Supplementary material for

Coordinating Intergenerational Redistribution and the Repayment of Public Debt

– An Experimental Test of Tabellini (1991) –

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Appendix A contains the proofs of the theoretical results in Section 3 of the paper. Appendix B complements the statistical analysis reported in the main text. Finally, Appendix C contains the experimental instructions and screenshots.

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Appendix A. Proofs

Proof of Lemma 1. Children ex ante prefer the low repayment rate if and only if overall welfare of children is decreasing in θ. Given investment profile $\boldsymbol{s}$ and repayment rate θ selected by the majority, the welfare of children is given by

$$\pi_c(\boldsymbol{s},\theta) = \sum_{i=1}^{I}\sum_{j=1}^{n}\pi_{i,j}(\boldsymbol{s},\theta) = I\,n\,w + \gamma_c\,I\,n\sum_{i=1}^{I}s_i + \theta\,r\,(\alpha_c - 1)\sum_{i=1}^{I}s_i.$$

Accordingly, $\partial\pi_c(\boldsymbol{s},\theta)/\partial\theta < 0$ if and only if $\alpha_c < 1$. □

Proof of Proposition 2. Let $\underline{\theta} < \frac{1-\gamma_p}{\alpha_p\,r} < \overline{\theta}$. The investment profile $\boldsymbol{s}_0^* = (0,\ldots,0)$ is an equilibrium, if no parent is able to benefit from investing a positive amount. Assume that parent i deviates from $\boldsymbol{s}_0^*$ by investing $s_i > 0$. It follows that $\bar{s} = s_i/I$. Therefore, parent i's children are induced to vote for the high repayment rate if and only if $\alpha_c > 1/I$. Furthermore, this vote suffices to form a majority with the old if and only if $\frac{I+n}{I+n\,I} > \frac{1}{2}$, or equivalently $n\cdot(I-2) < I$. If either of the two conditions is violated, i.e. $\alpha_c < 1/I$ or $n\cdot(I-2) > I$, a unilateral deviation from $\boldsymbol{s}_0^*$ is not profitable. Finally, uniqueness follows from Proposition 3. □

Proof of Proposition 3. *Ad (a):* Since $\underline{\theta} < \frac{1-\gamma_p}{\alpha_p\,r}$, investing a positive amount is not a best response when the low repayment rate is selected. Hence, $\theta^* = \overline{\theta}$ in any debt-equilibrium. Let

$$J = \left\lceil \frac{1}{2}\,\frac{n-1}{n}\,I \right\rceil.$$

We show that a debt equilibrium exists only if $\theta = \overline{\theta}$ is selected for the investment profile $\hat{\boldsymbol{s}}^*$ given by $\hat{s}_1^* = \ldots = \hat{s}_J^* = \hat{s}^*$ for some $0 < \hat{s}^* \leq \min_i e_i$ and $\hat{s}_i^* = 0$ for $i > J$. To see this, consider any debt-equilibrium and assume without loss of generality that $s_1^* \geq s_2^* \geq \ldots \geq s_I^*$. Equilibrium implies that $\alpha_c\,s_J^* > \bar{s}^*$. Reducing $s_1,\ldots,s_{J-1}$ to s_J^* and $s_{J+1},\ldots,s_I$ to zero reduces $\bar{s}^*$ and does not affect the voting outcome. The latter is also true for a change of $s_1,\ldots,s_J$ to $\hat{s}^*$. It follows that a debt equilibrium exists only if $\alpha_c\,\hat{s}^* > \frac{J}{I}\,\hat{s}^*$ since otherwise the high repayment rate would not be selected given investment profile $\hat{\boldsymbol{s}}^*$. Conversely, if $\theta = \overline{\theta}$ given $\boldsymbol{s} = \hat{\boldsymbol{s}}^*$, starting from the profile $\hat{\boldsymbol{s}}^*$ and increasing investments parent by parent until any further increase would imply $\theta = \underline{\theta}^*$ yields a debt-equilibrium.

