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Coordinating intergenerational redistribution and the repayment of public debt: an experimental test of Tabellini (1991)

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Abstract

Is there a link between public debt and wealth inequality? Could government bond-holders use intra-generational redistribution strategically to make the repayment of debt politically viable? We reconsider the model of Tabellini (J Polit Econ 99:335–357, 1991) and expose the role of *coordination* and *divide-and-conquer*. By coordinating their bond investments, the old generation splits up the young generation and secures a majority favoring debt repayment. Coordination therefore mediates the impact of wealth inequality on public debt. We test the model in a laboratory experiment and find that subjects often coordinate to exploit the link between inter- and intragenerational redistribution. Hence, coordination plays an important role in the strategic creation and exploitation of minorities, and thus in the accumulation of public debt.

1 Introduction

In the wake of the Great Recession of 2008/2009, countries around the globe accumulated massive amounts of government debt. Figure 1 provides an overview for selected developed countries. Adjusting this unsustainable fiscal situation is among

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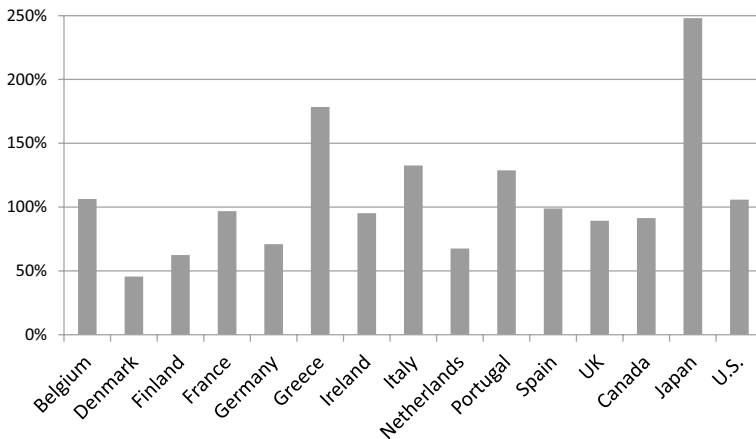
Fig. 1 Ratio of gross public debt to GDP for selected countries. Source: IMF World Economic Outlook Database, April 2016

the main fiscal policy challenges of the near future. Yet, fiscal policy before the crisis casts serious doubts upon a successful fiscal adjustment process. Contrary to the prescriptions of optimal debt policies (e.g. Barro 1979; Startz 1989), governments persistently accumulated debt in peace time. As convincingly argued by a large and growing literature, politics is at the heart of this problem (see Alesina and Passalacqua 2016; von Weizsäcker 1992, 2015).

Although the debt problem is shared by most countries, there are marked differences. Consider the two countries with the largest debt-to-GDP ratio, Japan and Greece. Whereas Greece has gone through considerable turmoil in the past years with haircuts and even default repeatedly on the table, Japan "continues to enjoy low and stable interest rates" (Hoshi and Ito 2014). The conventional explanation put forward in the literature is the large fraction of domestic debt in Japan, which is purportedly less susceptible to default (Hoshi and Ito 2014; see Mallucci 2015, for an overview of domestic to total debt ratios). Yet, default on domestic government debt is hardly rare (Reinhart and Rogoff 2011). This raises the question why some countries default on their domestic debt, while others don't.

A special feature of government debt is the associated promise of transfers from future to current generations, usually made without the consent of the former. Why are these promises kept? Tabellini (1991) shows that repudiating the debt affects both the *inter-* and the *intragenerational* distribution of resources. Concretely, debt repudiation harms the wealthy members of the old generation more than the poor. Intergenerational altruism then implies that the children of the wealthiest debt holders join the old in a coalition which supports repayment of the debt. The central aspect of Tabellini's paper is the link between inter- and intragenerational redistribution, "a topic which is surprisingly understudied both theoretically and empirically" (Alesina and Passalacqua 2016, p. 2626).

In this paper, we investigate more closely when and how the old generation can exploit the link between inter- and intragenerational redistribution to make the

repayment of debt politically viable. The main objective of the paper is to provide controlled empirical evidence on the theoretical framework proposed by Tabellini (1991). However, we also offer some novel theoretical insights on the factors determining intergenerational redistribution.

We develop a version of Tabellini's (1991) model with a finite number of players and strategies. The model exposes a so-far neglected aspect of intergenerational redistribution, namely *coordination*. Similar to Tabellini (1991), the repayment of debt is politically viable if and only if government bonds are held neither too narrowly nor too widely. Contrary to Tabellini (1991), this property of the debt distribution is not predetermined by the initial wealth distribution in our model. Instead, the members of the old generation may generate a debt distribution with the desired property by coordinating their bond investments. Accordingly, domestic debt will be honored, if coordination is successful, and it will be repudiated otherwise. As a consequence, the repayment of debt may become politically viable under less stringent assumptions on the initial wealth distribution. A moderate amount of wealth inequality favors debt repayment, because it facilitates coordination. On the other hand, debt repayment may not be viable even with a favorable wealth distribution, if coordination fails.

Our model also discloses that the old generation effectively employs a *divide-and-conquer* strategy towards the young generation. Although the young generation is opposed to issuing debt ex ante, successful coordination enables the old to form a coalition with some of the young voters. This insight connects our paper to a wide literature in political economics (see Sect. 2) which holds the potential to shed new light on e.g. the role of budgetary institutions and constitutional reform. We also extend the theoretical basis of this literature by adding coordination as a prerequisite for divide-and-conquer.

The paper's main contribution lies in the empirical validation of the redistributive mechanism proposed by Tabellini (1991). We provide an experimental paradigm to investigate the interplay between redistribution, coordination, and divide-and-conquer. This is important as empirical studies on this topic are often plagued by problems of data availability, measurement, and causality. It is not clear, for example, how a binding vote on debt repudiation could be organized in practice.[1] Experiments have the potential to overcome some of these issues and to stimulate future empirical studies (see also Sutter 2003; Fochmann et al. 2018; Battaglini et al. 2019).

In our experiment, subjects repeatedly play the simplest possible version of the model with two *parents* (members of the old generation) and four *children* (members of the young generation) who each receive a wealth endowment. The game proceeds in two stages: First, the two parents simultaneously decide over their bond investments. Second, parents and children vote on accepting or rejecting the investments. If investments are accepted by a strict majority, investments must be repaid with interest and the costs are shared equally among all children. Otherwise, parents lose their investments. The structure of payoffs enables parents to induce a majority preferring acceptance by successfully coordinating their investments.

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[1] The case of Greece provides a good example of the difficulties involved.

We implement two treatments that differ with respect to the difficulty of coordination: In treatment *Unequal*, parents receive unequal endowments and coordination succeeds, if both parents invest their entire endowment. In contrast, in treatment *Equal*, both parents receive the same endowment and one of the parents must invest less than the other to induce a majority favoring acceptance. Accordingly, coordination is hard and repayment should not ensue based on the predictions of Tabellini (1991).

