The Dynamic Interplay of Inequality and Trust - An Experimental Study*

Ben Greiner†, Axel Ockenfels‡, and Peter Werner§

Abstract

We study the interplay of inequality and trust in a dynamic growth game, in which trust increases efficiency and thus allows higher growth of the laboratory economy in the future. We find that trust is initially high in a treatment starting with equal endowments, but decreases over time. In a treatment with unequal endowments, trust is initially lower yet remains relatively stable. The reason is that, with unequal initial endowments, trust depends less on wealth comparisons. As a result, with respect to efficiency, the initially more unequal economy grows slower in the short run but faster in the long run, and the disparity of wealth distributions across economies mitigates over time.

Keywords: inequality, trust, growth, laboratory experiments

JEL Classification: C73, C92, D63, E25, O15

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† *Corresponding author:* University of New South Wales, School of Economics, UNSW Sydney, NSW 2052, Australia, Tel: +61 2 9385 9701, Fax: +61 2 9313 6337, e-mail: bgreiner at unsw.edu.au.

‡University of Cologne, Department of Economics, Albertus-Magnus-Platz, D-50923 Köln, Germany. Tel.: +49/221/470-5761, Fax: +49/221/470-5068, e-mail: ockenfels at uni-koeln.de.

§University of Cologne, Department of Economics, Albertus-Magnus-Platz, D-50923 Köln, Germany. Tel.: +49/221/470-4354, Fax: +49/221/470-5068, e-mail: peter.werner at uni-koeln.de.

I Introduction

The degree of trust in an economy may positively influence economic growth and the distribution of wealth. Yet trust is difficult to identify and measure in the field, both on the microeconomic and the macroeconomic level. Survey data frequently discover individual attitudes towards trust, but cannot easily identify to what extent such self-reported attitudes reflect actual economic behavior, and how trust evolves in a dynamic environment. Furthermore, as has been argued by Durlauf (2002), the causal relationship between trust and economic variables is often ambiguous. He thus advocates the use of laboratory studies. In this paper we follow Durlauf's advice and complement the empirical and survey literature with laboratory experiments that systematically investigate the dynamic interplay of trust, efficiency and distribution.

The working horse of our experiment is a growth game, which embeds a variant of the trust game introduced by Berg, Dickhaut and McCabe (1995) into a dynamic context. In this game, an investor can send an amount of money to an anonymous trustee. Before received by the trustee, the amount sent is multiplied by a factor greater than one, and thus yields efficiency gains. Subsequently, the trustee decides on how much of the amount received she wishes to send back to the investor. The amount sent can be interpreted as a measure of trust, while the amount returned measures the degree of trustworthiness.[1] However, in our game, income from interactions is cumulated over time. Participants start with either an unequal or equal distribution of initial endowments within a group. In each of several rounds they play the trust game with a randomly matched anonymous partner. Before making decisions, both transaction partners are informed about the current wealth of their opponent. Round payoffs are added to endowments, and therefore determine the amount that can be exchanged in future rounds. That is, investments and repayments (i.e. trust and trustworthiness) jointly

[1] Berg et al. (1995)'s original game is sometimes called 'investment game', and the amount sent is interpreted as a measure for investment in risky projects. In our setting, that interpretation fits as well.

affect the current and potential future growth rates of the 'laboratory economy', as well as the evolution of economic inequality.[2]

We observe that initial investment levels are lower in the treatment starting with unequal endowments (IEQ) compared to the treatment with equal endowments (EQ). However, in IEQ trust depends less on wealth comparisons. Part of the reason is that the source of inequality plays a role in what can be inferred from wealth comparisons: while in EQ all wealth differences must be due to differences in trust and trustworthiness across subjects, in IEQ differences in behavior are concealed by differences in the initial wealth allocation. As a result, trust is triggered differently across treatments. Investment rates decrease steadily and strongly over time in EQ, yet they remain rather stable in IEQ. The wealth distributions in equal and unequal economies converge to each other.

