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AN EXPERIMENTAL STUDY ON THE CROWDING-OUT EFFECT OF PUBLIC TRANSFERS IN A MODEL WITH MULTIPLE FAMILIES

By Werner Güth, Theo Offerman, Jan Potters,
Martin Strobel and Harrie Verbon

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An experimental study on the crowding-out effect of public transfers in a model with multiple families

Werner Güth
Theo Offerman
Jan Potters
Martin Strobel
Harrie Verbon[*)]

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Abstract

We study an overlapping-generations experiment with multiple families in which redistributional transfers can take the form of support to the elderly or grants to children. Supporting the old is a purely inter-generational (intra-family) transfer, whereas grants to children also involve an element of intra-generational (inter-family) solidarity. Our treatment variable is the tax rate determining the amount of redistribution by means of the compulsory pension scheme. We investigate to which degree compulsory solidarity crowds out voluntary solidarity. We also consider whether voluntary solidarity relies more on grants to children or on support to the old aged, and the mechanisms which are used in eliciting transfers from family members from other generations.

JEL code: C91, H55
Keywords: within-family transfers, overlapping generations, redistributive public-pension system, crowding out of private transfers, reciprocity

Affiliations: Güth and Strobel are at the Humboldt University, Berlin, Offerman is at the University of Amsterdam, and Potters and Verbon are at Tilburg University. Potters acknowledges a grant from the Dutch Royal Academy of Sciences which financed his contribution to this research project.
[*)]Corresponding author: H.A.A. Verbon, Tilburg University, Department of Economics, P.O.Box 90153, 5000 LE Tilburg, the Netherlands, phone: +31 (13) 4662878; fax +31 (13)4663042; e-mail: H.A.A.Verbon@kub.nl.

1. Introduction

Voluntary transfers to one's parents or children are a major factor in the allocation of individuals' income and time. Parents invest time, energy and money in raising their children, and they also provide them with substantial sums of money in the form of gifts, college tuition and grants. Although the exact figures are contestable, estimates indicate that as much as 80% of total assets in the U.S. is involved with intergenerational transfers from parents to adult children (Kotlikoff, 1988), with about 50% of these being *inter vivos* (Gale and Scholz, 1994). Children, on the other hand, not only spend time and energy in attention and care of their parents, they also provide them with old-age support. For example, McGarry and Schoeni (1995) use data from the Health and Retirement Study to observe that 7.1% of the adult children give financial transfers to their parents.

The explanation of these voluntary intergenerational transfers is not a well-established matter. Some explanations rely on altruism that arises from kinship (e.g., Becker, 1974), or on childrens' feelings of guilt or duty towards their parents having been instilled in them by their parents because of their concern about their old-age support (Becker, 1993); others refer to direct or indirect reciprocity and strategic motives (e.g., Bernheim et al. 1985, Cigno, 1993, Cox, 1987).

Another issue is the implication of a tax-financed transfer system for voluntary within-family transfers. If private transfers are motivated by altruism, public transfers are known to crowd out private transfers $-for-$ because of the Ricardian-equivalence effect. Moreover, under altruism voluntary transfers are often found to be negatively related to the recipient's pre-transfer welfare (see, e.g. McGarry and Schoeni (1995)). If, on the other hand, financial transfers are motivated by a reciprocity or exchange motive, government intervention can also be expected to lead to a (typically not $-for-$) crowding out of transfers from parents to their children. Becker (1993), e.g., notes that a government program that transfers resources to the elderly will lead parents "to not (to) try as hard to make children more loyal or guiltier or otherwise feel as well disposed towards their parents" (loc.cit. p. 401). As children are no longer expected (or needed) to help out in old age, parents will invest less in their children. Moreover, if investing in one's children aims at increasing their income-generating capacity, the private return to these investments decreases as soon as future incomes will get taxed, making these investments less attractive.

The degree to which crowding out occurs is not well established in the literature. Künnemund and Rein (1999), e.g., found no support for crowding out. Cigno and Rosati (1996), on the other hand, found in a different context that an expansion of social security displaces intra-family solidarity.

In the present study we examine the crowding-out effect of compulsory (government) transfers on voluntary intergenerational transfers in an experimental setting. One advantage of this method in the present context is that in experiments with students as subjects motives that derive from kinship can be excluded. Hence, to the extent that we will observe voluntary cross-generational transfers they are likely to derive from reciprocal and strategic considerations. Another advantage is that experiments by their very nature give detailed information on individual behavior and make it, moreover, possible to isolate the effect of a key variable, in this case being the effect of government intervention on voluntary intra-family transfers.

We implement an experimental design with two families coexisting at the same time in which every subject has one child and one parent. Intertemporal consumption smoothing cannot be achieved by savings. Instead, the experimental subjects are supplied with two instruments. One instrument ('support') involves a purely intra-family intergenerational transfer from child to parent. The other instrument ('grant') involves a transfer in the opposite direction, from parent to child. Notice that in our experiment fertility is taken as exogenous (each parent has one child), so grants should be interpreted as an investment in the quality of the child. The grant increases the income-earning capacity of the child. In line with this, grants are added to the wage income children earn when entering adulthood.[1]

In the absence of government intervention support is an effective form of redistribution since at the time of the support the adult child has a wage income and the parent is in his old-age and has no wage income. Grants, however, cannot be used as a consumption-smoothing device in this case. Grants might be deployed, nevertheless if subjects consider these grants as a device to commit the child to supporting the parent when old. In other words, grants can appeal to direct reciprocity: giving a grant might induce the descendants to give support in return.

Total adult income (wage plus grants) is taxed on behalf of a compulsory pension of the pay-as-you-go (PAYG) variety. So, the pension scheme is a collective scheme, redistributing income from the present young (working) generation to the present old (retired) generation, involving both families. Therefore, grants also imply an intra-generational (inter-family) redistribution.

The above framework enables us to investigate our central question, i.e. to what extent (increasing) government intervention crowds out voluntary intergenerational intrafamily transfers. The treatment variable in our experiments is the pension tax rate which can be low or high. Pensions complement voluntary (old-age) support. Hence, individuals might consider the compulsory pension scheme as an alternative to within-

[1] More generally, the grant variable can also be interpreted as an individual's investment in the production possibilities of the next generation. The more is invested, the more the next generation will be able to provide for pensions to the previous generations.

family transfers. A comparison of the low and high tax treatment allows us to examine the extent to which the public pension scheme crowds out voluntary private support, and/or grants.