Our experimental results show that the link between inter- and intragenerational redistribution is exploited both if coordination is easy and if it is hard. In treatment *Unequal*, parents coordinate a majority preferring debt repayment in almost 80% of game plays, and the debt is repaid three out of four times. Though coordination is less successful in treatment *Equal*, parents manage to coordinate in almost half of the game plays and the debt is repaid two out of three times. In summary, coordination plays an important role in the strategic creation and exploitation of minorities, and thus e.g. in the accumulation of public debt. Still, our results also show that individuals' risk and pro-social preferences limit the extent to which redistribution takes place.

The paper is structured as follows: Sect. 2 discusses related literature. Section 3 introduces the game-theoretic model and derives the equilibria. Section 4 presents the experimental results. Section 5 concludes. The appendix contains the proofs, complementary statistical results, and the experimental instructions.

2 Related literature

The paper relates to a wide literature in public finance, political, and experimental economics.

First, we contribute to the political-economic literature on the strategic use of budget deficits. This literature explains deviations from optimal debt policy by strategic considerations of politicians and voters. The literature may be broadly categorized according to the underlying strategic motives (see e.g. Eslava 2011; von Weizsäcker 2015): opportunistic policymakers seeking re-election (early contributions are Nordhaus 1975; Buchanan and Wagner 1977), partisan incumbents attempting to bind their successors (Alesina et al. 1990; Tabellini and Alesina 1990), policymakers facing a common pool problem (Weingast et al. 1981; Baron and Ferejohn 1989), and current generations exploiting the possibility to redistribute from future generations to themselves (Tabellini 1991; Song et al. 2012). Our paper addresses the latter strand of the literature. Based on a simplified version of Tabellini's (1991) model with a finite number of players and strategies, we explore the impact of coordination and we reconsider the effect of the wealth distribution on the repayment of government debt (see also Larch 2012). Moreover, we provide an experimental test of the theoretical framework.

Few experimental studies investigate the strategic use of budget deficits. Sutter (2003) tests the partisan model of Alesina et al. (1990) in which one of two parties is elected with exogenous probability in each of two periods to distribute resources among two public goods. Parties differ in their preferences for the public goods. As

debt can be issued in the first period and must be repaid in the second, it may be used strategically by the first-period-incumbent to "tie the hands" of the other party in the second period. Alesina et al. (1990) show that the optimal level of debt is positive and thus inefficient, and it is larger the more the parties' preferences differ and the lower is the probability of being re-elected. Sutter (2003) finds support for these comparative statics, if variations are within-subjects, but not if they are between subjects.

Battaglini et al. (2019) test two other motives for public debt accumulation, namely dynamic distortions and non-unanimous voting. A legislature bargains over the level of a public good and private transfers in two periods. In both periods, each of the n members of the legislature submits a proposal, one of which is randomly selected and voted on with a quorum $q < n$. Incentives to run a deficit in the first period mainly derive from the non-unanimous voting rule which entails the risk of not being included in the winning coalition in the second period. In line with theory, Battaglini et al. (2019) find that public policies are inefficient, and that the level of debt is higher the lower the quorum q. In addition, a higher quorum may induce difficulties to reach an agreement, akin to political gridlock.

While the studies cited above focus on the strategic use of budget deficits to reach a certain goal,[2] we investigate how intragenerational redistribution—and thus accumulation of debt—is achieved by exploiting the link between inter- and intragenerational redistribution. Accordingly, the accumulation of debt is an end and not a strategic vehicle. Relatedly, Fochmann et al. (2018) investigate experimentally how intergenerational altruism affects public debt accumulation, i.e. shifting a financial burden to future generations. The authors find only weak evidence of intergenerational altruism. Contrary to our setup, individuals are not involved in deciding how much public debt is shifted upon them by past generations, but they may be able to pass it on to future generations.

Finally, we also contribute to the literature on *divide-and-conquer*. In a nutshell, divide-and-conquer refers to the use of discrimination and favoritism to exploit a group that could withstand by acting unanimously. This tactic has been identified as a building block of Roman imperialism (Abbott 1901). In recent years, the idea has been investigated both theoretically and experimentally in different contexts, e.g. market entry deterrence (Rasmussen et al. 1991; Landeo and Spier 2009), kleptocracy (Acemoglu et al. 2004), and constitutional design (Weingast 1995, 2005; Cason and Mui 2007, 2014, 2015). Posner et al. (2010) and Palfrey (2016) provide comprehensive overviews. Many of this literature's insights on divide-and-conquer can be useful in the context of redistribution and government debt, for example regarding the role of constitutional rules. On the other hand, a common feature of all these studies is the assumption that the divide-and-conquer strategy is employed by a single actor. Therefore, we also extend the literature by identifying and investigating a

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[2] See also Irlenbusch and Sutter (2006), who show that voting rules of the Stability and Growth Pact in the European Monetary Union may be used strategically by larger countries to run excessive deficits.

so far neglected prerequisite for a successful implementation of divide-and-conquer, namely coordination.[3] This plays a role e.g. in subcommittee legislation in the U.S. (see Eavey and Miller 1995) and might be an interesting extension of existing studies (e.g. Cason and Mui 2007, 2014, 2015).

3 A model of intergenerational redistribution

3.1 The intergenerational redistribution game

There are two periods, $t = 1, 2$, and two generations of players. Players in the parent generation are denoted by $i = 1, \dots, I$ where $I \geqslant 2$, and each of them has $n \in \mathbb{N}$ children. We frequently refer to the parent (child) generation as the old (young).

In period 1, parent i is endowed with the privately-observed individual wealth $e_i > 0$ drawn from a (commonly) known distribution with cumulative distribution function $G(\cdot)$. The parent then decides about her investment $s_i \in S_i \subset [0, e_i]$ in government bonds, which yields a secure gross rate of return $r > 1$. We assume that $S_i = \{0, d, 2d, \dots, e_i\}$ for each i where d is an indivisible monetary unit (hence $e_i/d \in \mathbb{N}$ for all i). The profile of investments $s = (s_1, \dots, s_I) \in S = \times_i S_i$ is publicly observed, and it is used to finance a public good of size $g = \sum_i s_i$.

Repayment of government debt (with interest) is due in period 2. To repay the debt, the government collects income taxes from the children, since only children earn income in period 2. We assume the latter to be constant across individuals and equal to w.[4] However, debt may also be fully or partially repudiated. To determine the fraction of debt that is repaid, parents and children vote on the *repayment rate* $\theta \in [0, 1]$. Conversely, $1 - \theta$ denotes the *repudiation rate* or the extent of the haircut that is invoked.