In Section II we review the literature related to our experiment. Section III explains the details of our experimental design and procedures, and sketches hypotheses based on previous empirical results and economic models. Our experimental data and statistical analysis are presented in Section IV. We discuss our results and conclude in Section V.

II Related Literature

There is a large body of empirical and theoretical economic literature on the relationship between inequality with a country and its level of growth and prosperity. The evidence is, however, not unambiguous.[3] Some authors have

[2]E.g., if all investments yield the same positive rate of return, the dynamic game allows initially rich subjects to increase their endowments much more than initially poor subjects.

[3]The academic discussion started in the 1950s with the Kuznets-Curve (Kuznets, 1955), which proposed a relation between inequality and economic development in the form of an inverted U. Most of the more recent theoretical literature assumes a negative relationship, including the models of Galor and Zeira (1993) and Persson and Tabellini (1994). Bénabou (1996), Ros (2000) and Glaeser (2005) survey the differing strains of literature. The majority of early empirical studies of the relationship of inequality and trust find a negative link between income disparity and growth (see Bénabou, 1996). However, some of the more recent studies, employing panel data and advanced econometrics, yield either no effect (e.g. Barro, 2000) or even a positive relationship (e.g. Castelló-Climent, 2004; Forbes, 2000). Banerjee and Duflo (2003) argue that non-linearity of the relationship might be a reason for the ambiguous results. They find that any *change* in inequality – in each direction –

argued that trust is the key for understanding this relationship: Inequality decreases the level of trust and trustworthiness in an economy, which in turn negatively affects growth.[4] Empirical evidence is provided by Knack and Keefer (1997) and Zak and Knack (2001), who found that countries with higher income dispersion (measured by the Gini coefficient for income) exhibit significantly lower values for a trust measure derived from the World Value Surveys (WVS).[5] Similarly, Alesina and Ferrara (2002) found a negative connection between social distance and trusting behavior in a study restricted to the United States. Gustavsson and Jordahl (2008) combine Swedish individual panel data with aggregate data on inequality and find that stronger disparities among people in the bottom half of the income distribution have a detrimental effect on trust. Furthermore, a number of empirical studies established a positive impact of generalized trust on economic development (Knack and Keefer, 1997; La Porta, Lopez-de-Silanes, Shleifer and Vishny, 1997; Zak and Knack, 2001).

Durlauf (2002), however, notes that there are various problems of causality and identification in many empirical studies on the relationship between social capital, trust and economic indices. He thus proposes the use of laboratory experiments to investigate the causal structure between these measures. Results from such economic experiments allow to build models of individual behavior to explain the relationship between social capital and economic measures on the aggregate (see, for example, the model by Glaeser, Laibson and Sacerdote, 2002).

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affects growth detrimentally. In their meta-analysis of empirical studies, De Dominicis, Florax and De Groot (2008) show that estimation techniques, included independents, development status of countries, and length of considered growth period have a significant impact on the estimated size and direction of the effect of inequality on growth.

[4]See Jordahl (2008) for an overview of different mechanisms explaining the negative impact of inequality on generalized trust. Other authors see other forms of human capital, such as education (e.g. Castelló-Climent, 2004), or social preferences as possible links. Corneo and Grüner (2000) and Corneo and Jeanne (2001) discuss concerns for social status, as these might discourage both poor and rich subjects to accumulate income in an unequal society and lower the political will for redistribution.

[5]The World Values Surveys are repeated interview studies with representative population samples on the changes in moral values and beliefs, conducted in 80 countries all over the world since 1981. One question is: "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?". The percentage of positive responses is used as a measure of generalized trust in a country.

There is experimental evidence on the relationship between cooperation and inequality in public goods games, which share a couple of features with the trust game studied here. This evidence is, however, mixed. In a survey on repeated public goods games with complete information, Ledyard (1995) comes to the conclusion that economic heterogeneity among subjects generally lowers cooperation levels. Chan, Mestelman, Moir and Muller (1996) find that poor subjects contribute more to a public good than rich subjects. Buckley and Croson (2006) conduct a linear public good game with heterogenous endowments of the subjects. In their study, rich and poor subjects contribute on average the same absolute amount to a public good. Thus, as poor subjects contribute a higher share of their respective endowments, economic inequality increases within the experimental groups.