In our experimental setting, every time period two families are 'living' both consisting of a young and an old generation. This feature makes the compulsory pension system (strategically) interesting as it introduces a free rider problem with respect to investments in children (grants). Because future tax incomes are redistributed via a flat pension benefit, a positive grant not only increases one's own pension, but also that of one's contemporary in the other family. As a result, subjects might tend to avoid intrafamily redistribution by relying less on investments in children and more on old-age support if the tax rate increases. Unlike grants, supports are direct inter-generational transfers, which do not interfere with the pension system and thus leave the other family's welfare untouched. So, basically two opposing forces are at work in our setting. First, we expect an increase in the PAYG-system to crowd out old-age support. But, second, we expect such an increase to lead to a redirection of transfers from children to parents.

It should be noted, though, that the partial crowding out of voluntary transfers does not necessarily mean that these transfers have become less efficient as a consumption-smoothing device. The PAYG-system guarantees that some automatic consumption smoothing will take place. The higher the tax the lower the voluntary transfers that are required in addition to the public pension in order to accomplish perfect consumption smoothing. So, if individuals are trying to accomplish consumption smoothing by voluntary intergenerational transfers, an increase of the size of the public pension system makes these transfers, both old-age support and investments in children, partly redundant. But, the net effect of government intervention cum voluntary transfers might be an increase in generations' welfare.

Ours is not the first experimental study of overlapping generations. For example, Cadsby and Frank (1990) study Ricardian equivalence in an overlapping generations experiment. A paper with a focus similar to the present one is Van der Heijden et al. (1998). They study the occurrence of cooperative transfers in a finite overlapping generations game. They employ only one-directional transfers (i.e. from young to old). They found that subjects are on average willing to give support somewhere halfway between the non-cooperative and the full efficient level, but tokens of (indirect) reciprocity were weak at best. However, they do not have the two-family structure, and they do not consider the effect of government intervention. By allowing for government intervention we are able to infer whether the willingness to transfer gets undermined; by allowing for transfers from old to young, we can investigate whether direct reciprocity plays a role in engendering support to the old.

The remainder of the paper is organized as follows. In section 2 we introduce the underlying overlapping generations model on which our experimental study relies. The

benchmark behavior as implied by perfect and efficient consumption smoothing as well as by pure selfishness is derived. We also discuss our behavioral hypotheses. After describing the experimental procedure in section 3 the results are presented in section 4. Concluding remarks in section 5 summarize our major findings and outline possible extensions.

2. The model structure and main hypothesis

In the overlapping-generations model that forms the basis for our experiments we allow for two families. Each family consists of a sequence of generations. One individual represents a generation of a family, and the generations of each family partially overlap. Individuals live for two periods. In the first period, they receive a fixed (labor) income of Y, in the second period they receive no fixed labor income. Instead they receive a flat pension benefit, financed from contributions by the then young individuals, possibly supplemented by a voluntary transfer from one's successor. Payoffs to each individual are equal to the product of the consumption levels in the first period and the second period of one's life. Hence, there is a strong incentive to try and smooth one's consumption over the two periods. Given the primary income distribution and the absence of a savings possibility, perfect consumption smoothing can only be achieved by means of transfers.

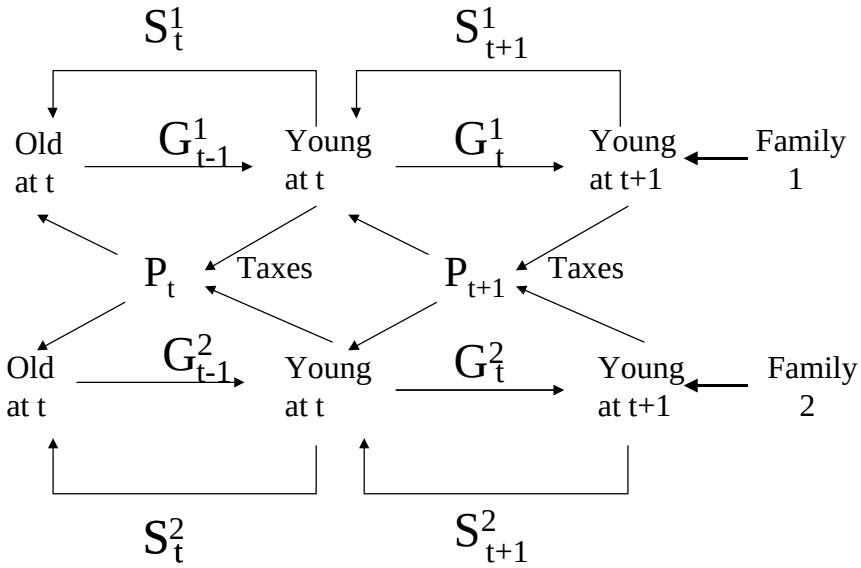
In the first period (when young) individuals make two decisions. First, they decide how much of their income they wish to transfer to their parent who is presently old. This amount is called the (old-age) support. Second, they decide how much of their income they wish to invest in their child. This investment is called the grant. Grants raise the child's income in the next period and thereby also the mandatory pension tax that is levied over this income. Tax receipts from the young are distributed equally over the present old generation. Hence, grants increase one's child's income, but they also increase one's own pension benefit and the pension benefit of one's contemporary in the other family.

To introduce the notation, let index t refer to generations (t = 1,...,T), and let index i refer to families (i = 1, 2). We then define:

$G_t^i(\geq 0)$	The grant that generation t of family i gives to generation $t+1$ of family i
$S_t^i(\geq 0)$	The support that generation t of family i gives to generation $t-1$ of family i
$C_{j,t}^i$ for $j=1,2$	The consumption level of generation t of family i in j-th phase of life
u_t^i	Payoff (or utility) of generation t of family i
P_{t+1}	Pension received by (all families of) generation t when old

The flow diagram in Figure 1 describes the direction of the flows of transfers in the experiment. Notice that grants are from old to young, while support and pensions imply a transfer from young to old. The taxes to be paid by every individual when young are proportional to exogenous labor income plus the grant received from one's predecessor, while every old individual receives a flat pension benefit. So, the PAYG-system can lead to redistribution between the two families.