Ad (b): Assume $\alpha_c > \frac{J}{I}$ and let $\boldsymbol{e} = (e_1,\ldots,e_I)$. First, $\boldsymbol{s} = \boldsymbol{e}$ implies that the empirical distribution of investments, H, coincides with $\hat{G}$. Accordingly, $\boldsymbol{e}$ is an equilibrium if and only if $\hat{G}$ satisfies condition (1) as otherwise the high repayment rate $\overline{\theta}$ would not be the majority vote.

Second, a no-debt-equilibrium exists unless $\alpha_c > 1/I$ and $n\cdot(I-2) < I$ by Proposition 2. Hence, the two conditions are necessary for uniqueness of the equilibrium $\boldsymbol{e}$. We show that they are also necessary and sufficient for the existence of a unique debt-equilibrium. Notice that $\alpha_C > J/I$ implies $\alpha_C > 1/I$ as $J \geq 1$.

Necessity: Let $\underline{e} = \min_i e_i$ and $K = \lfloor \alpha_c I \rfloor = \max\{z \in \mathbb{Z} : z < \alpha_c I\}$ and consider the strategy profile $\boldsymbol{s}'$ given by (i) $s'_1 = \ldots = s'_K = \underline{e}$, (ii) $s'_{K+2} = \ldots = s'_I = 0$, and

$$\text{(iii) } s'_{K+1} = \max\{s \in S_{K+1} : s < (\alpha_c I - K) \cdot \underline{e}\}.$$

It is easily seen that $\alpha_c \underline{e} - d/I < \bar{s}' < \alpha_c \underline{e}$. Furthermore, $s'_{K+1} < \underline{e}$ since $\alpha_c I - K < 1$. Therefore, the children of parents $1, \ldots, K$ $(K+1, \ldots, I)$ vote for $\overline{\theta}$ $(\underline{\theta})$. It follows from $\alpha_c I > \left\lceil \frac{1}{2} \frac{n-1}{n} I \right\rceil$ (part a) that $K \geq J$ and therefore $\theta = \overline{\theta}$. Hence, no parent has an incentive to deviate from $\boldsymbol{s}'$ by investing less. Furthermore, investing more is not a profitable deviation from $\boldsymbol{s}'$ for some parent $i > K$ if $n \cdot (I-2) > I$. To see this consider a deviation to $s_i \geq s'_i + d$. The new average investment satisfies $\bar{s}' + (s_i - s'_i)/I \geq \bar{s}' + d/I > \alpha_c \underline{e}$ which implies that the children of parents $j = 1, \ldots, K$ no longer vote for $\overline{\theta}$. Accordingly, only the children of parent i vote for $\overline{\theta}$ after such a deviation and this cannot be profitable if $n \cdot (I-2) > I$. Hence, $\boldsymbol{e}$ is the unique debt-equilibrium only if $n \cdot (I-2) < I$ since otherwise $\boldsymbol{s}'$ would constitute a debt-equilibrium as well.

Sufficiency: Assume $n \cdot (I-2) < I$ and, without loss of generality, $e_1 \geq e_2 \geq \ldots \geq e_I$. Consider a strategy profile $\boldsymbol{s} \neq \boldsymbol{e}$ which induces $\overline{\theta}$ and let $\ell = \min\{i : s_i < e_i\}$. Clearly, $\bar{s} < \bar{s} + (e_\ell - s_\ell)/I \leq \bar{e}$. We show that there exists a profitable deviation from $\boldsymbol{s}$ by distinguishing two cases:

If $\alpha_c e_\ell > \bar{e} \geq \bar{s} + (e_\ell - s_\ell)/I$, increasing s_ℓ to e_ℓ induces $\theta = \overline{\theta}$ because the children of parent ℓ vote for $\overline{\theta}$ and this suffices since $n \cdot (I-2) < I$.

If $\alpha_c e_\ell < \bar{e}$, we have that $s_i = e_i$ for $i < \ell$ by definition of ℓ, and $\ell > J$ by the ordering of the e_i and since $\boldsymbol{e}$ is an equilibrium by assumption. Therefore, $\alpha_c s_i = \alpha_c e_i > \bar{e} \geq \bar{s} + (e_\ell - s_\ell)/I$ for $i = 1, \ldots, J$ and increasing s_ℓ to e_ℓ is profitable since it does not change the voting outcome $\theta = \overline{\theta}$.

