demonstrated for in Proposition 1. Q.e.d.

But the corresponding proposition does not automatically apply to agent B. Defining $\vartheta = \{y_l \mid y_l \in L, u^B(y_l,c_l) \geq u^B(C_M^*)\}$ leads to

Proposition 4: *If the optimal in-kind-transfer policy of A belongs to ϑ, agent B is not better off by substituting in-kind-transfers by monetary transfers.*

Proof: Omitted

The set ϑ defines the set of in-kind-transfers which does not worsen the outcome for B compared to the optimal monetary transfer policy. Proposition 4 stipulates that agent B's disutility which originates from enforcing a specific consumption pattern must fall short of the utility of a greater endowment of in-kind-transfers compared to monetary transfers. Agent A as a Stackelberg leader does not automatically meet this condition because he evaluates his in-kind-transfer policy according to changes in the by-product. The following lemma helps to explain the essential meaning of Proposition 3:

Lemma: *If $\Sigma(q_l - c_l)y_l > C_M^*$ holds for the optimal in-kind-transfer policy, both agents are not worse off by the introduction of in-kind-transfers.*

In such a case, in-kind-transfers ensure at least this consumption of commodities which monetary transfers enable to consume. The lemma always applies if the optimal monetary transfers are zero. But it does not describe a complete condition because B's utility function defines implicitly a frontier of in-kind-transfers which just outweigh consumption pattern and endowment effects. This frontier belongs to ϑ but does not meet the lemma's condition.

Propositions 1-3 reveal that in a world of perfect information and non-enforcement, agent A cannot be worse off by the introduction of in-kind-transfers. Because this conclusion incorporates the optimal C_M as well as the optimal C_I, to exploit the advantages of in-kind-transfers is always a weakly dominant strategy for agent A. Together with Proposition 4, Propositions 1-3 have proven the following Theorem:

Theorem of Weak Pareto Superiority of In-Kind-Transfers:

Under conditions of perfect knowledge, if any agreement is not enforceable (i.e. must be self-enforcing), if the utilities and the by-product are given by (1) and (2), if retrading incurs positive costs and if the optimal in-kind-transfer policy belongs to ϑ, both agents are at least not worse off by in-kind-transfers compared to monetary transfers.

In such a case, A is able to enforce a certain consumption pattern of B which monetary transfers fail to meet. The Theorem always holds if A denies any positive monetary transfers because they do not improve his situation. However, if the optimal policy does not belong to ϑ, the Stackelberg leader A is able to improve his situation at the expense of B's utility.

Assuming positive amounts of two in-kind-transfer-commodities l and m and deviding the respective optimality conditions yields

$$\frac{\dfrac{\partial b}{\partial X_l^B} + \dfrac{\partial b}{\partial X_m^B}\,\omega_{lm} + \sum\limits_{i\neq l,m} \dfrac{\partial b}{\partial X_i^B}\,\omega_{il}}{\dfrac{\partial b}{\partial X_m^B} + \dfrac{\partial b}{\partial X_l^B}\,\omega_{ml} + \sum\limits_{i\neq l,m} \dfrac{\partial b}{\partial X_i^B}\,\omega_{im}} = \frac{q_l}{q_m}$$

The first terms in either numerator and denominator represent the unity-weighted direct effect and the second and the third terms represent the effects of changes in beneficial and harmful consumption, respectively. The formula reveals that - ceteris paribus - the lower the coefficients $\omega_{i.}$ are for an in-kind-transfer the higher is their relative share. $q_l = c_l$ and $q_m = c_m$ gives

$$(14) \qquad \frac{\partial b/\partial X_l^B}{\partial b/\partial X_m^B} = \frac{q_l}{q_m}$$

However, this "best non-compliance world" for self-enforcing agreements cannot substitute enforcement.

Proposition 5: *Generally, every self-enforcing agreement sustained by in-kind-transfers does not coincide with the cooperative outcome of full compliance (even if $q_l = c_l$ for all l in-kind-transfer-commodities).*

Proof: Suppose that for all m in-kind-transfers with $X_m^B \in M \subseteq L$, $q_m = c_m$. Agent B adjusts his consumption plan according to

$$\frac{\partial u^B}{\partial X_i^B} = \lambda' q_i \text{ for all } i \neq m \text{ and } \frac{\partial u^B}{\partial X_m^B} = 0 \text{ for all } X_m^B \in M$$

Because in-kind-transfers are not retradable, the shadow price λ remains at the λ'-level. A social optimum, however, would demand

$$i \in K \cup L: \quad \frac{\partial u^B}{\partial X_i^B} = \lambda q_i - \frac{\partial u^A}{\partial b} \frac{\partial b}{\partial X_i^B}$$

which differs from the best non-compliance world result above. Q.e.d.