Denote by θ_i (θ_{ij}) the repayment rate voted on by parent i (parent i's jth child). To simplify the analysis, we assume that $\theta_i, \theta_{ij} \in \Theta = \left\{ \underline{\theta}, \overline{\theta} \right\}$ with $0 \leqslant \underline{\theta} < \overline{\theta} \leqslant 1$. Given the vectors of votes $\boldsymbol{\theta}_p = (\theta_1, \dots, \theta_I)$ and $\boldsymbol{\theta}_c = (\theta_{i1}, \dots, \theta_{in})_{i=1}^I$, the repayment rate is selected by majority rule; formally

$$\theta \equiv \theta(\boldsymbol{\theta}_p, \boldsymbol{\theta}_c) = \min \left[\arg \max_{\hat{\theta} \in \left\{ \underline{\theta}, \overline{\theta} \right\}} \left(\sum_{i=1}^I \mathbb{1}_{\{\hat{\theta}\}}(\theta_i) + \sum_{i=1}^I \sum_{j=1}^n \mathbb{1}_{\{\hat{\theta}\}}(\theta_{ij}) \right) \right]$$

where $\mathbb{1}_A(x) = 1$ if $x \in A$, and $\mathbb{1}_A(x) = 0$ if $x \notin A$. The first (second) sum on the right-hand side is the number of parents' (children's) votes in favor of repayment rate $\hat{\theta}$. The RHS also specifies that in case of a tie the lower repayment rate is selected. Hence, the high repayment rate $\overline{\theta}$ must be supported by a strict majority.

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[3] The only other study with this feature we are aware of is Eavey and Miller (1995) on subcommittee bargaining. In that study, however, subjects are allowed to bargain freely, and repeated coordination within changing coalitions is necessary to reach the predicted outcome.

[4] Extending the model to allow for heterogeneous income of the children yields qualitatively similar results, but is notationally cumbersome. Results are available from the authors upon request.

The voting outcome θ and the sum of investments jointly determine the income tax rate τ through the government budget constraint $\theta\, r \sum_i s_i = \tau\, n\, I\, w$. Hence, τ depends on the voting outcome and the average investment $\bar{s} = \frac{1}{I} \sum_{i=1}^{I} s_i$ via

$$\tau = \frac{\theta\, r \sum_i s_i}{n\, I\, w} = \frac{r\, \bar{s}}{n\, w}\, \theta.$$

Given the investment profile s and the voting profile (θ_p, θ_c), parent i's payoff is

$$\pi_i(s, \theta_p, \theta_c) = e_i - s_i + \gamma_p \sum_{i=1}^{I} s_i + \alpha_p\, \theta\, r\, s_i$$

where $\gamma_p \in [0, 1)$ denotes the extent to which the public good benefits the parents, and $\alpha_p > 0$ denotes the degree to which parents benefit from their own investment.

The payoff of parent i's jth child is

$$\pi_{ij}(s, \theta_p, \theta_c) = (1 - \tau)\, w + \gamma_c \sum_{i=1}^{I} s_i + \alpha_c\, \theta\, r\, \frac{s_i}{n} = w + \gamma_c \sum_{i=1}^{I} s_i + \theta\, \frac{r}{n} \left[\alpha_c\, s_i - \bar{s} \right]$$

where $\gamma_c > 0$ denotes the degree to which the public good benefits the children, and $0 \leqslant \alpha_c < 1$ denotes the fraction of the parent's investment which is inherited. The assumption $\alpha_c < 1$ is made to ensure that there is a conflict of interest between the two generations (cf. Tabellini 1991, p.341):

Lemma 1 *Ex ante, children prefer the low repayment rate if and only if* $\alpha_c < 1$.

Accordingly, children prefer that no government debt be issued. Our analysis will focus on the question how the intergenerational conflict is resolved. In particular, we investigate when and how parents can enforce a positive amount of government debt and thus a redistribution in their favor.[5]

We study pure, subgame perfect equilibria (*equilibria* henceforth). Thus, the relevant strategy space is $S_i \times \Theta^S$ for parent i and Θ^S for any child, where $\Theta^S = \{f : S \rightarrow \Theta\}$. Furthermore, we assume that no player plays a weakly dominated strategy in equilibrium. Because voters choose among two repayment rates, this ensures *sincere voting*, i.e. each individual votes in favor of the repayment rate that would maximize her payoff (Besley and Coate 1997).

The assumption that only two alternatives are available is restrictive. However, since the parents' payoffs are increasing in θ and the payoffs of parent i's children are increasing (decreasing) in θ if $\alpha_c\, s_i > (<)\bar{s}$, each voter favors either full repayment or full repudiation of the debt. This suggests that political platforms will converge towards those two extremes. Factors beyond the scope of the model may

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[5] Note that repudiating the debt is the only possibility to redistribute from old to young in this model. At the voting stage (when the young have political power), parents have no income besides their investment returns. An alternative interpretation of the model is that parents and children vote on the rate $1 - \theta$ at which investment returns are taxed, i.e. the *tax rate on debt* (cf. Tabellini 1991, p. 339).

limit the extent to which the debt may be repudiated (or repaid). For example, a too extreme haircut severely limits a government's opportunities to borrow in the future (Cruces and Trebesch 2013).

3.2 Voting and divide-and-conquer

Our first result characterizes equilibrium voting.

Proposition 1 *In any equilibrium, $\theta_i^* = \overline{\theta}$ for each $i = 1, \ldots, I$, and*

$$\theta_{ij}^*\left(s_i^*\right) = \begin{cases} \overline{\theta} & \text{if } \alpha_c \, s_i^* > \overline{s}^* \\ \underline{\theta} & \text{if } \alpha_c \, s_i^* < \overline{s}^* \end{cases}$$

for each $i = 1, \ldots, I$ and each $j = 1, \ldots, n$. Accordingly, $\theta^* = \overline{\theta}$ if and only if

$$H\left(\frac{\overline{s}}{\alpha_c}\right) < \frac{1}{2}\frac{n+1}{n}. \tag{1}$$

where $H(s) = \left|\{i \,:\, s_i < s\}\right|/I$ is the empirical distribution function of investments.

The proposition shows that the high repayment rate $\overline{\theta}$ is supported by (i) parents,[6] and (ii) the children of those parents who invested the most in government debt. Unless debt is fully repudiated, the latter are the wealthiest in the young generation. In contrast, poor children prefer the low repayment rate $\underline{\theta}$. Accordingly, debt repayment is supported by a coalition of the old and the wealthy young, as in Tabellini (1991).

The repayment of debt is politically viable if and only if the coalition of the old and the wealthy young holds the majority. Whether this will be the case depends on the distribution of bond investments within the old generation. The necessary and sufficient condition is given by (1) which states that the fraction of investments below $\overline{s}/\alpha_c$ is bounded above. In other words, the proportion of parents investing little to nothing in government bonds cannot be too large. Otherwise, the coalition of poor children is large enough to prevent the repayment of debt. Debt repayment is therefore politically viable only if the degree of inequality in the distribution of bond investments is limited. On the other hand, a uniform distribution of investments ($s_i = s$ for each $i = 1, \ldots, I$) also results in the low repayment rate, since $\overline{s}/\alpha_c > \overline{s}$ and therefore $H\left(\overline{s}/\alpha_c\right) = 1 > (n+1)/(2n)$. In summary, for debt repayment to be politically viable, debt can be held neither too widely nor too narrowly.