Ad (c): Conditions (i) and (ii) are easily seen since $G\left(\frac{\bar{e}}{\alpha_c}\right) > \frac{1}{2} \frac{n+1}{n}$, and since $s_1 = s_2 = \ldots = s_I = \bar{s}$ violates condition (1). For conditions (iii) and (iv), consider a strategy profile $\boldsymbol{s}$, a parent j such that $s_j < e_j$, and a deviation $s'_j = s_j + d$ which implies $\bar{s}' = \bar{s} + \frac{d}{I}$. The deviation may induce player j's kids to change their votes from $\underline{\theta}$ to $\overline{\theta}$ but not vice versa. On the other hand, the deviation induces the children of parents $i \neq j$ with $s_i \in \left[\frac{\bar{s}}{\alpha_c}, \frac{\bar{s}}{\alpha_c} + \frac{d}{I \alpha_c}\right]$ to switch votes from $\overline{\theta}$ to $\underline{\theta}$. If $s_i \notin \left[\frac{\bar{s}}{\alpha_c}, \frac{\bar{s}}{\alpha_c} + \frac{d}{I \alpha_c}\right]$ for each $i = 1, \ldots, I$, this does not happen and the deviation is profitable. If $1 - H\left(\frac{\bar{s}^*}{\alpha_c} + \frac{d}{\alpha_c I}\right) > \frac{1}{2} \frac{n-1}{n}$, the deviation leaves the majority in favor of the high repayment rate unaffected and is also profitable. In conclusion, $\boldsymbol{s}$ is an equilibrium only if $s_i \in \left[\frac{\bar{s}}{\alpha_c}, \frac{\bar{s}}{\alpha_c} + \frac{d}{I \alpha_c}\right]$ for some $i \in \{1, \ldots, I\}$ and $1 - H\left(\frac{\bar{s}^*}{\alpha_c} + \frac{d}{\alpha_c I}\right) < \frac{1}{2} \frac{n-1}{n}$.

To see multiplicity of debt-equilibria, assume first that $n(I-2) < I$. Hence, starting from $(0, \ldots, 0)$, any single parent i can guarantee the high repayment rate by investing $s_i = e_i$. Increasing investments parent by parent for the remaining parents must stop at an equilibrium with $s^*_j < e_j$ for some $j \neq i$. Noting that i was chosen arbitrarily finishes the proof for $n(I-2) < I$. Finally, the proof for $n(I-2) > I$ follows from the construction of the equilibrium $\boldsymbol{s}'$ as in (b) by noting that the assignment of $s_i = \underline{e}$ to parents $i \in \{1, \ldots, K\}$ (rather than any other subgroup of size K) is arbitrary. $\square$

Appendix B. Complementary Econometric Results

	Propensity to Vote Sincerely							
	(1)		(2)		(3)		(4)	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Constant	4.083***	(0.515)	0.616	(0.441)	0.851*	(0.442)	0.608	(0.880)
Supporting Child	-1.379**	(0.571)	1.554***	(0.434)	1.640***	(0.433)	1.650***	(0.438)
Opposing Child	-2.052***	(0.545)	0.430	(0.433)	0.480	(0.430)	0.544	(0.438)
Equal								
× Parent	-0.173	(0.590)	0.360	(0.554)	0.427	(0.552)	0.531	(0.548)
× Supp. Child	-0.289	(0.410)	-0.249	(0.415)	-0.252	(0.411)	-0.181	(0.389)
× Opp. Child	-1.032**	(0.468)	-0.641	(0.429)	-0.598	(0.422)	-0.594	(0.403)
Payoff Difference			0.738***	(0.141)	0.750***	(0.146)	0.736***	(0.138)
Round					-0.031**	(0.015)	-0.036**	(0.016)
Addit. Controls	No		No		No		Yes	
Observations	3,437		3,437		3,437		3,437	
Log-Likelihood	-1,023.1		-964.6		-959.9		-931.6	

Notes: Ties are excluded. Standard errors in parentheses, clustered at the group level. Significance levels: * (10%), ** (5%), *** (1%).