The necessary limitation on beneficial in-kind-transfers precludes that the best in-kind-transfer-scheme can obtain the result of the compliance world. A social optimum would demand not only an increase in the consumption of beneficial commodities but also a decrease in the consumption of harmful ones. In-kind-transfers cannot accomplish this outcome unless the by-product-function assumes sufficient scope effects. These effects could principally allow the reduction of harmful consumption X_i^B by an in-kind-transfer z_l if $\partial u^{B2}/\partial X_i^B \partial X_l^B$ is negative but an outcome identical to the cooperative one is also not ensured and unlikely. Additionally, the effects are ambiguous if at least one harmful X_j^B exists for which a z_m, $X_m^B \in M \subseteq L$, yields $\partial u^{B2}/\partial X_j^B \partial X_m^B > 0$. Hence, only non-positive scope effects with respect to the in-kind-transfers can unambiguously diminish the gap between the outcome based on in-kind-transfers and the cooperative outcome.

This section has shown that in-kind-transfers are able to realize gains which monetary payments leave unexploited. Because this non-cooperative outcome will be anticipated for the final period of a finitely repeated game, it also turns out in all previous periods including the first one when discounting effects can be ruled out. Discounting effects accrue to a difference in the interest rates for saving and borrowing and the individual time preference. E.g., if agent B exhibits a low time preference compared to the saving interest rate, he will smooth his intertemporal consumption plan by saving in early periods and dissaving in later ones in order to maximize his lifetime utility. A who knows that redevoted in-kind-transfers of early periods will be saved and spent later will anticipate this behaviour. Dependent on his individual time preference, A will evaluate the optimal plan of in-kind-transfers. Thus, discounting effects change the game essentially from a repeated into a general dynamic finite one.

4. The Role of In-Kind-Transfers in Infinitely Repeated Games

Individual time preferences and interest rates decide on the question of a cooperative outcome in an infinitely repeated game. The infinite repetition can render such strategies of an agent credible which punishes another agent for any deviance from the agreement. The economic literature, especially game-theoretic applications, discuss intensively the conditions of self-enforcement and stabilization issues in infinite games. Many papers deal with the corresponding problem of incomplete contracts. E.g., Shavell (1984) explores the role of remedies for breach and of opportunities to renegotiate for contract designs. Hart and Moore (1988) describe a game of incomplete contracts which clearly produce under-investment. Thomas and Worrall (1988) investigate the conditions of self-enforcing of wage contracts. In another paper, Thomas and Worrall (1990) show that, when expropriation of foreign direct investments cannot be ruled out, any self-enforcing contract between a host country and an investor will show up under-optimal investments at least in the first periods. Bulow and Rogoff (1989), Atkeson (1991), Mohr (1991) and others deal with the impact of sovereignty constraints on the design of international debt contracts.

However, the adopted approaches restrict themselves on the instruments at hand and investigate the role of self-enforcement-conditions on the optimal behaviour of the donor. Again, the instrument set is much larger in most cases because in-kind-transfers which are known to ameliorate the conditions of compliance can substitute monetary transfers. The ease of argumentation allows dropping the assumption of A's Stackelberg leadership which is hardly defensible when addressing infinite repetitions. Applied on the structure which was outligned in the previous sections, self-enforcement of an agreement is given for time period τ if

$$(15)\quad U^{B*} = \sum_{t=\tau}^{\tau+T} \alpha_t^B u_t^{B*} \geq U^{B'} = \alpha_\tau^B u_\tau^{B'} + \sum_{t=\tau+1}^{\tau+T} \alpha_t^B u_t^{B'}$$

is fulfilled. U^{B*} and $U^{B'}$ denote the discounted sum of the relevant utilities of compliance and non-compliance and α_t^B, $0 < \alpha_t^B < 1$, which is strictly non-increasing in t denotes the discount factors. The condition that realizing the deterrence case must not make the threating party itself worse off shrinks the credibility of threats. T (which can be infinite) represents the maximum credible time span of A's threat. The paths of realized utilities $[u_t^B]_\tau^{\tau+T}$ depend on the individual time preferences represented by the discount factors $[\alpha_t^B]_\tau^{\tau+T}$ and the interest rates for borrowing and saving, $[r_t^b]_\tau^{\tau+T}$ and $[r_t^s]_\tau^{\tau+T}$. A self-enforcing contract must meet condition (15) for all τ.