Note that the required degree of inequality in the distribution of bond investments depends on the rate of population growth. For large n, a majority in favor of debt repayment only exists if the median of the distribution of bond investments is larger than its mean. The smaller n, the smaller is the fraction of parents holding the largest

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[6] We assume that parents vote for the high repayment rate even when investing nothing to avoid cumbersome notation.

amount of the debt (equivalently the fraction of wealthy children) that is necessary to ensure debt repayment.

In the light of Lemma 1, whenever the coalition of the old and the wealthy young holds the majority, children effectively fall prey to a divide-and-conquer mechanism. Withstanding such a mechanism would require the young to cooperate and unite against the old. Weingast (2005) and Cason and Mui (2014, 2015) (among others) discuss possible solutions to this social dilemma. On the other hand, parents in our model may exploit the possibility to divide-and-conquer. We discuss this opportunity in the next sub-section where we show that successful divide-and-conquer requires the parents to resolve a *coordination problem*.

3.3 Bond investments and coordination

Turning to equilibrium investments, notice first that parent i's payoff is increasing (decreasing) in her investment s_i, if $\theta \, \alpha_P \, r \, > \, (<) \, 1 - \gamma_P$. Accordingly, parents will not invest into government bonds and no public debt is issued in any equilibrium, if $\overline{\theta} < (1 - \gamma_P)/(\alpha_P \, r)$. Conversely, debt is issued in any equilibrium, if $\underline{\theta} > (1 - \gamma_P)/(\alpha_P \, r)$. In line with the focus of our experiment, we restrict our analysis to the constellation $\underline{\theta} < (1 - \gamma_P)/(\alpha_P \, r) < \overline{\theta}$ in which debt arises endogenously in some but not all equilibria and is thus the outcome of *coordination*.[7]

We distinguish two types of equilibria: We first establish conditions for a *no-debt-equilibrium* (Proposition 2), in which government debt is not issued since it will not be repaid ($s_i^* = 0$ for each $i = 1, \dots, I$). We then investigate *debt-equilibria* (Proposition 3), in which $s_i^* > 0$ for some $i \in \{1, \dots, I\}$. Jointly, these two results show that coordination is necessary and sufficient to enable the accumulation and repayment of government debt.

Proposition 2 *Let* $\underline{\theta} < \frac{1-\gamma_P}{\alpha_P \, r} < \overline{\theta}$. *A no-debt-equilibrium exists if and only if* (i) $\alpha_c < \frac{1}{I}$, *or* (ii) $n \, (I - 2) \, > \, I$. *It is the unique equilibrium under condition* (i) *if* $n > 1$, *and under condition* (ii) *if* $\alpha_c < \left\lceil \frac{1}{2} \frac{n-1}{n} I \right\rceil / I$.[8]

The conditions are easily interpreted. First, a no-debt-equilibrium exists, if children benefit little from parents' investments since this prevents the majority coalition supporting repayment of debt from forming. Second, a no-debt-equilibrium is easier to sustain if population growth is larger because the latter implies a smaller political influence of the older generation. Notice that the voting outcome is indeterminate for any no-debt-equilibrium, since both parents and children are indifferent with regard to the repayment rate. Nevertheless, any voting outcome yields the same equilibrium payoffs.

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[7] See March and von Weizscker (2016) for a full equilibrium analysis of the above game.

[8] $\lceil x \rceil = \min \{z \in \mathbb{Z} : z > x\}$.

To present our results on debt-equilibria, let $\hat{G}(\cdot)$ denote the *empirical wealth distribution*, i.e. the distribution of realized wealth levels e_i drawn independently from $G(\cdot)$, and let $\bar{e} = \int_{\mathbb{R}_+} e \, d\hat{G}(e)$.

Proposition 3 *Let* $\underline{\theta} < \frac{1-\gamma_p}{\alpha_p r} < \bar{\theta}$.

(a) *At least one debt-equilibrium exists if and only if* $\alpha_c > \underline{\alpha}_c(n, I) \equiv \left\lceil \frac{1}{2} \frac{n-1}{n} I \right\rceil / I$. *Any debt-equilibrium satisfies* $\theta^* = \bar{\theta}$.

(b) *If* $\alpha_c > \underline{\alpha}_c(n, I)$ *and* $\hat{G}\left(\frac{\bar{e}}{\alpha_c}\right) < \frac{1}{2} \frac{n+1}{n}$, *the strategy profile given by* $s_i^* = e_i$ *for each* $i = 1, \dots, I$ *constitutes a debt-equilibrium. It is the unique equilibrium if and only if (additionally)* $n(I - 2) < I$.

(c) *If* $\alpha_c > \underline{\alpha}_c(n, I)$ *and* $\hat{G}\left(\frac{\bar{e}}{\alpha_c}\right) > \frac{1}{2} \frac{n+1}{n}$, *multiple debt-equilibria exist, and any debt-equilibrium satisfies (i)* $s_i^* < e_i$ *for some* $i \in \{1, \dots, I\}$, *(ii)* $\min_i s_i^* < \max_i s_i^*$, *(iii)* $H\left(\frac{\bar{s}^*}{\alpha_c} + \frac{d}{\alpha_c I}\right) - H\left(\frac{\bar{s}^*}{\alpha_c}\right) > 0$, *and (iv)* $1 - H\left(\frac{\bar{s}^*}{\alpha_c} + \frac{d}{\alpha_c I}\right) < \frac{1}{2} \frac{n-1}{n}$.

The proposition delivers three messages. First, it establishes that coordinating intergenerational redistribution is only possible if children benefit sufficiently from their parent's investment (part a). Second, it identifies conditions that favor coordination and therefore intergenerational redistribution (part b). If the (empirical) wealth distribution satisfies condition (1), coordination is easily achieved.[9] Concretely, every parent can fully invest into government bonds and still ensure the high repayment rate, and the maximum amount of debt is issued in this equilibrium. It is the unique equilibrium, if it suffices that a single child supports the old, i.e. if population growth is close to zero ($n < I/(I - 2)$). Otherwise, a no-debt-equilibrium and other debt-equilibria exist where the latter are less favorable for parents, but also less salient. Finally, the proposition shows how coordination is also possible if the wealth distribution is unfavorable (part c). Coordinating intergenerational redistribution requires some parents to hold back and not invest their entire endowment. In particular, investments must be unequal, some parents' investments must be larger than but close to the threshold $\bar{s}/\alpha_c$ (inducing moderately wealthy heirs), and these investments are decisive in the sense that the very wealthy are not sufficient to guarantee a high repayment rate.