Table B1: Determinants of Truthful Voting – Logit Regression with Clustered SE

	Investment / Endowment			
	(1)	(2)	(3)	(4)
Constant	0.796***	0.844***	0.575***	0.556***
	(0.044)	(0.050)	(0.108)	(0.135)
High Endowment	0.074***	0.074***	0.074***	0.074***
	(0.012)	(0.012)	(0.012)	(0.012)
Equal	-0.152**	-0.138**	-0.111*	-0.096
	(0.061)	(0.062)	(0.058)	(0.059)
1/Round	-0.302***	-0.302***	-0.302***	-0.302***
	(0.026)	(0.026)	(0.026)	(0.026)
× *Equal*	0.164***	0.164***	0.164***	0.164***
	(0.037)	(0.037)	(0.037)	(0.037)
Age		-0.005	-0.003	-0.003
		(0.003)	(0.003)	(0.003)
Female		-0.015	0.009	0.006
		(0.032)	(0.033)	(0.033)
Engineering		0.012	-0.005	0.006
		(0.036)	(0.034)	(0.034)
Other Field of Studies		-0.079**	-0.070*	-0.060*
		(0.039)	(0.036)	(0.036)
Non-German Mother Tongue		-0.015	-0.033	-0.027
		(0.037)	(0.035)	(0.034)
Risk Affinity			0.058***	0.049***
			(0.011)	(0.011)
Egoism			0.000	-0.001
			(0.009)	(0.009)
Gifts			0.012	0.012
			(0.011)	(0.011)
Ambition			-0.010	-0.004
			(0.011)	(0.011)
Generosity			-0.005	-0.002
			(0.010)	(0.010)
Importance of Payment				-0.002
				(0.013)
Importance of Majority				0.005
				(0.007)
Voting Motive = Own Payoff				0.014
				(0.039)
Voting Motive = Partners' Payoff				-0.013
				(0.042)
Voting Motive = Efficiency				0.030
				(0.031)
Voting Motive = Equity				-0.097***
				(0.036)
Observations	3,672	3,672	3,672	3,672
Log-likelihood	-302.6	-297.2	-282.2	-276.8

Notes: Table presents results for a three-level model which accounts for clustering on the level of the subject and the group. Standard errors are in parentheses. Significance levels are given by * (10%), ** (5%), and *** (1%). Base category for the field of studies is "Business Administration".

Table B2: Determinants of Investment Decisions

Appendix C. Sample Instructions

We here provide instructions for treatment *Unequal*. The instructions for the other treatments are available from the authors upon request.

C.1. Instructions for Treatment *Unequal*

For the experiment, we randomly divide the participants in groups of six. You stay with your group until the end of the experiment.

The experiment consists of **20 independent rounds**, and each round is conducted in the same way.

A. The progress of a round

At the beginning of each round, 3 participants in each group are selected randomly and independently of the outcome of previous rounds to receive an initial endowment A equal to

$$\boxed{A = 600 \text{ points}}.$$

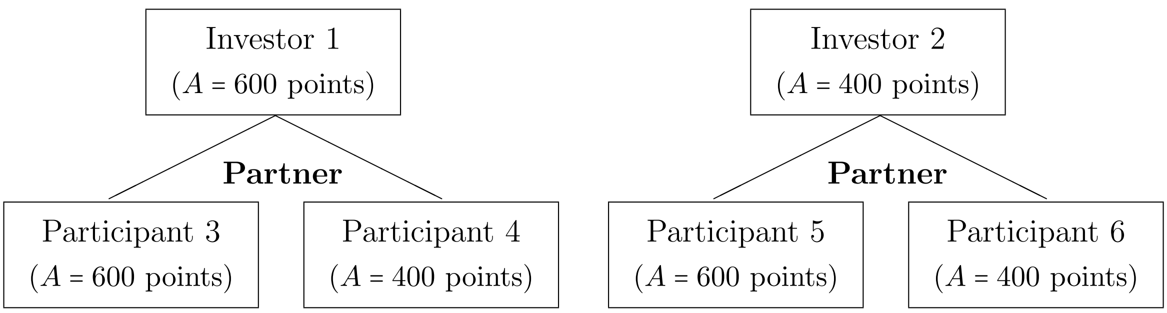
The 3 remaining participants in each group receive an initial endowment A equal to

$$\boxed{A = 400 \text{ points}}.$$

Each round consists of two parts:

- In the **first part** you and every other participant decide how many points to invest. You can invest each multiple of 10 points between 0 and your initial endowment (i.e. 0, 10, 20, 30, . . . , or A points). The payoff of your investment is determined in the second part of the round.