If the compliance constraint were not binding even in the case of a full exploitation of bargaining gains by agent B, one could adopt the strategic bargaining approach of Rubinstein (1982) and distribute the maximum bargaining gains dependent on the discount factors α_t^A and α_t^B alone when first-mover advantages are negligible. If the compliance constraint binds, the bargaining gains are diminished because B cannot guarantee to stick to the agreement. Hence, the agreed-upon b will increase and C will decrease.[6]

Proposition 6: *If the compliance constraint (15) is violated for the socially optimal (b^*,C^*)-contract and C_M is the degree of monetary compensations which just fulfills (15), there exists a $C_I \geq C_M$ which also just fulfills (15).*

Proof (non-technical): According to (7), in-kind-transfers drive a wedge between the price-weighted marginal utilities for the total utility maximum of B. This wedge is responsible for $u_\tau^{B'}(C_I) \leq u_\tau^{B'}(C_M)$ for $C_I = C_M$ because only monetary payments allow the exact balancing of price-weighted marginal utilities. Furthermore, the retrading potential is lower than in the case of monetary payments. This lower endowment translates directly into lower future utilities during the time span $[\tau+1,\tau+T]$ which embraces the periods of punishment. Hence, the discounted sum of utilities is not higher in the case of in-kind-transfers for any $C_I = C_M$. Because the temporary utilities and the

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6 The compliance constraint is the more likely to be binding the more bargaining power B ex ante has, i.e. with respect to discounting, the more patient B is. Thus, the distribution of gains in the case of compliance directly affects the seize of gains in the case of non-compliance.

sum of discounted utilities are an increasing function of transfers, the C_I which just fulfills (15) is an ε-margin, $\varepsilon \geq 0$, greater than the corresponding C_M. Q.e.d.

If a corresponding in-kind-transfer policy does belong to ϑ, in-kind-transfers prove their weak Pareto superiority for infinitely repeated games, too. They are likely to guarantee higher bargaining gains when the compliance constraint is binding because they worsen the outside option for a given amount C. I cannot even exclude the case in which in-kind-transfers exactly cure a compliance problem which is existent for monetary payments. Thus, contrary to the finitely repeated games, in-kind-transfers can even serve to safeguard the full cooperative outcome because they can imply a reduction of the consumption of harmful commodities by decreasing the outside option's profitability.

5. A Note on Applications

Although the economic literature has by and large neglected the stabilizing role of in-kind-transfers, a lot of self-enforcing contracts actually exploit in-kind-transfers. This chapter gives some insights into the application of in-kind-transfers with respect to self-enforcing contracts. Stability problems arise most apparently for international problems when any compliance promise must be doubted due to a principally unconstrained sovereignty of countries. Therefore, international environmental agreements are often not based on tied compensations. For example, a country can hardly be prevented to continue investing in pollution-intensive industries even if it has just received financial compensations to restrict pollution. Thus, the support concentrates on technical assistance, financial aid for projects which have proven their environment-friendliness, and direct investments. Generally, in-kind-transfers among sovereign nations are able to stabilize agreements which would not come into force if they should be based solely on monetary payments. For example, erecting a modern power plant can serve as an efficient in-kind-transfer to stabilize a bilateral agreement about reducing transboundary pollution.

But compliance problems are also existent in a national framework. E.g., in most countries, at least elementary school services are provided free of charge instead of paying the parents for sending their children to school. This organization may originate from the danger that low-income people would prefer to spend the money for their individual comsumption instead of school services for their children. Because poor people have nearly nothing to lose when they become subject of non-compliance sanctions, free school services can enforce at least a certain degree of education.

Until now, the paper has not addressed the normative relevance of the b-function. But enforcement problems are very often closely related to so-called merit goods. I refrain from a critique of this concept but it should be carefully noticed that in-kind-transfers lose any strict superiority if b and u^B coincide, i.e. when it is the purpose of agent A to increase B's utility. Merit goods, however, drive a wedge between the assessment of B's utility *by B* and an assessment of B's utility *by A* which can be represented by the b-function. Thus, in-kind-transfers are often observable in cases of paternalistic relations, especially in social policy. Therefore, coupons for clothing, food, etc. support the poor to avoid or at least to render the retrade in alcohol, drugs, etc. more difficult.