3.4 Discussion: inequality, debt, and coordination

How does wealth inequality affect the accumulation and the repayment of government debt? Similar to Tabellini (1991), we show that debt may be held neither too

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[9] As the number of families, I, grows large, the condition is put on the actual distribution of endowments.

widely nor too narrowly to make debt repayment politically viable. This suggests that a similar property must hold for the initial wealth distribution. However, contrary to Tabellini (1991), our model identifies *coordination* as an important factor of intergenerational redistribution. First, multiple equilibria often exist even if the wealth distribution favors debt repayment. Accordingly, coordination is necessary to achieve intergenerational redistribution. Second, coordination enables intergenerational redistribution even if the wealth distribution is unfavorable towards debt repayment. Coordination therefore mediates the impact of wealth inequality on the budget deficit.[10]

The central role of coordination in our model raises the question whether the required coordination within the old generation can be achieved. This follows especially from the size of the groups we have in mind in this model. We address this question in two ways. Our experiment provides evidence that individuals recognize the coordination problem and attempt to exploit it. In the conclusion, we complement this evidence with a discussion of mechanisms that are able to foster coordination in large groups.

To flesh out the role of coordination, we provide a simple model which disregards many aspects of intergenerational redistribution. First, parents have no way of providing transfers to their children other than through the bond investments s_i. Parents are therefore not able to save and transfer money and at the same time protect their children from having to pay for the bond investments. In addition, parents altruism' towards their children is severely limited as it only takes into account the returns children receive from their own parent's investment. These assumptions (also present in Tabellini 1991) generate a large asymmetry between rich parents, who leave large bequests in bonds to their children, and poor parents who let their children pay for these bequests.[11] Second, taxation only affects the (labor) income of children, which is equal by assumption, but not their investment returns (or bequests). (Progressive) Taxation of bequests could therefore alleviate the opportunity of parents to divide and conquer the young generation through coordination. Finally, in an overlapping-generations-model with more than two periods, children could pass on the burden of public debt to future generations (see e.g. Fochmann et al. 2018). This could make them less opposed to supporting the bond investments of the old.

Despite the limitations of our model, recognizing the role of coordination may offer additional insights into debt accumulation. First, the literature has identified factors that hinder debt accumulation, e.g. a larger population growth, lower wealth inequality, or boundaries on inheritance (see e.g. Tabellini 1991). Our model suggests that even small changes can have large impact, if they cause coordination to break down. Second, our model may inform empirical studies on the relationship between wealth inequality and government debt.[12] In particular, comparing the

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[10] Technically, the reason for the existence of multiple equilibria in our model is the restriction to a finite number of players and to finite strategy spaces. This is most clearly seen from condition (iii) in part (c) of Proposition 3. As $d \to 0$, the interval of moderate bond investments sustaining any (asymmetric) equilibrium becomes arbitrarily small.

[11] We are grateful to one referee for pointing this out.

[12] To the best of our knowledge, the only empirical study which addresses the relationship between government debt and inequality (of income) is Larch (2012).

properties of the wealth distribution with those of the distribution of bond invest-
ments may provide insights into the role of coordination in intergenerational redis-
tribution. As empirical studies likely face problems of data availability, comple-
menting such studies with experimental analyses can be helpful. In the next section,
we present a first attempt in this direction.

4 Experimental evidence

To shed more light on the relevance of the redistributive mechanism we conduct an
experimental test of our model. This approach enables us to study behavior under
controlled, *ceteris paribus* conditions and therefore to avoid problems of measure-
ment and reverse causality that abound in field studies (cf. Sutter 2003).

Our experiment is focused on two main questions: do subjects (attempt to) coor-
dinate to exploit the redistributive mechanism? And do subjects respond to the prop-
erties of the wealth distribution which are either favorable or unfavorable to coordi-
nation? To address these questions, we implement a scenario in which subjects have
an incentive to issue debt only if they are confident that it will be repaid. In addi-
tion, to investigate the role of coordination, we compare behavior under a favorable
wealth distribution for which issuing the maximum amount of debt is the unique
equilibrium (Proposition 3b) to behavior under an unfavorable wealth distribution
which induces multiple asymmetric equilibria (Proposition 3c).

4.1 Design and procedures

The game played (repeatedly) in the laboratory features two parents ($I = 2$) with
two children each ($n = 2$). We abstract from the public good aspect of the game and
assume that $\gamma_p = \gamma_c = 0$. Furthermore, we assume $r = 2$, $\alpha_p = 1$, and $\alpha_c = 0.9$. The
game proceeds as follows: First, parents and children learn about their endowments
and parents choose investments $s_i \in S_i = \{0, 0.1, 0.2, \ldots, e_i\}$ (hence, $d = 0.1$). Sec-
ond, both parents and children cast their votes on the repayment rate $\theta \in \{0, 1\}$ and
the high repayment rate is chosen if and only if at least 4 out of the 6 subjects in the
group vote for it. We deviate slightly from the game discussed above and allow chil-
dren to have heterogeneous endowments. By assuming additionally that each child
bears the same tax burden $r \cdot \theta \cdot \sum_i s_i / 4$, we maintain the basic structure of payoffs
and guarantee comparability across treatments. Accordingly, the payoff function of
parents is given by

$$\pi_i(s_1, s_2) = \begin{cases} e_i + s_i & \text{if } \theta = 1 \\ e_i - s_i & \text{if } \theta = 0 \end{cases},$$

and the payoff function of children is given by

$$\pi_{ij}(s_1, s_2) = \begin{cases} w_{ij} + 0.4\, s_i - 0.5\, s_{-i} & \text{if } \theta = 1 \\ w_{ij} & \text{if } \theta = 0 \end{cases}$$

where w_{ij} denotes the endowment of child j of parent i.

To investigate the impact of the distribution of endowments, we implement two treatments named, respectively, treatment *Equal* and treatment *Unequal*. In treatment *Equal*, each parent and each child receives an endowment of 5€. In treatment *Unequal*, one parent and one child of each parent are endowed with 6€, and the other parent as well as the other children are endowed with 4€.

Predictions for the stage game are as follows: In treatment *Unequal*, a unique equilibrium exists in which parents invest their entire endowment ($s_i = 6$€ and $s_j = 4$€ for $i \neq j$) and the high repayment rate $\bar{\theta} = 1$ is selected (cf. Proposition 3b). In treatment *Equal*, there are multiple equilibria each characterized by one parent investing her entire endowment ($s_i = 5$€) and the other investing either 78% ($s_j = 3.90$€) or 80% ($s_j = 4$€) of her endowment (cf. Proposition 3c).