Figure 1
Flows of transfers within and between families



The basic structural relationships are:

(1) $u_t^i = C_{1,t}^i \cdot C_{2,t}^i$ Intertemporal payoff function of generation t of family i

(2) $C_{1,t}^i = (1-t)\left[Y + G_{t-1}^i\right] - S_t^i - G_t^i$ Consumption level of generation t of family i when young

(3) $C_{2,t}^i = S_{t+1}^i + P_{t+1}$ Consumption level of family i of generation t when old

(4) $P_{t+1} = t\left[Y + \left(G_t^1 + G_t^2\right)/2\right]$ Pension of every individual of generation t when old

Here t with $0 < t < 1$ is the constant marginal tax rate, and Y is the (labor) income one earns while young (the wage income level of the old is set to 0). The other variables have already been defined above.

Equation (1) indicates that the payoff is equal to the product of the consumption levels in the two periods of life. As equation (2) shows, consumption when young is what remains after labor income and grant (from the parent) are taxed and after support (to the parent) and grant (to the child) are subtracted. Equation (3) indicates that consumption when old, is equal to the sum of the support received from the next generation (one's child) and the collective pension benefit. Equation (4) describes the PAYG pension. Incomes of both families of generation t+1 including the grants are taxed and redistributed equally over the two families of the previous generation (who are now old).

Starting from the above model two benchmark outcomes naturally suggest themselves. The first is where no voluntary intergenerational linkages exist. If future choices do not depend on present ones, then generation t of family i has no incentive to support its parent, so the optimal decision is

(5) $\quad S_t^i = 0$ for $i = 1,2$ and $t = 1,2,\ldots.$

Anticipating this, leaves only one reason for a positive grant, namely consumption smoothing via the pension system. By means of a positive grant G_t^i generation t of family i increases the income of generation $t+1$ of family i when young and thus the pension P_{t+1}, as defined by (4), which generation t of family i receives when old. It is easily verified, however, that this does not justify positive grants and, hence, that every stationary and symmetric equilibrium implies[2]

(6) $\quad G_t^i = 0$ for $i = 1,2$ and $t = 1,2,\ldots.$

The intertemporal payoff in this case can be seen to be equal to $u_t^i = \tau(1-\tau)Y^2$.

As an alternative benchmark we look at the most efficient stationary way of consumption smoothing, that is,

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[2] Result (6) follows from $\partial u_t^i / \partial G_t^i < 0$ which, using (5), is equivalent to $(1-t)G_{t-1}^i - G_t^j - Y(1+t) < 2G_t^i$ for $j \neq i$. Since in a stationary equilibrium one has $G_{t-1}^i = G_t^j$, the condition simply requires $-Y(1+t) < G_t^i(2+t)$ which holds for all grants $G_t^i \geq 0$. Hence, equations (5) and (6) describe a subgame perfect equilibrium.

(7) $C_{1,t}^{i} = C_{2,t}^{i}$

The intertemporal payoff in this case can be seen to be equal to $u_t^i = ¼Y^2$ which is larger than the pay-off for the non-cooperative outcome as long as the tax rate is not equal to 0.5.

Under the condition that $S = S_t^i$ and $G = G_t^i$ for $i = 1,2$ and $t = 1,2,\ldots,$ perfect consumption smoothing can be seen to lead to the following condition in terms of G and S,

(8) $S + tG = (1 - 2t)Y / 2$.

According to equation (8) there exists a continuum of (S,G)-constellations allowing for **efficient stationary consumption smoothing**. Thus even if all individuals of all generations agree on this, they still would face a considerable intergenerational coordination problem. Notice, moreover, from (8) that for any given value of τ, if subjects were to rely merely on grants, these would need to take on much larger values than if they were to rely on supports only. For example, for tax rates less than or equal to 25% the consumption-smoothing grant would have to be larger than labor income Y, while consumption-smoothing levels of support will always be less than labor income.

The treatment variable used in our experimental study is the tax rate for which we distinguished just two levels, namely

- the **low tax** rate $\underline{t}$ = 0.05 and
- the **high tax** rate $\bar{t}$ = 0.25.

Our basic behavioral hypothesis concerns the effect of the level of the public pension scheme upon the level of private transfers. It is hypothesized that a larger degree of compulsory transfers, i.e., a larger tax rate, crowds out voluntary transfers. This can be due to the subjects' perception of the public pension scheme as a substitute to voluntary transfers.

Crowding-Out Hypothesis: The higher tax leads to lower levels of supports S_t^i and grants G_t^i.

In the above hypothesis it is neither specified what will be used more (grants or support) nor which of the two transfers will be crowded out to a larger extent. As noted earlier, grants can only be used as a consumption-smoothing device as long as a positive tax rate is in place. This makes grants a less effective consumption-smoothing device than support. On the other hand, it should be noted that as grants are taxed and

used for financing the pension benefit, a grant automatically smooths consumption to some extent. A positive grant raises one's child income and thereby future tax revenues and one's own old-age pension. So, even though positive grants are not always individually rational, at least there is always some direct positive feedback (which is not true for support). So, beforehand it cannot be unambiguously established whether grants will dominate support, or not. By the same token it cannot be established whether crowding out will affect grants more than support. Given this indeterminacy, we prefer to put the issue of grant dominance by means of the following questions, related to the crowding-out phenomenon:

Related Questions (I)

(a): Will grants dominate support, i.e. $G_t^i \geq S_t^i$?

(b): Will grants be more susceptible to crowding out than support?

Apart from the values of grants (G_t^i), support (S_t^i), and payoffs (u_t^i), the experimental results will also be represented by the realized efficiency of redistribution. The standard efficiency measure (realized payoff / maximal payoff) overstates performance, as subjects realize a part of the payoff even if grants and supports are zero. More importantly, this aspect biases a comparison of the efficiency levels in favor of the high tax treatment, because there the payoff in case of zero transfers is substantial. In particular, as noted earlier for values of the tax rate close to 50% optimal consumption smoothing will almost be realized without any voluntary intergenerational transfer. Obviously, in the high tax treatment lower voluntary transfer are required anyhow to get consumption smoothing realized. As we want to measure the efficiency gain which results from subjects behavior only, we use realized efficiency, R_{eff}, defined as the increase in the actual payoff over the payoff generated with zero transfers, expressed as percentage of the maximal increase of payoff. As, again, the theory does not lead us in formulating hypotheses on the efficiency of voluntary transfers, we formulate this issue in the form of a question to be answered by the experimental results.

Related Question (II)

Will the higher tax rate lead to a higher or lower efficiency of voluntary transfers?

