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Endowment inequality in public goods games: A re-examination

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Highlights

- Presents a clean test of the effects of endowment inequality in public goods games
- Control for possible wealth or endowment effects at the individual
- Inequality has an adverse effect since rich lower contributions in the face of inequality
- The rich always contribute less than do the poor
- The effect is robust to different endowments at the group level

Endowment inequality in public goods games: A re-examination[†]

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Abstract

We present a clean test of whether inequality in endowments affects contributions to a public good. It is a clean test because, to our knowledge, it is the first to control for possible endowment effects. We find that the key adverse effect of inequality arises because the rich reduce their contributions when there is inequality.

JEL Codes: C91, C92, D31, D63, H41

Keywords: public goods, experiment, inequality, wealth, cooperation

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1. Introduction

The effect of inequality in endowments on contributions to a public good has typically been studied by comparing behavior in a public goods game when endowments are equal with a game where endowments are unequal (e.g., Issac and Walker, 1988, Cherry et al , 2005, Anderson *et al*, 2008, and Keser *et al*, 2011). The evidence is mixed, but on balance inequality of endowment lowers contributions (Zelmer, 2003). This is potentially important because it suggests a micro underpinning for the macro-level observation connecting increasing inequality with worse economic performance (e.g. OECD, 2015, and Ostrey *et al*, 2014).

The difficulty, however, with this experimental evidence and the inference is that two things change when equality of endowment is compared with inequality: individual endowments and the degree of inequality. If people's behavior responds to existence of inequality and to their endowment, then the comparison does not isolate the effect of inequality alone. To our knowledge, ours is the first paper to control for the possible individual endowment effect and so isolate cleanly the influence of inequality.

We study voluntary contributions to a public good (VCM) in 3 person groups under two conditions. The equality condition gives everyone the same endowment. This common endowment varies: in one case it is 20 =VCM-20, one 50 = VCM-50 and another 80 = VCM-80. The second condition has inequality: one person has 20, another 50 and the third has 80 =VCM-20-50-80. To test for the effect of inequality, controlling for individual endowment, we compare the contributions of subjects with the same endowment in the equality and inequality conditions (e.g, people in VCM-20 with the person who has 20 in VCM-20-50-80, etc).[1]

We find that the poor and middle (defined by their endowment) individuals contribute the same in their equal VCMs as they do in the unequal VCM. The rich, however, contribute less in the unequal VCM than in their equal VCM. We test whether this effect of inequality is sensitive to the total endowment by running two further inequality conditions. They preserve the inequality relativities above but change the total endowment to match the total in VCM-20 and VCM-80: i.e., VCM-8-20-32, and VCM-32-80-128. The fall in the contribution of the

[1] The 4:1 ratio between the rich and the poor in our 3 person interaction is close to what is found in OECD countries for the ratio between the average incomes of the top 1/3 to the bottom 1/3.

rich relative to the poor is a robust pattern under inequality and this difference in behaviour drives a fall in overall contributions under inequality.

This result is important for two reasons. First, it is a clean test of the influence of inequality *per se* in endowment on contributions to public goods. Second, as the lower contribution is due to the behavior of the rich, this kind of inequality poses a practical difficulty. To tackle inequality through the tax system requires increasing taxes on the rich and lowering them on the poor. However, since, in effect, the contribution to the public good in the experiment is a decision about how much to tax oneself, the experiment shows that these are exactly the circumstances when the rich are less inclined to tax themselves (at least for public goods) even as highly as others, let alone more highly.

2. Experimental Design and Procedures

Subjects played a repeated linear public goods game (VCM) in groups of three. Each subject received an endowment of tokens to allocate between a private and a group account. Return from the private account was 1. For each token allocated to the group account, each member of the group earned 0.5 tokens, i.e., MPCR = 0.5. Each round, each subject was informed of his/her group's total contribution and his/her individual earning from the round.

We ran six treatments. In three, all subjects of the group received the same per-period endowment: 20 in VCM-20; 50 in VCM-50 and 80 in VCM-80. In the remaining three, there is inequality. In VCM-8-20-32, one subject has an endowment of 8, the second 20, and the third 32. The total endowment is the same as VCM-20. Endowments were similarly unequal in the other two inequality treatments: VCM-20-50-80 and VCM-32-80-128 and their total endowments are the same as, respectively, VCM-50 and VCM-80.