Subjects play 20 repetitions (*rounds* henceforth) of the above stage game in groups of six. Groups are randomly determined at the beginning of a session and fixed throughout. This design feature enables us to have several independent observations for each session, and it facilitates coordination by enabling investment adjustments over time in response to outcomes in previous rounds. On the other hand, fixed groups raise concerns regarding the validity of the stage game predictions, as many more equilibria of the repeated game may exist. Three features of the experiment alleviate this concern: First, subjects are randomly assigned to the role of parents and children in each round. Subjects learn about their roles *after* submitting their investment decisions, and only the investments of parents are payoff-relevant. Second, subjects receive limited feedback after each round. Concretely, they only learn about the number of votes in favor of repayment and repudiation and they are never able to assign investment or voting decisions to a single group member. Third, only two rounds are randomly selected at the end of the experiment to determine subjects' earnings. These properties severely limit the opportunities to play a repeated game equilibrium, since punishment cannot be reliably implemented.

We finally note that the random assignment of subjects to roles differs in the two treatments: In treatment *Equal*, two subjects in each group are randomly selected to be parents and each parent is randomly assigned two of the remaining subjects as children. In treatment *Unequal*, three subjects in each group are randomly assigned, respectively, the low and the high endowment at the beginning of each round. After investments have been submitted, exactly one subject with the high and one subject with the low endowment is selected as a parent, and each parent is randomly assigned one child each with the low and the high endowment.

4.1.1 Procedures

To avoid specific associations in our subjects, we frame the experiment in neutral terms and we avoid any reference to public debt. Accordingly, parents are called *investors* and children are called *partners*. To keep the paper consistent, we maintain the non-neutral terms throughout.

Table 1 Frequencies of sincere voting

| Treatment | Player type | | | |
| | All | Parents | Children who ... repayment | |
			Support	Oppose
Unequal (%)	93.3	98.3	93.7	88.4
Equal (%)	85.2	98.0	91.8	73.1

Four sessions were conducted for each treatment. The sessions took place at the experimental laboratory of the Technical University of Munich ("experimenTUM") in July 2015, May 2019, and June 2019. Students from TU Munich were invited using the ORSEE recruitment system (Greiner 2015). 24 subjects participated in each session. Accordingly, we collected data from 16 independent groups for each treatment.

Each session proceeded as follows: Upon arrival at the lab, subjects were randomly assigned to cubicles that did not allow for any visual communication between them. Once all subjects were seated, paper instructions were distributed and subjects were given time to read them at their own pace. Instructions were then read aloud and subjects were permitted to ask questions. All decisions were submitted through computer terminals using an interface programmed in zTree (Fischbacher 2007). The interface also provided tools to assist subjects in their decision-making. In particular, before choosing their investment, subjects had the opportunity to enter fictitious investments for themselves and the other investor to learn about the resulting distribution of earnings in the group under the two possible voting outcomes. Similarly, before voting, subjects where shown the earnings of all six group members (anonymized) for each possible voting outcome. At the end of the experiment, one repetition each out of the first and the last ten repetitions were randomly selected to determine subjects' earnings (in addition to a show-up-fee of 4€).[13] Subjects were asked to fill out a short questionnaire consisting of some demographic questions and some questions related to the experiment. Afterwards, they retrieved their earnings in private and left.

Sessions lasted 70 min on average. The average payment was 15.19€ in treatment *Unequal* and 14.33€ in treatment *Equal*. Overall, we collected 3672 investment and voting decisions submitted by 192 subjects.

4.2 Results

We discuss the experimental results in three steps. We first discuss subjects' voting behavior. Second, we analyze subjects' investment decisions. Finally, we combine the results to address the effectiveness of redistribution.

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[13] Due to time constraints, one session in treatment *Unequal* had to be stopped after round 13.

Table 2 Determinants of sincere voting

| | Propensity to vote sincerely | | | | | | | |
| | (1) | | (2) | | (3) | | (4) | |
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Constant	4.928∗∗∗	(0.406)	1.211∗∗	(0.537)	1.542∗∗∗	(0.550)	1.709	(1.133)
Supporting child	− 1.463∗∗∗	(0.401)	1.783∗∗∗	(0.517)	1.957∗∗∗	(0.524)	1.952∗∗∗	(0.524)
Opposing child	− 2.150∗∗∗	(0.377)	0.589	(0.472)	0.712	(0.476)	0.726	(0.476)
Equal								
×Parent	0.215	(0.544)	0.100	(0.615)	0.204	(0.622)	0.250	(0.624)
×Supp. child	− 0.563	(0.382)	− 0.561	(0.391)	−0.580	(0.396)	− 0.531	(0.400)
×Opp. child	− 1.024∗∗∗	(0.306)	− 0.600∗	(0.318)	− 0.537∗	(0.324)	− 0.519	(0.327)
Payoff difference			0.740∗∗∗	(0.091)	0.756∗∗∗	(0.091)	0.755∗∗∗	(0.091)
Round					− 0.047∗∗∗	(0.013)	− 0.048∗∗∗	(0.013)
Additional controls	No		No		No		Yes	
Observations	3437		3437		3437		3437	
Log-likelihood	− 883.2		− 828.0		− 820.7		− 813.7	

Ties are excluded. Standard errors in parentheses. Significance levels: ∗ (10%), ∗∗ (5%), ∗∗∗ (1%)

4.2.1 Voting

Table 1 presents average frequencies of *sincere voting*, i.e. voting for the alternative that yields the higher payoff, separately for each treatment and different types of players. The numbers exclude voting decisions in which a subject was tied between the two options. We make three observations: First, a large majority of subjects vote sincerely across treatments and player types. Second, frequencies of sincere voting differ across types with children voting less sincerely than parents, and children opposed to redistribution voting least sincerely. Third, we find mild evidence that subjects vote less sincerely in treatment *Equal* than in treatment *Unequal* ($p = 0.094$ in a Kolmogorov–Smirnov test on the distribution of group averages) which mainly stems from differences in the behavior of children opposed to redistribution (see Table 2).