However, the ad-hoc-assumption of merit goods is not necessary for differences in the b- and u^B-function when externalities are absent. Strotz (1956) has demonstrated that consistent dynamic consumption plans may fail to meet the efficient ones. He showed that agents cannot stick to an optimal consumption plan when they discount future utilities in a non-exponential manner. This inconsistency results in a permanent change of plans and individual welfare losses. Because such "weak" agents are fully aware of their inefficient behaviour, they agree to long-term contracts with specific institutions (Bolle (1990)). At the beginning of the contract, the agents transfer resources to these institutions which these will use to provide commodities in a way that maximizes the long-run utility of the agent. In such a scenario, agent B is the initiator who pays agent A at the beginning of the contract for providing certain in-kind-transfers which increase his long-term utility. Minors who receive ice-cream and milk on a daily basis instead of monthly income (which could be exclusively spent for ice-cream causing stomach aches and inducing parents not to pay at all) as well as adults who join a book club to be permanently inclined to read fit into such contracts.

6. Summary and Conclusions

This paper has shown that in-kind-transfers are an effective instrument to stabilize agreements when compliance cannot be guaranteed. However, in-kind-transfers were often regarded as incurring welfare losses because the donor is hardly able to know the receiver's preferences exactly. Welfare losses seem to arise because the receiver has to sacrifice a significant share of the transfer for transaction costs when he reallocates his commodity bundle to maximize his utility.

When compliance raises no special problem or when we are aiming at improving the other agent's utility, all these arguments are well-founded. Dropping the assumption of certainty under these conditions, in-kind-transfers are no suitable policy instrument. But there is a rationale for in-kind-transfers if non-compliance cannot be ruled out. Then, the transaction costs of retrading can serve as an efficient instrument to realize mutual bargaining gains which would be left unexploited by mere monetary payments.

Asymmetric informations do not change this result essentially. On the contrary, a risk-averse agent A who does not know B's preferences exactly will even rely more heavily on in-kind-transfers which are known to improve the outcome. According to the reputation-based results of Kreps, Milgrom, Roberts and Wilson (1982), an information asymmetry is able to initiate cooperation even in finitely repeated prisoners' games for the first periods. Because in-kind-transfers can increase the degree of realized bargaining gains, they can support the reputation-based outcome. I hope to present a comprehensive approach which investigates the role of in-kind-transfers in a world of uncertainty in another paper(s).

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Appendix

The previous chapters employed a strictly separable utility function for agent B. The appendix will outline the sufficient conditions for a general utility function of A when A and B consume two commodities. The two commodities which B consumes also determine the by-product. I refrain from discussing the sufficient conditions for B because they coincide with the corresponding first two sufficient conditions for A. A's utility is dependent on the level of consumed commodities, on the *direct impact* of the by-product on A's utility and on the *indirect impact* via the consumption which originates from a variation of the marginal utility of consumption through the by-product. Define $\chi_i{}^C\chi_j{}^D$ as $\partial^2 u^A/\partial X_i{}^C \partial X_j{}^D$, i.e. the derivative of A's marginal utility of consumption of commodity i (i= 1,2) through agent C (C= A,B) with respect to a change of the consumption of commodity j (i= 1,2) through agent D (D= A,B).[7] The utility function

$$u^A = u^A (X_1{}^A, X_2{}^A, b[X_1{}^B, X_2{}^B])$$

has a 4x4-Hessian:

$$H = \begin{bmatrix} \chi_1{}^A\chi_1{}^A & \chi_1{}^A\chi_2{}^A & \chi_1{}^A\chi_1{}^B & \chi_1{}^A\chi_2{}^B \\ \chi_2{}^A\chi_1{}^A & \chi_2{}^A\chi_2{}^A & \chi_2{}^A\chi_1{}^B & \chi_2{}^A\chi_2{}^B \\ \chi_1{}^B\chi_1{}^A & \chi_1{}^B\chi_2{}^A & \chi_1{}^B\chi_1{}^B & \chi_1{}^B\chi_2{}^B \\ \chi_2{}^B\chi_1{}^A & \chi_2{}^B\chi_2{}^A & \chi_2{}^B\chi_1{}^B & \chi_2{}^B\chi_2{}^B \end{bmatrix}$$