Other studies are devoted to the relationship between social distance (measured on various scales) and investment behavior in the trust game introduced by Berg et al. (1995). Glaeser, Laibson, Scheinkman and Soutter (2000) combine questionnaires on social backgrounds and trust attitudes with an experimental trust game. In their experiment, subjects interacting face-to-face with a partner of a different race or nationality exhibit a lower level of trustworthiness. In addition, a higher social status of the sender seems to be positively related to the earnings of a trusting decision. Hence, the results of this study indicate detrimental effects of social distance. However, their survey measures of generalized trust are not correlated with actual trusting behavior.

Fershtman and Gneezy (2001) find significantly different degrees of trust towards different ethnical groups in the Israeli-Jewish society, although these groups do not differ concerning their trustworthiness. In a recent study, Haile, Sadrieh and Verbon (2006) conduct a trust game experiment with South-African students. They find negative effects of socio-economic differences, as low-income subjects trust less when confronted with a high-income transaction partner from another ethnic group.

To our knowledge, there are only two experiments which specifically study the role of payoff inequality in the trust game. Contrary to the studies discussed above, social distance is induced by the experimental design.

Brülhart and Usunier (2007) vary endowments of the trustees, which however does not affect trust. Anderson, Mellor and Milyo (2006) employ an equal as well as a symmetric and a skewed unequal distribution of show-up fees in a trust game. The distribution of show-ups is either private or public information. The authors observe only small and non-systematic effects of unequal endowments on trusting behavior.

III Experimental design and hypotheses

In our study, we focus on the dynamic interaction of trust, trustworthiness and inequality. Therefore, we develop a growth game which embeds the essentials of Berg et al. (1995)'s trust game, but puts them into a dynamic growth and distribution context. The growth game is played over 20 rounds. In each round, two randomly and anonymously matched subjects play a variant of the trust game. One of the subjects is randomly assigned the role of the investor, the other the role of a trustee. Before decisions are made, each subject is informed about his own and the opponent's wealth in the current round. Wealth is defined as the initial endowment plus any payoffs that have been accumulated in earlier rounds. A player's wealth limits the amounts that he can invest or return in the current round of the growth game in the following way. The investor decides on an amount S, which is not allowed to exceed his current wealth, to be sent to the trustee. Any amount sent is multiplied by the factor 1.2, i.e. the trustee receives $1.2S$. Next, the trustee can decide on the amount R to be sent back to the investor. The minimum amount to be returned is $0.9S$, or 90% of the amount sent.[6] The upper limit is given by the sum of the current wealth of the trustee plus the received amount. Because payoffs are accumulated over the course of the repeated trust game, our laboratory economies could maximally grow by an expected factor of 6.2.[7]

[6]These rules make the one-round interaction in our game equivalent to the original trust game interaction with a sent amount multiplier of three, with the exception that the amount that can be sent is restricted to 10% of the investor's wealth. Without such restrictions, the experiment could have gone beyond the scope of any reasonable financial budget.

[7]As in each round only half of the subjects in the economy are randomly assigned to the role of the investor, the expected maximum growth rate over 20 rounds with full

As our main experimental parameter, we varied the distribution of the initial endowments across our two treatments. In the equality condition (EQ), all subjects were endowed with an amount of 500 ET (Experiment Talers) before the first round. In the inequality treatment (IEQ), half of the subjects in each matching group received 200 ET, and the other half received 800 ET. In order to investigate experience effects and to test robustness of behavior, we played two runs of 20 rounds; that is, after the first 20 rounds of the experiment we restarted the game for another 20 rounds. Subjects were told before the session that the experiment consisted of several runs, one of which would be randomly selected for payoff.

The experimental sessions took place in the Cologne Laboratory for Economic Research. We conducted four sessions, two for each of our treatments. Subjects were recruited using the Online Recruitment System by Greiner (2004). Altogether 128 student subjects participated. Each session consisted of 32 participants. Random matching per round was restricted to groups of 8 participants.[8] It was publicly known that two subjects would never interact with each other in consecutive rounds. Due to this procedure, we obtained observations on 8 statistically independent 'economies' for each treatment. Overall, we collected 2,560 choices for each player role.