Notice that up till now we have not said anything on how subjects try to commit their successors to supporting them during old age. In the results section we will shed light on this issue by reporting the correlations between grants and support that can be derived from regression analyses. The idea is that voluntary transfers to the old might require a behavioral link between the decisions of the different players. One possible device might be that by giving grants subjects want to elicit support from their successors. In that case, a positive grant may act to raise one's own consumption via

direct reciprocity („I give to you, because you give to me“, Elster, 1989, Gouldner, 1960): by the child 'repaying ' a grant with (old-age) support.

If intertemporal consumption smoothing came about via support only, on the other hand, individuals are apparently relying on indirect reciprocity. By giving to his predecessor a subject might try to engender his successor to do the same to him. For example, the rule could be to support the parent in the same way as the parent supported her or his parent. Hence, the rule is to treat someone nicely in return for how this person has treated someone else (and not in return for how this person has treated you, Hammond, 1975).

In the context of the present experiment, direct reciprocity could reveal itself through a positive correlation between S_t^i and G_{t-1}^i, that is, a player rewards her parent with a higher support if the grant from the parent was higher. Indirect reciprocity would require a positive correlation between S_t^i and S_{t-1}^i.

3. Experimental procedure[3]

In the experiment we have relied on two families (i = 1,2) and sequences of five generations (t = 1, 2, ..., 5). Subjects were informed that there were two families and a sequence of generations. The number of generations and their place in the sequence was not revealed to the participants. To play a sequence of rounds with 2 families and 5 generations, we would need only 10 subjects. When conducting the experiment, however, we actually did run two or three independent sessions at the same time. This prevented the subjects from inferring the lengths of the queues from the number of subjects present in the laboratory. 6 sessions were run with tax treatment $\underline{t}$ (60 subjects) and 5 sessions were run with tax treatment $\bar{t}$ (50 subjects), giving us 11 independent observations in total.

The experiment was performed at Tilburg University, The Netherlands, in December 1997 on four different days. An announcement in the university bulletin invited participants for a decisionmaking experiment that would earn them money. Some background of the participants (age, subject of study, and gender) is available from the answers to the post-experimental questionaire (Appendix C). The details of the experimental procedure are described by the Protocol (Appendix 0) as well as by the other appendices mentioned there.

[3]We would like to thank Klaus Abbink and Abdolkarim Sadrieh for providing RatImage (Abbink and Sadrieh, 1995) which we used to implement the experiment software.

The decision variables of generation $t = 1,2,\ldots$ of family $i = 1,2$ are the variables G_t^i and S_t^i, i.e. its grant and its support[4]. The sum of these two (non-negative) variables was restricted to be less than or equal to net income, inclusive of received grants. In addition, each generation ($t = 1,2,\ldots$) of each family ($i = 1,2$) was also asked to specify its expectations concerning S_{t+1}^i as well as P_{t+1}. That is, subjects were asked how much support they expected to receive from their child and how much pension they expected to receive from the collective scheme. When making decisions and specifying expectations generation t of family i was informed about the following historical variables: G_{t-1}^i (grant received from parent) G_{t-2} (grant parent received from grandparent), S_{t-1}^i (support by parent to grandparent) and $C_{1,t-1}^i$ (consumption level of parent when young).[5]

In the experiment the fixed gross income when young (Y) was set at 20. Remember that tax rates in the two treatments were $\underline{t}$ = 0.05 and $\bar{t}$ =0.25, respectively. With grants (G) and support (S) equal to zero this would give a payoff (u_t^i) of 19 (19×1) and 75 (15×5) in treatment $\underline{t}$ and $\bar{t}$, respectively. Optimal consumption smoothing, on the other hand, would secure a payoff of 100 (10×10) in either treatment.

Except for starting (t=0) and stopping (t=6) conditions[6], every generation (t= 1, ..., 5) of every family i was encountering the same type of situation. We refer to each series of successive plays by the five generations of both families as a round. To allow for learning, subjects played 5 or 6 successive rounds. At the beginning of a round, subjects were randomly (re)assigned to a family and a generation.

The sequence of events for a subject in a round is as follows: (0) waiting screen (1) screen lights up, giving historical information (see above), and asking for decisions about support and grant, (2) after decisions are entered, subject is asked to state expectations regarding support and pension; (3) as soon as the next generation has made its decisions a screen lights up with support and pension received, and the corresponding earnings, (4) after confirmation the round ends and the waiting screen for the next round appears.

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[4] In the experiment we do not use expressions like parent, child, or family but refer to *predecessors*, *successors*, and *queue*; grant and support are referred to as *transfer* and *gift*, respectively.

[5] The last three of these variables could be retrieved only after a (registered) mouse click by the particpant. As a matter of fact we also allowed generation t of family i to compute the consumption level $C_{2,t-1}^i$ of its parent by inserting a value S_t^i. From this information about $C_{2,t-1}^i$ a subject could ,in principle, also deduce the previous choice G_{t-1}^j with $j \neq i$ by means of equations (3) and (4).

[6] The relevant choices for the generation before the first one (t=0) and the generation after the last one (t=6) were predetermined by the experimenters (but not revealed to the subjects). The starting and stopping values that we employed are: G_{-1}^i=4, $S_0^i = G_0^i = S_6^i$=3.

We anticipated that the subjects would find the experiment rather complicated. Therefore, we made sure that the subjects had plenty of time to go through the instructions, to ask questions, and practice with the time structure of the game and the relation between decisions and payoffs. In total, sessions lasted between 2½and 3 hours. About 1½hour was reserved for instructions, questions and individual practice. As the post-experimental questionnaire and conversations with subjects indicated, we were successful in explaining the game to the subjects; 93% stated that the instructions were clear.

4. Experimental results

In this section we will, first, test our main hypothesis and consider the formulated related questions. In the second subsection we will shed some light on the dynamics of the transfers and on the mechanism subjects use in trying to extract transfers.

4.1 Main hypothesis and related questions

According to the crowding-out hypothesis forced redistribution by a system of higher taxes leads to lower grants and lower supports. This hypothesis is largely supported by the data. Table 1 presents the average levels of transfers, and the corresponding payoffs and effciency levels.