The first two conditions give

$$|H_1| = \chi_1{}^A\chi_1{}^A < 0,$$

$$|H_2| = \chi_1{}^A\chi_1{}^A \chi_2{}^A\chi_2{}^A - [\chi_1{}^A\chi_2{}^A]^2 > 0,$$

and hence $\chi_2{}^A\chi_2{}^A < 0$ when $|H_n|$ denotes the determinant of the nth principal minor of the Hessian. Besides these well-known conditions, the third minor demands

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7 I omit the cross derivatives which means that $\partial u^A/\partial b \; \partial b/\partial X_i{}^B$ is written as $\chi_i{}^B$.

$$|H_3| = \chi_1{}^B\chi_1{}^B\ |H_2| + 2\,\chi_1{}^A\chi_1{}^B\,\chi_2{}^A\chi_1{}^B\,\chi_1{}^A\chi_2{}^A - \chi_2{}^A\chi_2{}^A\,[\chi_1{}^A\chi_1{}^B]^2 - \chi_1{}^A\chi_1{}^A\,[\chi_2{}^A\chi_1{}^B]^2 \overset{!}{<} 0$$

The employed utility and by-product-function fulfill this condition because the determinant of the third minor is $\partial u/\partial b\ \partial^2 b/\partial X_1{}^{B2}$ which is always positive independent of a marginally beneficial or harmful commodity 1. But if the externalities affect A only via a change in the marginal consumption utilities, $|H_3|$ is likely to indicate a corner solution. Let commodity 1 represent the beneficial commodity which any voluntary contract needs to guarantee mutual improvement, i.e. $\chi_1{}^A\chi_1{}^B$ and $\chi_2{}^A\chi_1{}^B > 0$. In such a case, the absence of direct effects which shift the whole marginal utility like asset effects in the paper do implies that $\chi_1{}^B\chi_1{}^B$ is zero. The last two terms in the second row are clearly positive. The second term of the first row consists of two negative terms and the consumption-scope-term $\chi_1{}^A\chi_2{}^A$. On the one side, this term must be strongly negative to save a negative $|H_3|$. On the other side, a too high absolute $\chi_1{}^A\chi_2{}^A$ leads to a negative $|H_2|$. Thus, if externalities of the by-product which change the marginal utility directly are absent, the second-order-conditions are likely to be not fulfilled. Any non-positive scope-term $\chi_1{}^A\chi_2{}^A$ ensures a corner solution at least with respect to compensations. In such a case, agent A will not engage in any transfer business. If the scope-term still leaves the positive sign of $|H_2|$, A will concentrate on the two commodities $X_1{}^A$ and $X_2{}^A$; if this condition is violated, too, A will concentrate on either one. In both cases, A refrains from any efforts to change the consumption plans of B.

The fourth minor deals with the scope effects among all commodities and demands:

$$\begin{aligned}
|H_4| = \;& \chi_2{}^B\chi_2{}^B\ |H_3| - [\chi_1{}^B\chi_2{}^B]^2 \\
+ \;& [\chi_1{}^A\chi_1{}^B\,\chi_2{}^B\chi_2{}^B - \chi_1{}^A\chi_2{}^B\,\chi_2{}^A\chi_1{}^B]^2 \\
+ \;& \chi_1{}^B\chi_2{}^B\,(\chi_2{}^A\chi_2{}^B\,\chi_1{}^A\chi_1{}^A - \chi_1{}^A\chi_2{}^B\,\chi_1{}^A\chi_2{}^A)\,(\chi_2{}^A\chi_1{}^B - \chi_2{}^A\chi_2{}^B) \\
+ \;& \chi_1{}^B\chi_2{}^B\,(\chi_1{}^A\chi_2{}^B\,\chi_2{}^A\chi_2{}^A - \chi_2{}^A\chi_2{}^B\,\chi_1{}^A\chi_2{}^A)\,(\chi_1{}^A\chi_1{}^B - \chi_1{}^A\chi_2{}^B) \\
- \;& \chi_1{}^B\chi_2{}^B\,\chi_1{}^A\chi_1{}^B\,(\chi_1{}^A\chi_2{}^A\,\chi_2{}^A\chi_1{}^B - \chi_2{}^A\chi_2{}^A\,\chi_1{}^A\chi_1{}^B) \\
+ \;& \chi_1{}^B\chi_2{}^B\,\chi_2{}^A\chi_1{}^B\,(\chi_1{}^A\chi_1{}^A\,\chi_2{}^A\chi_1{}^B - \chi_1{}^A\chi_2{}^A\,\chi_1{}^A\chi_1{}^B) \\
& \overset{!}{>} 0
\end{aligned}$$

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