Table 1 summarizes the treatments.[2] In all, the Nash equilibrium of the stage game is zero contribution while the social optimum is full contribution. Both remain unchanged under finite repetition.

Table 1. Treatments

Treatment	Endowments	# groups
VCM-20	20-20-20	11
VCM-50	50-50-50	12
VCM-80	80-80-80	11

[2] Data from the equality treatments were also used in Hargreaves Heap *et al* (2015).

VCM-8-20-32	8-20-32	11
VCM-20-50-80	20-50-80	13
VCM-32-80-128	32-80-128	12
Total	**-**	**70**

Twelve to eighteen students from UEA were recruited for each session, totaling 210 students. In all treatments, the game was repeated for 20 periods. Subjects were anonymously and randomly assigned to fixed three-person groups (partner-matching). Subjects received printed instructions which were read aloud by an experimenter and they had to correctly answer a quiz before the experiment could start. The experiment was programmed in z-Tree (Fischbacher, 2007). A session lasted approximately 45 minutes. Token earnings were converted to cash at the rate of 150 tokens to £1 and a subject earned between £10 and £11 on average including a £2 show-up fee.

3. Results

Figures 1 and 2 provide a summary of the results focusing on % contributions.[3]

Three things stand out.

1. Contributions in VCM-20 and VCM-50 are indistinguishable from, respectively, that of those endowed with 20 and those with 50 in VCM-20-50-80 (Figure 1).
2. Contributions in VCM-80 are higher than that of those endowed with 80 in VCM-20-50-80 (Figure 1).
3. The rich contribute less than the poor for every total endowment level, and this pulls down overall contributions under inequality cf. equality (Figure 2).

[3] The % contributions control for endowment effects across subjects with different endowment levels. The average (over 20 periods) % contribution across treatments with equality are not different: VCM-20 vs. VCM-50 ($p = 0.712$); VCM-20 vs. VCM-80 ($p = 0.533$); VCM-50 vs. VCM-80 ($p = 0.902$). There are also no differences in any sub-period.