Table 1
Average levels of grants G, support S, realized payoff u, and efficiency R_{eff}

	G	S	u	R_{eff}
$\underline{t}$	3.90	1.53	50.9	39.4%
$\bar{t}$	2.19	1.01	92.8	71.7%
p-values	0.004	0.117	0.004	0.004

We have:

Crowding-out hypothesis: In comparison with the low tax treatment, the high tax treatment yields significantly lower levels of grant ($G(\bar{t})$=2.19 versus $G(\underline{t})$=3.90; Mann-Whitney rank test: m=5, n=6, p=0.01). The difference in support between the two treatments has the expected sign but misses conventional significance levels ($S(\bar{t})$=1.01 versus $S(\underline{t})$=1.53; Mann-Whitney rank test: m=5, n=6, p=0.12).

The result suggests that support is more immune to government intervention than grants which must be due to the combined effect of the free-rider problem (a larger part of the grant is transferred to the other family under the high tax treatment) and the decreasing importance of grants as a token of direct reciprocity. As support remains unaffected it becomes relatively less attractive to keep relying on grants. Notice, moreover, that crowding out is not complete: in the high tax treatment supports and especially grants are still positive.

Table 1 also answers the questions on grant dominance:

Related questions (I); grant dominance. (a) Players choose grants significantly higher than supports: $G(\bar{t})>S(\bar{t})$ as well as $G(\underline{t})>S(\underline{t})$, (in both treatments the hypothesis of no difference is rejected at the 5% level; Wilcoxon rank tests using independent averages per group of 2 families as data points; low tax treatment: n=6 and p=0.03; high tax treatment: n=5 and p=0.04), but **(b)** the percentage decrease due to the tax increase is larger for grants than for support, i.e. a 57% and a 33% decrease, respectively.

In spite of the established grant dominance, for both treatments the actual level of the grant is far below the consumption-smoothing level while this holds less so for the actual level of support.[7] Obviously, as noted earlier, grants are a very ineffective device for consumption smoothing, and so, this result once more suggests that a more likely reason for giving grants would be to commit the successors to giving support in return. We come back to this point below.

Notice from table 1 that the efficiency of transfers is lower in the low tax treatment than in the high tax treatment. Efficient consumption smoothing would have led to a payoff of 100 (per subject per round) in either treatment. The average actual payoff equals 92.8 in the high tax treatment and it equals 50.9 in the low tax treatment, so that in the former case 71.7% of the potential gain is realized (i.e. 17.8 out of 25), while in the latter case the realized gain is only 39.4% (i.e. 31.9 out of 81). The former efficiency level is significantly larger than the latter level (71.7% versus 39.4%; Mann-Whitney rank test: m=5, n=6, p=0.01). So, we have,

Related question (II), efficiency The realized efficiency level is significantly higher in the high tax treatment than in the low tax treatment.

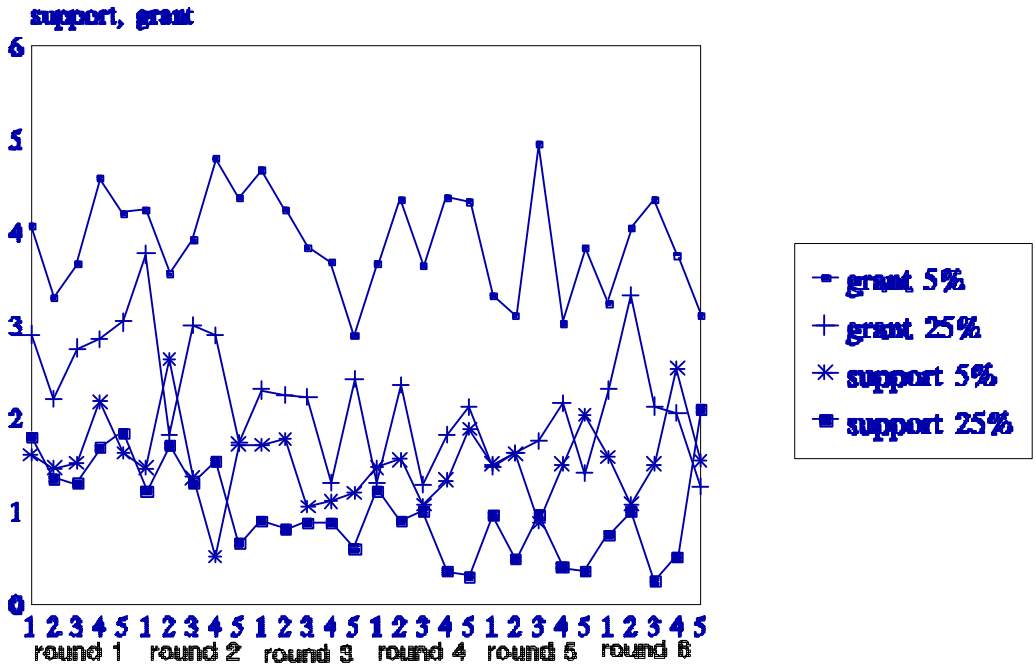
[7]In the low-tax treatment the consumption-smoothing level of grants (at a given level of $\overline{S}_t$ =1.53) would have to be equal to 149.40, while for support (at a given level of $\overline{G}_t$ =3.90) , this level would have to be equal to 8.80. In the high-tax level the corresponding numbers would be 15.96 for grants and 4.45 for support.

Thus, although a higher tax leads to crowding out in our experiment, it does not decrease efficiency. To the contrary, the larger the collective pension system, the more consumption smoothing subjects are able to achieve with their voluntary transfers.

4.2 Additional analysis

The foregoing analysis abstracts from the dynamics of the transfers over time. The actual dynamics are graphically illustrated by Figure 2 which lists the time sequence of the average support and grant in the natural time order (starting with generations t = 1, 2, 3, 4, 5 of round 1, then of round 2 etc.).

Figure 2
The dynamics of average support and grants



What emerges from this figure is that in the low tax treatment $\underline{t}$ grants and supports are relatively stable. In the high tax treatment $\bar{t}$ there is a slight erosion of both supports and grants. Moreover, over time grants are unambiguously larger in the low tax treatment than in the high tax treatment while that holds not so for support. In some rounds supports in the high tax treatment are higher than in the low tax treatment.

After subjects had made their decisions for S_t^i and G_t^i in a round, they were asked to report their belief $\hat{S}_{t+1}^i$ about how much support they expect to receive from their successor. Subjects appear to be too optimistic about the support to be received. In the low tax treatment subjects expect to receive $\hat{S}_{t+1}^i$ =2.53 while they receive S_t^i=1.53 (difference is significant: Wilcoxon rank test: n=6; p=0.03). In the high tax treatment $\bar{t}$ subjects expect to receive $\hat{S}_{t+1}^i$ =1.85 while they receive S_t^i=1.01 (difference is significant: Wilcoxon rank test: n=5; p=0.04). Obviously, these results also imply that participants give less in support to their parent than what they expect to receive from their child.