Average frequencies do not account for the incentives to vote sincerely. Indeed, the average difference between the payoffs of a sincere and an insincere vote in treatment *Unequal* and *Equal*, respectively, is 7.82€ and 6.28€ for parents, 0.79€ and 0.62€ for children supporting redistribution, and 1.47€ and 0.87€ for children opposed to redistribution. To take into account the different incentives subjects face, we estimate a logit model of the decision to vote sincerely. The model includes as explanatory variables the payoff difference between the more and the less preferred option and treatment dummies fully interacted with dummies for the different player types, and it allows for subject-specific random effects. In alternative specifications, we also incorporate the round, demographics and further control variables.[14]

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[14] Concretely, we control for age, gender, academic major, mother tongue, and self-assessments on risk-aversion, egoism, joy of giving gifts, ambition, and generosity.
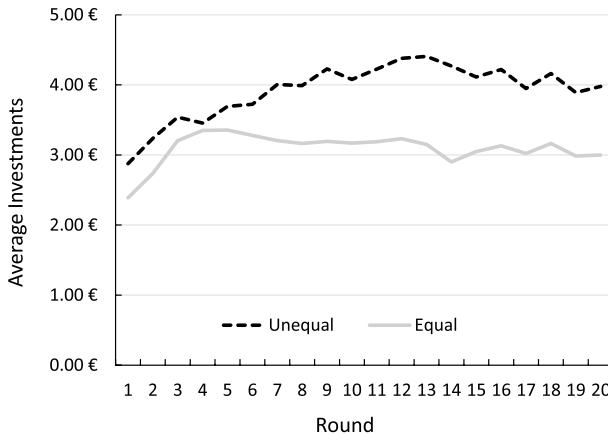
Fig. 2 Evolution of average investments across rounds

The results are presented in Table 2. We find a strong incentive effect, as the coefficient of the difference in payoffs is always positive and highly significant. Averaging across observations where the payoff advantage of a sincere vote is at least 1.00€, the frequency of sincere votes is at least 90% for each treatment and each player type. Second, we find that controlling for incentives alleviates the differences between treatments. Indeed, treatment differences fully disappear once further controls are added. Finally, holding incentives constant, children supporting redistribution are significantly more inclined to vote sincerely in each treatment than parents or children opposed to redistribution, and voting behavior of the latter two groups is not significantly different.[15]

The following result summarizes our findings for the voting stage.

Result 1 A large majority of subjects vote sincerely and they are more inclined to do so the larger the incentives. Voting behavior is not significantly different between treatments.

4.2.2 Investment decisions

Figure 2 displays the evolution of average investments across rounds for the two treatments. We make the following observations: First, investments fall short of the Nash equilibrium predictions. In treatment *Unequal*, average (relative) investments equal 3.91€ (77.3%) across all rounds and 4.18€ (82.5%) across the last ten rounds, and we reject the Nash equilibrium prediction of 5.00€ (100%) at any conventional significance level based on a t test on group averages. Similarly, average

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[15] We obtain the same qualitative results using a standard logit regression with standard errors clustered at the group level. These results are presented in Supplementary Appendix B. Likelihood-ratio tests strongly favor the random-effects models.

Table 3 Determinants of investment decisions

	Investment/endowment							
	(1)		(2)		(3)		(4)	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Constant	0.796∗∗∗	(0.044)	0.844∗∗∗	(0.050)	0.575∗∗∗	(0.108)	0.556∗∗∗	(0.135)
High endow-ment	0.074∗∗∗	(0.012)	0.074∗∗∗	(0.012)	0.074∗∗∗	(0.012)	0.074∗∗∗	(0.012)
Equal	− 0.152∗∗	(0.061)	− 0.138∗∗	(0.062)	− 0.111∗	(0.058)	− 0.096	(0.059)
1/Round	−0.302∗∗∗	(0.026)	− 0.302∗∗∗	(0.026)	− 0.302∗∗∗	(0.026)	− 0.302∗∗∗	(0.026)
× *Equal*	0.164∗∗∗	(0.037)	0.164∗∗∗	(0.037)	0.164∗∗∗	(0.037)	0.164∗∗∗	(0.037)
Control variables								
Demo-graphics	No		Yes		Yes		Yes	
Self-assess-ments	No		No		Yes		Yes	
Decision motives	No		No		No		Yes	
Observa-tions	3672		3672		3672		3672	
Log-likelihood	− 302.6		−297.2		− 282.2		− 276.8	

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%)

(relative) investments in treatment *Equal* are 3.09€ (61.9%) across all rounds and 3.08€ (61.7%) across the last ten rounds, significantly smaller than the Nash equilibrium prediction of 4.50€ (80%). Second, average investments are always higher in treatment *Unequal* than in treatment *Equal*, and considerably so in the later rounds. A Mann–Whitney U test applied to group averages yields a significant difference between the two treatments both across all rounds ($p = 0.032$) and across the last ten rounds ($p = 0.016$). Subjects also invest their entire endowment more frequently in treatment *Unequal* (55.2% of decisions) than in treatment *Equal* (31.5% of decisions). Third, average investments are increasing in the first ten rounds of treatment *Unequal*, while they hardly change in treatment *Equal* from round 4 onwards. A similar result prevails for the frequency of investments equal to the endowment: It increases from 46.7% in the first ten rounds to 65.5% in the last ten rounds in treatment *Unequal*, while it changes considerably less in treatment *Equal* (27.2% and 35.7% of decisions in the first and last ten rounds, respectively).

We also find that the within-group-dispersion of relative investments tends to be larger in treatment *Equal* than in treatment *Unequal*: Across the last ten rounds, the

Table 4 The success of coordination and redistribution

Treatment	Unequal	Equal
Number of voting rounds	292	320
Investments favoring repayment	232 (79.5%)	145 (45.3%)
Voting outcome = repayment	200 (86.2%)	120 (82.8%)
Voting outcome = repudiation	32 (13.8%)	25 (17.2%)
Investments favoring repudiation	60 (20.5%)	175 (54.7%)
Voting outcome = repayment	17 (28.3%)	85 (48.6%)
Voting outcome = repudiation	43 (71.7%)	90 (51.4%)

average within-group standard deviation of relative investments equals 0.263 (0.236) in the former (latter) treatment. However, this difference is not significant.[16]

The above results suggest that subjects recognize the incentives to coordinate with both heterogeneous and homogeneous endowments. To better understand what drives investment behavior, we apply multi-level modeling (see e.g. Moffatt 2016, Chapter 4). Concretely, we estimate a three-level model of relative investments, which accounts for dependence at both the subject-level and the group-level. As explanatory variables we include a dummy for treatment *Equal*, a dummy for the high endowment, the inverse of the round, and its interaction with the treatment dummy. In further specifications, we also include demographics and further responses to our final questionnaire.[17] Table 3 contains the estimation results.[18]

The estimation results confirm that investments are significantly lower in treatment *Equal*. Furthermore, relative investments are increasing across rounds in treatment *Unequal*, while they change significantly less across rounds in treatment *Equal*. We also find that subjects in treatment *Unequal* invest a larger fraction of the high than of the low endowment. Finally, we find that subjects who are more risk averse and subjects who care about equity of payoffs invest less (see Table B2 in the Supplementary Appendix). March and von Weizsäcker (2016) discuss how the model may be adapted to account for these factors.

Overall, the estimation results confirm a difference in subjects' behavior between the two treatments which is in line with coordination incentives. The following result summarizes our findings on investment behavior.

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[16] Subjects in two groups in treatment *Equal* all invest their entire endowment in each of the last ten rounds, and redistribution is always accepted. Excluding these groups from the analysis yields a significant difference of the distributions of within-group standard deviations based on a Kolmogorov–Smirnov test.