Figure 1. Average percent contributions by individual endowment level

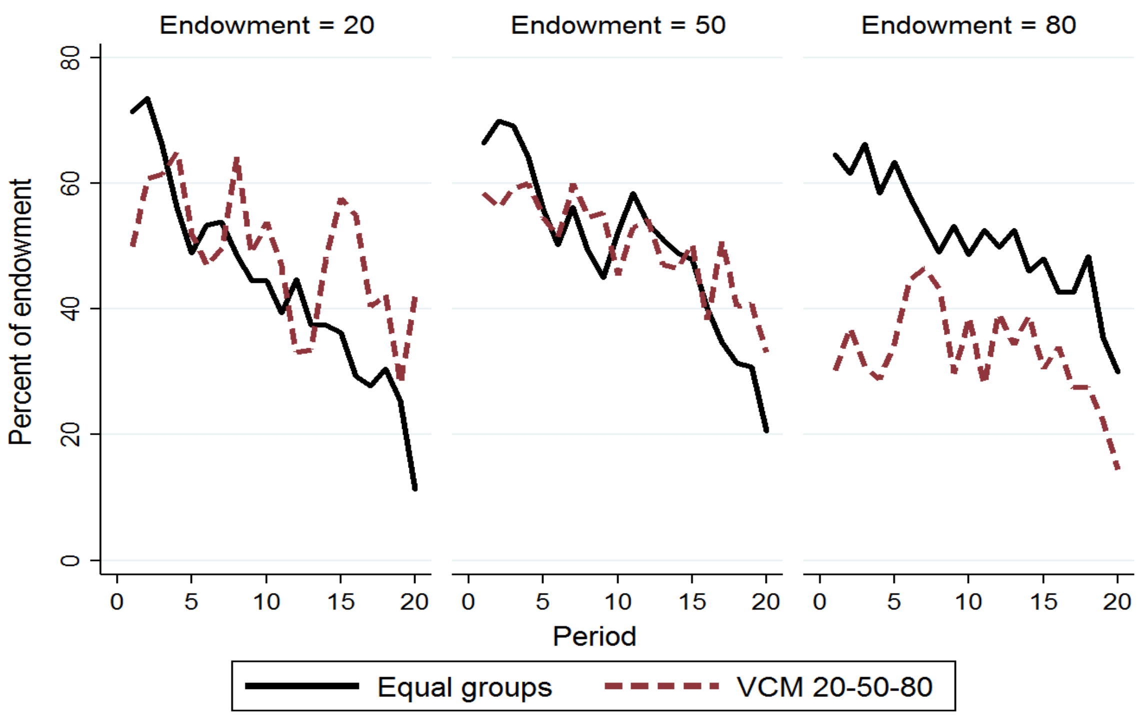
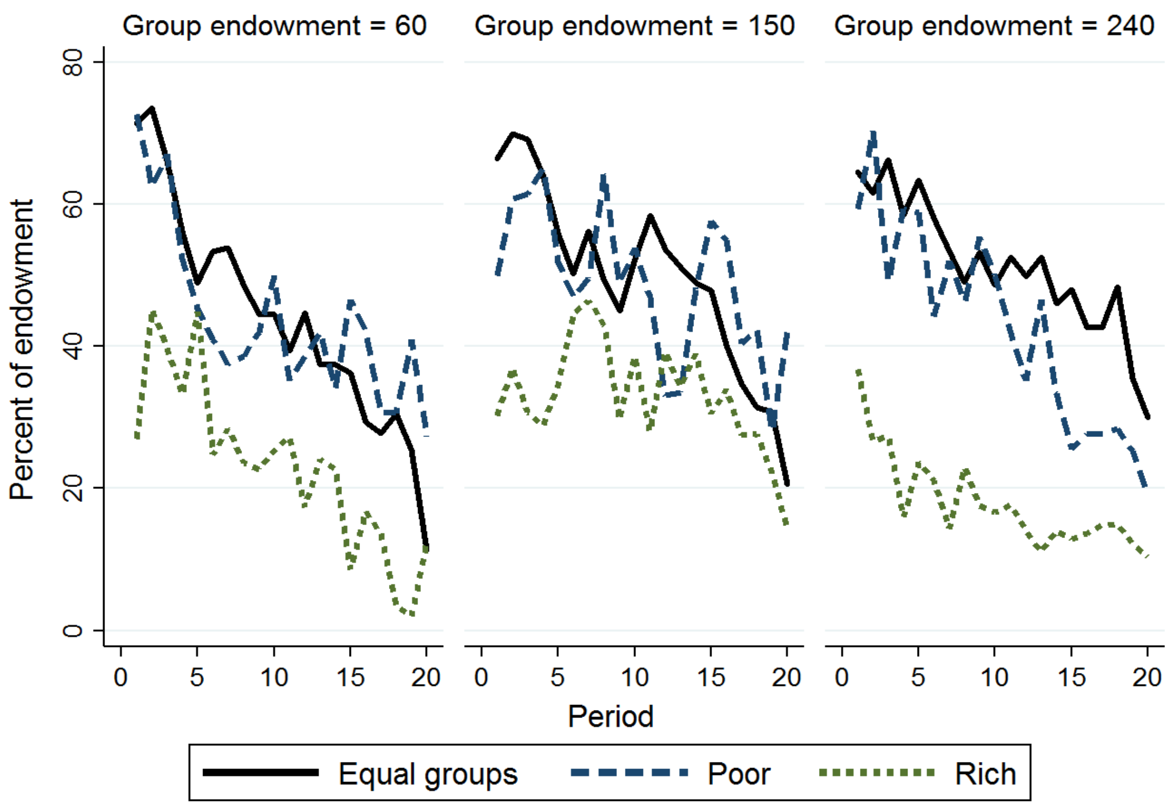


Figure 2. Average percent contributions by total endowment level



The tables below present statistical tests of these patterns. Table 2 compares the average (over 20 periods) individual percent contribution for each individual endowment level under equality and inequality (Table B1 in Appendix B presents the comparisons for various sub-periods). There is no significant difference between equality and inequality for those with the 20 and 50 endowments in any sub-period or overall. The average contribution is, however, always higher for those with an endowment of 80 under equality than inequality and this is statistically significant in the first five periods (62.88 vs. 32.31; p=0.024).