The expected support gives some clue as to the importance of (expected) reciprocity in the individuals' transfer behavior. The case of **direct reciprocity** requires a positive dependency of S_t^i on G_{t-1}^i, that is, participants give more support to their predecessors if these predecessors have given a higher grant to them. Support is a more effective consumption-smoothing device and so some subjects merely want to rely on them. In that case giving support to the predecessor might trigger support from the successor. According to such **indirect reciprocity** S_t^i should depend on S_{t-1}^i, that is, participants give more support to their predecessors if their predecessors have given more support to their own predecessors. Similar behavioral dependencies are advanced for the level of grants (G_t^i depending on S_{t-1}^i and G_{t-1}^i). A grant (G_t^i) may be used to *elicit* reciprocity from a successor (S_{t+1}^i) but is less well suited to *provide* reciprocity to the predecessor (S_{t-1}^i and G_{t-1}^i).

Table 2 gives OLS regression results, for each treatment separately, on how the decisions for S_t^i and G_t^i are related to the decisions by the predecessor (S_{t-1}^i and G_{t-1}^i)[8]. Since the value for S_{t-1}^i only appears on a subject's screen after a mouseclick, we include only those cases in which the subject actually requested to see the variable. As an additional explanatory variable we include the expected support, $\hat{S}_{t+1}^i$, from the successor in the same family. Grants and supports may also be motivated by 'anticipated' reciprocity, and participants may perhaps attempt to match the support they expect to receive from their successors.

[8] We do not wish to put too much emphasis on the results. For one thing, the regressions assume independence of all observations, which is not satisfied according to the most rigorous standards (only session aggregates can be assumed to be independent). Also, there may be simultaneity in the decisions about the *S* and *G*, which our simple OLS regressions do not take into account. Nevertheless, the regressions yield several interesting results which may at least be indicative for the behavioral regularities in participants' choices.

Table 2

Regression results for supports S_t^i and grants G_t^i

	S_t^i		G_t^i	
	$\underline{t}$	$\overline{t}$	$\underline{t}$	$\overline{t}$
Const	0.37 (1.38)	0.37 (2.62)	3.18 (9.62)	1.39 (6.37)
G_{t-1}^i	0.09 (1.81)	0.03 (0.58)	-0.00 (0.00)	0.12 (1.63)
S_{t-1}^i	0.07 (1.12)	0.18 (3.16)	-0.16 (2.11)	0.19 (2.07)
$\hat{S}_{t+1}^i$	0.36 (7.23)	0.08 (5.49)	0.33 (5.24)	0.00 (0.15)
R_{adj}^2	0.18	0.21	0.10	0.04
obs.	261	173	261	173

Note: t-values are between parentheses; for S_{t-1}^i we only considered the cases where the former decision was actually looked at by mouseclick.

From table 2 we find, first, very little evidence for direct reciprocity. The grant received (G_{t-1}^i), appears to have very little impact on the support supplied (S_t^i). The result holds for both tax levels, but is especially clear in the high tax treatment. Hence, participants do not seem to reward their predecessors with higher support when they receive a higher grant. So, although grants are generally larger than supports, they don't appear to be very effective as a device for eliciting support.

Second, the strongest signs for indirect reciprocity are in the high tax treatment. Here we find that the support given to the predecessor (S_t^i) is positively and significantly affected by the support given by the predecessor (S_{t-1}^i). For the low tax treatment, however, we do not find such a relationship. This is in line with our result, established earlier, that participants concentrate relatively more on supports in the high tax treatment. To achieve this they rely more on indirect reciprocity.

Finally, the expected support from the successor ($\hat{S}_{t+1}^i$) appears to have a stronger impact in the low than in the high tax treatment. For both S_t^i and G_t^i, we find higher and more significant coefficients for expected support in the low than in the high tax treatment. So, subjects appear to base their transfer decisions on expected instead of actual direct or indirect reciprocity under the low-tax treatment. In the high-tax treatment only indirect reciprocity is expected, and subjects behave according to their expectation although the actual indirect-reciprocity effect is not very strong.

5. Concluding discussion

In our two-family experiment we have allowed for intergenerational transfers in both directions, i.e. from parent to child, by so-called grants, and from child to parent, by so-called (old age) support. Besides, a compulsory transfer system proportionally taxed income of the adults of both families and transferred the receipts to the old-aged of both families in a lump-sum fashion. We implemented a high tax treatment and a low tax treatment. It was hypothesized that a large compulsory tax system would erode voluntary intergenerational transfers (crowding-out hypothesis).

The experimental data were by and large in line with the crowding-out hypothesis: in the high tax treatment both lower levels of grants and lower levels of supports were observed. However, only the difference in grants reached a statistically significant level. In both tax treatments the levels of grants were significantly higher than the levels of supports. Moreover, in the high tax treatment subjects were better able to smooth their income over time. Hence, although the larger collective transfer scheme does partially crowd out voluntary transfers in our experiment, the net effect on utility is clearly positive.

The crowding out of transfers was not $-for-$ (as it should be if altruism were the driving force), which forcefully suggests that private transfers in our experiments were based on an exchange or reciprocity motive. Given the possibility of two-way transfers in our experiments, (at least) two forms of reciprocity could motivate private transfers. One possibility is that individuals provide support conditional on the support provided by the predecessor. We find some evidence for such indirect reciprocity in the high tax treatment but not in the low tax treatment.

Another possibility is that individuals provide support conditional on the grant of their predecessor. We do not find evidence for such direct reciprocity in either tax treatment. Nevertheless, in the low tax treatment subjects mistakingly tend to lay much confidence in grants as a mechanism for eliciting support.

From theoretical studies it is well known that a social security system potentially can distort family choices regarding fertility, savings and intergenerational transfers (See e.g. Ehrlich and Lui, 1998 for a recent example). Empirical tests in this area are sometimes based on macroeconomic cross sections of time series data, sometimes on household surveys. The paper by Cigno and Rosati (1996) is an example of the former method, while Cigno et al. (1996) provide an example of the latter method. After estimating fertility and savings equations based on macroeconomic data for a number of countries Cigno and Rosati (1996) conclude that an expansion of social security discourages fertility and raises household savings. Cigno et al. (1996) test whether within-family transfers are based on altruism or are driven by self-interest. Corresponding to our results they do not find much evidence for altruism. As their survey and many other surveys in the field mostly have been collected for other purposes, it turned out not to be possible to control for all relevant variables.