[17] Specifically, in addition to the control variables explained above, we include the reported importance attached to own earnings and creating a majority, and dummy variables for stated motives for the voting decision where subjects were able to choose among five possibilities: "maximizing own payoff", "maximizing the sum of payoffs in the group", "maximizing the payoff of the partner(s)", "achieving a (nearly) equal distribution of payoffs in the group", or "I always rejected".

[18] To check for robustness, we also estimate (i) linear regression models with subject-specific random-effects and standard errors clustered at the group level, (ii) Tobit models with subject-specific random effects, and (iii) models for absolute investments. In each case, we obtain qualitatively similar results, which are available upon request.

Result 2 Treatment differences in investment behavior are in line with coordination incentives: Subjects frequently invest their entire endowment in treatment *Unequal*, whereas investments are significantly lower and more dispersed in treatment *Equal*.

4.2.3 The success of coordination and redistribution

We finally examine the success of parents in coordinating and redistributing in their favor. Table 4 summarizes the number of selected investment profiles $s = (s_1, s_2)$ which would lead to repayment and repudiation, respectively, if subjects voted sincerely. The table also summarizes the actual voting outcomes in each case.

In treatment *Unequal*, a large majority of investment profiles (79.5%) favor repayment of the debt. In most of these cases, votes also led to repayment such that overall, subjects managed to coordinate redistribution in 68.5% of game plays. As investments were accepted in 17 additional cases in which sincere voting would have led to repudiation, 74.3% of game plays involved redistribution in favor of parents. The high frequency of successful redistribution results in a substantial payoff inequality. On average, parents (children) attained a payoff equal to 7.17€ (4.70€).

Frequencies of successful coordination are lower in treatment *Equal*. Still, parents managed to coordinate a majority in favor of redistribution in 145 out of 320 game plays (45.3%). Ultimately, 120 of these proposals were accepted. Notice that due to our experimental design, coordination is harder to achieve in this treatment. For instance, if exactly half the players in each group were to choose each the low and the high equilibrium investment, the expected frequency of coordinated proposals would be merely 50%. A uniform distribution of investments yields an expected frequency of coordination as high as 80%. Accordingly, subjects were quite successful in coordinating redistribution in treatment *Equal*, though less than under the more favorable conditions in the other treatment. Indeed, average payoffs for parents (6.07€) and children (4.79€) reveal that redistribution took place to some extent even under unfavorable conditions.

Our results also show that subjects in treatment *Unequal* become more successful at coordinating redistribution across rounds. The relative frequency of investment profiles which favor the repayment of debt increases from 74.4% in the first ten rounds to 85.6% in the last ten rounds. As a consequence, the difference in average payoffs between parents and children increases from 2.36€ to 2.62€. In contrast, the relative frequency of investment profiles favoring debt repayment decreases from 50.0% (first ten rounds) to 40.6% (last ten rounds) in treatment *Equal*. Still, the payoff difference between parents and children also increases over time (from 1.20€ to 1.36€), which suggests that parents coordinate on more favorable investment profiles.

Result 3 Subjects frequently achieve debt repayment both if this is favored by the initial wealth distribution, and if it is not.

In summary, our experimental results confirm that coordination is an important factor in the creation and exploitation of minorities.

5 Conclusion

How does the link between inter- and intragenerational redistribution foster the repayment and, in turn, the accumulation of government debt? We expose a strategic component of Tabellini's (1991) redistributive mechanism that has been neglected in previous work on this topic. By *coordinating* their bond investments, parents can exploit a link between inter- and intragenerational redistribution. Accordingly, debt will be honored, if coordination is successful, and it will be repudiated otherwise.

Our model shows that coordination mediates the impact of wealth inequality on the budget deficit. First, coordinating the repayment of government debt is possible even if the wealth distribution does not favor debt repayment, i.e. features too much or too little inequality. Second, multiple equilibria also exist if the wealth distribution favors debt repayment. The model also sheds light on other factors of debt accumulation. In particular, higher population growth and bounds on inheritance limit debt accumulation. Since coordination also mediates the impact of those factors, small changes can have large effects if they cause coordination to break down.

The main contribution of the paper is an experimental test of Tabellini's (1991) redistributive mechanism. The experimental results show that subjects coordinate to exploit the link between intra- and intergenerational redistribution. Indeed, subjects manage to coordinate the repayment of debt in almost half of the game plays even if wealth inequality is absent and the wealth distribution therefore does not favor debt repayment. Coordination is even more successful, when it is favored by the wealth distribution. The results therefore suggest that coordination is an important factor in the strategic creation and exploitation of minorities, which drives the accumulation of government debt in the model of Tabellini (1991). Still, our subjects' behavior is also affected by risk aversion and concerns for efficiency which both limit the extent to which redistribution takes place.

One potential concern is that coordination is harder to achieve in large groups (see e.g. Devetag and Ortmann 2007). Yet, real-world settings offer mechanisms to foster coordination. For example, advice (see e.g. Van Huyck et al. 1992; Chaudhuri et al. 2009), communication (e.g. Cooper et al. 1990, 1994), and a common identity or culture (e.g. Chen and Chen 2011; Jackson and Xing 2014) have all been shown to enhance coordination. In addition, recent evidence suggests that innovations in information and communication technologies have the potential to improve coordination (e.g. Dessein and Santos 2006; Colfer and Baldwin 2016). Evidence for successful coordination on asymmetric equilibria in large groups has been provided for market entry games (see e.g. Rapoport et al. 1998) and for lottery selection (see e.g. Bereby-Meyer et al. 2013). Finally, attempts to achieve coordination need not be identified as such. As argued by Tabellini (2000), the link between inter- and intragenerational redistribution also provides a justification for the persistence of public pension systems, which are upheld by a coalition of the old and the poor young. In this case, a duality between public and private pension systems may be seen as an attempt to achieve the necessary coordination. We leave a thorough investigation of the factors enabling coordination among a large group of voters as an important topic for future research.

The limitations of our model offer several other avenues for future research. First, as discussed above, introducing progressive income taxation may impede the use of the divide-and-conquer mechanism, and thus coordination. It would be interesting to study how this affects the success of coordination both theoretically and experimentally. Second, parents who invest into government bonds in our model both increase their life time consumption and provide transfers to their children. Allowing parents to separately pursue these two savings motives will likely act as a further barrier to coordination as it requires parents to coordinate with others while making multiple decisions. Finally, we focus on a static snippet of an inherently dynamic environment. Overlapping generations models often allow for more complex dynamic equilibria (Marimon et al. 1993; Offerman et al. 2001), and they enable the burden of government debt to be shifted from one generation to the next (Fochmann et al. 2018). Still, as there are usually multiple equilibria in such dynamic settings, coordination will likely play an important role (see e.g. Marimon et al. 1993). An interesting question would then be whether asymmetric equilibria that feature divide-and-conquer exist alongside symmetric equilibria that do not favor some generations, and which of these equilibria (if any) individuals coordinate on.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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