Table 2. Average percentage contributions by endowment level

	End20	**End50**	**End80**
Equality VCM	44.04	49.86	51.27
	(26.60)	(30.66)	(28.75)
VCM 20-50-80	49.00	50.49	33.05
	(33.48)	(35.44)	(29.46)
p-values	0.664	0.957	0.164

Standard deviations in parentheses. p-values for Ranksum tests. #observations equal #groups in the treatment.

Table 3 examines whether the aggregate difference between the rich under equality and inequality is supported at the individual level using panel random effects regressions on individual % contributions. The first equation has controls for the inequality treatment interacted with endowment levels to test for differences under inequality for each endowment level. The only interaction that is significant is the endowment of 80 and the coefficient is negative; the rich contribute a smaller percentage of their endowment under inequality than equality but the poor and middle endowment individuals contribute the same percentage under inequality as equality. Equation (2) adds the standard explanatory variables that are used in such regressions. Both variables are significant and take the expected signs; and the inequality interacted with 80 endowment remains negative and is still the only significant inequality variable.

Table 3. Individual Panel RE regressions: All treatments, all 20 rounds

	Percentage contribution	
	(1)	(2)
Unequal group dummy	2.062	5.189
	(10.72)	(3.610)
Unequal × End 20 dummy	-1.492	-0.415
	(5.513)	(2.379)
Unequal × End 80 dummy	-17.44***	-8.484**
	(5.705)	(3.316)
Lagged percent contribution		0.737***
		(0.033)
Lagged deviation from percent contribution of others		-0.142***
		(0.018)
Constant	62.74***	16.72***
	(4.315)	(3.432)
Observations	2820	2679

SE clustered on groups in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Includes period dummies (not reported).

Result 1. *Controlling for individual endowment effects, contributions of the poor (20) and middle (50) are not affected by inequality. Contributions of the rich (80) decrease with inequality.*

We test for whether the difference between the rich and the poor under inequality is robust to changes in the total endowment in Table 4. It is. The average % contribution of the rich is significantly lower than the poor (and this is supported by analogous regressions to those in Table 3 in the Appendix Table B2).[4] This pushes down the overall contribution for each total endowment level under inequality (cf. equality) and significantly so for the total endowment of 60 (p=0.0710) and 240 (p=0.0164), but not for 150 (p=0.4795).

[4] The comparison of the middle income individuals in each inequality treatment with their respective equal endowment VCM uniquely controls for both individual and total endowment effects. Their pooled contributions fall significantly from 48.43 on average under equality to 33.79 under inequality (p=0.0256).

Table 4. Average percentage contributions by total endowment level

	Obs	Group	Poor	Middle	Rich	p-values
VCM 8-20-32	11	27.45	43.86	27.77	23.15	0.0366
		(16.73)	(29.41)	(21.71)	(16.93)	
VCM 20-50-80	13	40.99	49.00	50.49	33.05	0.0131
		(30.05)	(33.48)	(35.44)	(29.46)	
VCM 32-80-128	12	22.36	42.80	21.22	17.95	0.0060
		(21.46)	(37.03)	(20.70)	(21.57)	

Standard deviations in parentheses. p-values for sign-rank tests comparing poor and rich

Result 2. *The rich contribute significantly less than the poor under inequality for each level of total endowment and this lowers overall contributions under inequality cf. equality (significantly so for total endowment =60 and 240).*

4. Conclusion

Our experiment is distinguished from those in the literature because it supplies what is to our knowledge the first clean test of whether endowment inequality affects contributions to a public good. We find, after controlling for endowments effects, that inequality critically affects the contributions of the rich. Their contributions fall when there is inequality as compared with equality. This is important not only because it identifies an adverse consequence of inequality, it also suggests a practical difficulty with reversing such inequality by increasing taxes on the rich. Since the contribution in our experiment is a decision to tax oneself to pay for a public good, our result means that it is exactly when you might want to tax the rich more highly, that the rich would actually prefer to pay lower taxes than everyone else.

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