Experiments such as ours give by their very nature detailed information on individual behavior and make it, moreover, possible to isolate the effect of key variables, thus yielding more insight into the driving forces behind transfer behavior. This paper shows the potential of experimental methods for the study of social-security systems' impact on family-based choices. One key choice has been omitted from our set up: the decision on the number of children. Obviously, apart from investing less in children, government intervention might as well incite parents to have fewer children. This is the basis of the so-called old-age-security hypothesis (see, e.g., Cigno, 1993, for a survey). The basic assumption is here that children are raised in order to uphold an intergenerational transfer system that has been agreed upon by some implicit intergenerational contract. A crowding-out hypothesis would then imply that founding a social-security system will lead to a break down of the contract, and a decrease of the fertility rate. In our experiment fertility is taken as exogenous (each parent has one child). It is not difficult, however, to think of a set up in which a grant is persistent in the sense of increasing the future size of the dynasty. We leave this extension to future research.

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Appendix 0: PROTOCOL

1. Invitation by announcement (university news bulletin) and registration at the secretary's office (background data: see post-experimental questionnaire)

2. Subjects were randomly seated at personal computers (visually isolated); received written instructions (**Appendix A**) which were read aloud (to generate common knowledge) taking about 15 minutes; further 10 minutes to study instructions individually and to ask private questions (of clarification).

3. Written instructions for practicing (three pages; available upon request) including the basic time scheme (dynamic structural relationships) of the model (**Figure 1**) were explained and distributed. During practice subjects decides for both families and all generations with bookkeeping requiring understanding of the dynamic structure and how payoffs are related to decisions (on average 45 minutes).

4. Pre-experimental questionnaire (**Appendix B**); in case of wrong answers mistakes were explained (15 minutes)

5. Main experiment with 5 or 6 successive rounds for given initial and termination conditions; subjects did not know in advance the number of trials (they only were told that there will be several rounds with randomly allocated roles (families and generations); 10 subjects formed a matching group among which the 10 roles per play (2 families x 5 generations) were randomly allocated (on average: 90 minutes).

6. Post-experimental questionnaire (**Appendix C**) and afterwards private payments (15 minutes)

Appendix A: General Instructions

Instructions

Welcome to this experimental study of decision making. During the experiment you can earn money with the choices you make. The money you earn will be paid to you, privately and in cash, after the experiment.

We will first go through the instructions together. As you will notice, the instructions are fairly complicated. Therefore, we will give you a lot of opportunity to ask questions and to practice with the procedure of the experiment. It is not allowed to talk or communicate during the experiment.

Choices and earnings

The experiment consists of several rounds. In each round two groups will be formed. You will be assigned to one group. You cannot know which subjects will be in your group. In each group the subjects will be put in a row. In turn each participant of the group will make two choices. These choices will be explained below. You will not know which place you will have in the row.

The choices that you make when it is your turn, affect your own earnings. Your choices also affect the earnings of the participant before you in the row of your group (your predecessor) and the earnings of the participant after you in the row of your group (your successor). Furthermore, your choices affect the earnings of the participant in the other group that makes her or his choices at the same time as you do (your contemporary). Conversely, the choices of your predecessor, your successor and your contemporary affect your earnings.

The stage in which you make your choices is called the **active stage**. After the active stage there is a **passive stage**. In the passive stage you do not make any choices. During the passive stage your earnings in the round are determined. In both the active and the passive stage all amounts will be denoted in points. How you can earn money with these points will be explained below.

You make two choices during the active stage just like every other participant. Firstly, you decide whether or not you want to make a **transfer** ["transfer"] *to your successor* in your group. If you make a transfer you must also indicate the size of the transfer. It is convenient to remember that transfers always go forward in time. Secondly, you decide whether or not you want to make a **gift** ["overdracht"] *to your predecessor*. If you make a gift you must also indicate the size of the gift. Gifts always go back in time.

Your earnings will be determined as follows. At the beginning of the active stage you get a starting endowment of 20 points. If your predecessor in your group has decided to give you a transfer, then your **starting endowment** ["startbezit"] is supplemented with this transfer. Notice that you are the successor of your predecessor, so you receive the transfer determined by your predecessor. For example, if your predecessor decides on a transfer of 4 then your starting endowment is increased with 4 points. The resulting amount will be called your **gross endowment** ["bruto bezit']. In the example, your gross endowment is 24 points. From your gross endowment you must pay a **contribution** ["afdracht"] of 5%. Your contemporary in the other group will also contribute 5% of her or his gross endowment. This is done to make a general payment to your predecessor and the predecessor of your contemporary. In the example above you would contribute 5% of 24 points is 1.2 points. If you subtract your contribution from your gross endowment, you get your **net endowment** ["netto bezit"]. In the example, this is 2.8 points. Notice that a contribution like a gift goes back in time.

Then you can make your decisions. Firstly, you can make a transfer to your successor. Secondly, you can make a gift to your predecessor. The transfer and the gift cannot be negative. Furthermore, the sum of the two must be smaller than your net endowment; you cannot spend more than your net endowment in a certain round. If you subtract your transfer and your gift from your net endowment, you get your **end endowment 1**. This is the end of your active stage in the round.

Then follows the passive stage. In the passive stage you do not make decisions. In the passive stage you may receive two amounts. Firstly, it is possible that your successor makes a transfer to you. Secondly, you as well as your contemporary receive a **general payment** out of the contributions by your successor and the successor of your contemporary. This general payment is determined as follows. The gross endowment of your successor is equal to 20 supplemented with your transfer. From this endowment your successor contributes 5%. The gross endowment of the successor of your contemporary is equal to 20 plus the transfer of your contemporary. From this endowment the successor of your contemporary contributes 5%. The general payment to you as well as your contemporary is equal to half of the sum of these two contributions.

Suppose for example that during your active stage you decided to make a transfer of 4 points, while your contemporary decided to make a transfer of 2. Then the gross endowment of your successor is 24 points (20+4),while the gross endowment of the successor of your contemporary is 22 points (20+2). Your successor then contributes 1.2 points (5% of 24) and the successor of your

contemporary contributes 1.1 points (5% of 22). The sum of these two amounts is 2.3 points. This amount is divided over you and your contemporary: you as well as your contemporary receive a general payment of 1.15 points.