- At the beginning of the **second part**, one participant with an initial endowment of 600 points and one participant with an initial endowment of 400 points are randomly selected in each group. These two participants are called **investors** henceforth. Only the investments of the investors affect the payoffs in the given round. Each of the 4 remaining participants in the group is randomly matched to one of the investors as a partner. The random assignment is such that every investor is matched with exactly one participant with an initial endowment of 600 points and one participant with an initial endowment of 400 points:



- In the **second part** of the experiment *all 6 participants* in each group vote on the approval of the two investors' investments. The investments are approved, if at least 4 participants in the group vote in favor of the investments, otherwise the investments are rejected.

B. The Payoffs in a Round

Payoffs of the investors

If you are randomly selected as an investor in a given round, your payoff I in this round equals:

$$I = \begin{cases} A \; + \text{ your investment}, & \text{if the investments are approved.} \\ A \; - \text{ your investment}, & \text{if the investments are rejected.} \end{cases}$$

Payoffs of the remaining group members

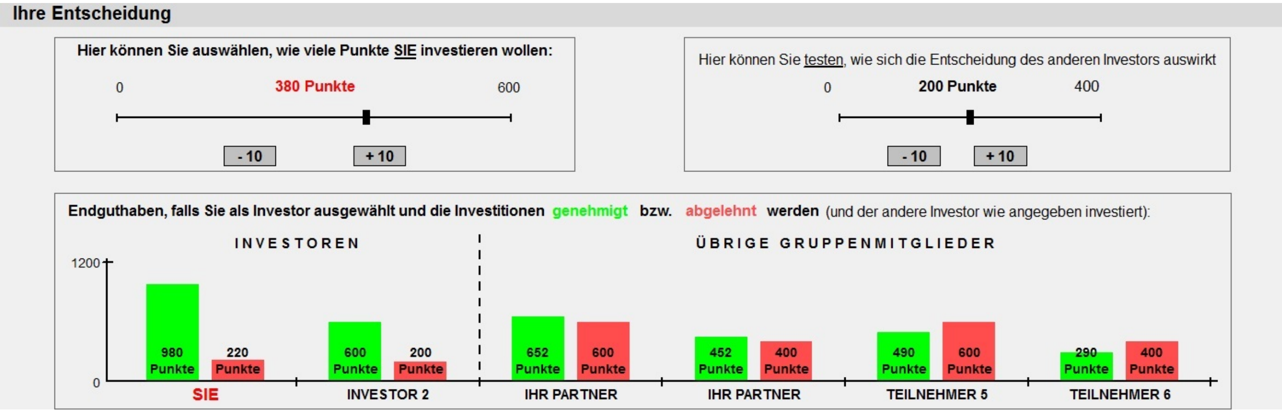
If you are not selected as an investor in a given round, your payoff I in this round equals:

$$N = \begin{cases} A + 0,4 \cdot \text{your partner's investment} - 0,5 \cdot \text{the other investor's investment}, & \text{if investments are approved} \\ A, & \text{if investments are rejected} \end{cases}$$

C. Decision Support

Investment decision

Before you decide how many points to invest, you have the possibility to test the effects of your and the other investor's decision on the payoffs in the group. Please note that your decision only affects the payoffs as indicated, if you are randomly selected as an investor.



Voting

Before you cast your vote, you will be shown on your screen

(i) whether you are selected as an investor or not.

(ii) how many points you invested (if you are an investor) ,
or how many points your partner invested (if you are not an investor).

(iii) how many points the other investor invested,

(iv) the payoffs you and the other participants in your group achieve,
if the investments are approved and if they are rejected.

D. Earnings

At the end of the 20 rounds, two rounds are randomly selected. The sum of the payoffs you achieved in these rounds will determine your earnings in this experiment. To select these rounds, one participant will be asked to throw a 10-sided dice twice:

- The number of points of the 1st throw determines one of the rounds 1 – 10.
- The number of points of the 2nd throw + 10 determines one of the rounds 11 – 20.