If you add the gift from your successor to you and the general payment to you, you get the **end endowment 2**. Your earnings in a round in guilders are equal to the product of the two end endowments in the two stages divided by 10:

earnings = 0.1 * (end endowment 1 * end endowment 2) guilders

Notice that you need to acquire points in both your active and passive stage to earn money.

You do not know which place in the row your group you will have. It cannot be excluded that you have the first or the last place in the row, though the chance for this is rather small. If you are the first in the row, then the choices of your predecessor are determined by us. Similarly, if you are last in the row, then the choices of your successor are determined by us. Notice, furthermore, that the situation is the same for each participant. Each participant takes the same decisions and for each participant earnings are determined in a similar way.

Information

During the active stage the computer screen will standard display the transfer from your predecessor to you. However, if you wish, you can request for more information about your predecessor. Thus you can ask for the transfer by the predecessor of your predecessor to your predecessor. You can ask for the gift from your predecessor to her or his predecessor. You can ask for the end endowment 1 of your predecessor. Finally, if you have entered a value for your gift to your predecessor, you can request for the end endowment 2 of your predecessor.

Multiple rounds

Each round you will be newly assigned to one group. Also your place in the row of your group may be different from the one in the previous round. In each round you will have to wait until all of your predecessors have made their choices. Then your active stage starts, in which you make your two choices. Then your passive stage follows, in which the choices of your successors and your contemporary determines your earnings. After that you will have to wait until all your successors

have made your choices before a new round starts. Your earnings in the experiment will be equal to the sum of your earnings in all the rounds.

Schematic summary of the experiment

Active stage

starting endowment	=	20	
transfer by predecessor to you	=		+
gross endowment	=		
contribution (5% of gross endowment)	=		-
net endowment	=		
transfer from you to sucessor	=		- (first choice)
gift from you to predecessor	=		- (second choice)
end endowment 1	=		

passive stage

transfer from successor to you	=		
general payment to you and contemporary from contributions successors	=		+
end endowment 2	=		

earnings = 0.1 * (end endowment 1 * end endowment 2) guilders

PS. general payment to you and contemporary from the contributions of successors = 0.5*[0.05*(20+your transfer)+0.05*(20+transfer contemporary)]

Appendix B: Pre-experimental Questionaire

Before we start practicing the procedure of the experiment, we would like you to indicate which of the statements below you think are correct or incorrect (circle the appropriate answer). Please raise your hand as soon as you are finished. One of us will come to your table to check your answers.

1. Your decisions affect your contribution.	correct	incorrect
2. Your decisions affect your general payment.	correct	incorrect
3. Your transfer to your successor affects the general payment to your contemporary.	correct	incorrect
4. Your transfer to your successor affects the end endowment 1 of your successor.	correct	incorrect
5. Your gift to your predecessor affects the earnings of your contemporary.	correct	incorrect
6. Your gift to your predecessor affects the earnings of your predecessor.	correct	incorrect
7. The transfer of your contemporary to her or his successor affects your earnings.	correct	incorrect

Correct answers:
1 incorrect, 2 correct, 3 correct, 4 correct, 5 incorrect, 6 correct, 7 incorrect

Appendix C: Post-Experimental Questionaire

At the completion of the experiment the following questionnaire was distributed. Between brackets [ ] the scaling and corresponding outcomes (percentages or average value, mv) are indicated.

1. Are the instructions clear in your opinion? [1=yes (93%), 2=no (7%)]

2. Could you indicate to what extent you agree/disagree with the following statement?
"The experiment only becomes clear after some practicing."
[1-7 scale: 1=disagree; 7=agree, av=5.2]

3. Could you indicate to what extent you agree/disagree with the following statement?
"The experiment only becomes clear after some real experimental rounds."
[1-7 scale: 1=disagree; 7=agree, av=4.0]

4. Has the experiment been carried out in accordance with the instructions in your opinion?
[1=yes (97%), 2=no (3%)]

5. Did you receive sufficient, too much or not enough information about the decisions of other subjects during the experiment? [1=sufficient, (66%), 2=too much (9%), 3=not enough (25%)]

6. Could you indicate to what extent you agree/disagree with the following statements? [1-7 scale: 1=disagree; 7=agree.]

"In this experiment you should pay attention to the decisions of your predecessors." [av=4.7]

"Your decision has to depend on what you think that your successor will choose." [av=5.0]

"Your own choice has clear influence on what your successor will choose." [av=4.6]

"You made your decisions mainly on the basis of fairness considerations." [av=3.9]

"Other subjects in the experiment made their decisions mainly on the basis of fairness considerations." [av=2.9]

"You made your decisions mainly on the basis of considerations about what is good for your own earnings." [av=5.9]

"Other subjects in the experiment made their decisions mainly on the basis of considerations about what is good for their own earnings." [av=6.1]

7. Could you indicate to what extent you agree/disagree with the following statements about your decisions on *gifts*? [1-7 scale: 1=disagree; 7=agree]

"If your predecessor made a gift to her or his predecessor, then it is beneficial for your own earnings to make a gift to your own predecessor." [av=3.3]

"If your predecessor made a gift to her or his predecessor, then it is fair to make a gift to your own predecessor." [av=4.9]

"If your predecessor made a transfer to you, then it is beneficial for your own earnings to make a gift to your predecessor." [av=3.3]

"If your predecessor made a transfer to you, then it is fair to make a gift to your predecessor." [av=5.0]

"It is in every case the best thing to make a gift to your predecessor, independent of what previous subjects do". [av=3.1]

8. Could you indicate to what extent you agree/disagree with the following statements about your decisions on *transfers*? [1-7 scale: 1=disagree; 7=agree]

"If your predecessor made a transfer to you, then it is beneficial for your own earnings to make a transfer to your successor." [av=4.5]

"If your predecessor made a transfer to you, then it is fair to make a transfer to your successor." [av=4.1]

"It is in every case the best thing to make a transfer to your successor, independent of what previous subjects do". [av=4.6]

9. What would your recommendation be (about how to play the game) for fututre subjects of similar experiments?

10. Do you have suggestions to improve the experiment? If yes, please elaborate on them below.

Finally, we would like to know a few things about you.

* You sex is are [1=male (61%); 2=female (24%), missing (15%)]

* What do you study [1=economics or related, (72%) 2=other (11%), missing (17%)]

* Did you participate in any earlier experiments? [1=yes (69%); 2=no (16%), missing (16%)].