The experiment was computerized using the zTree software (Fischbacher, 2007). After subjects arrived and were randomly assigned to a cubicle, instructions were distributed.[9] Questions were answered privately. At the end of the experiment subjects filled in a post-experimental questionnaire asking for demographical data and containing open questions for motivations of subjects' decisions. Finally, either run 1 or run 2 was selected for payoff by publicly rolling a die. Participants were paid out privately and left the laboratory. The exchange rate was fixed at 150 ET = 1 Euro. The average payoff was 12.25 Euros (including a show-up fee of 2.50 Euros) with a standard deviation of 5.09 Euros. Each session lasted approximately one and a half hours.

investments corresponds to 1.2^{10}.

[8]Subjects were not informed that the matching procedure was restricted in such a way, conveying the impression that being matched with the same opponent more than once is very unlikely.

[9]Instructions are included in the appendix.

In the rest of this chapter, we will motivate a number of competing hypotheses for the dynamic interplay of inequality and trust based on (simplified) theoretical reasoning and empirical findings. These hypotheses help organizing our analyses and findings. At the same time, however, we wish to caution that our experiment is mainly designed to complement the empirical studies, and not as a test of any particular theory - if only because there is no theory yet that addresses the potentially complex dynamics we are interested in.

The standard game theoretic prediction is trivial. Because of the finiteness of the growth game, there is no trust and no trustworthiness among selfish and rational players if selfishness and rationality are common knowledge. However, starting with Berg et al. (1995), numerous experiments have shown that subjects are willing to invest and return non-trivial amounts of money in the trust game. For a survey of the trust game literature see, for example, Camerer (2003).

While the experimental one-shot version of the trust game is by now well-analyzed and -understood, the dynamic interplay of inequality and trust in the context of our growth game is not easily predicted. However, observe that both of our treatments start with identical *average* endowments. If inequality does not affect subjects' willingness to send and return money, relative to their endowments, the two treatments may be expected to yield equivalent results with respect to growth rates.[10] On the other hand, the empirical and experimental literature on social and economic heterogeneity cited in Section II suggests that we may observe a negative impact of inequality on trust in our setting. Dispersion of wealth could increase social distance between economic agents and, as a result, trust and trustworthiness may decrease. To the extent our experiment captures some of the underlying mechanisms assumed in this literature, we should expect less growth and lower efficiency in treatment IEQ.

[10] In the beginning of the first round, the average endowment of investors in treatment EQ is equal to 500, as it is in treatment IEQ. Thus, if the same share is sent and returned, expected overall invested amounts are the same, as well as the amounts returned. Therefore, the expected endowments of investors in round 2 are the same in both treatments. The same reasoning applies to all consecutive rounds of the game.

Finally, we note that theories of social preferences can organize some of the deviations from standard equilibrium behavior observed in the trust game. For instance, inequity aversion models (Bolton and Ockenfels, 2000; Fehr and Schmidt, 1999) can in principle explain both trust and trustworthiness in the trust game.[11] However, these models do not yield unambiguous comparative static predictions across the two treatments of our growth game. To see why, observe for instance that a rather fair-minded investor who is matched with a relatively poor trustee may send money to equalize payoffs, while a rather selfish investor may not send money because he cannot expect to get anything back from a relatively poor opponent. Thus, the predictions of inequity aversion models will depend on the distribution of preferences. It appears, though, that 'myopic', straightforward concerns for equal payoffs lead to more trust and trustworthiness in IEQ in the following sense: Even when an inequality averse subject assumes that everybody else behaves in a completely selfish manner, he still has reason to trust and to be trustworthy towards relatively poor opponents in the inequality treatment (where, in the beginning of round 1, the payoff distribution is unfair), but no such incentive exists in the equality treatment (where the payoff distribution is fair if everybody behaves selfishly).

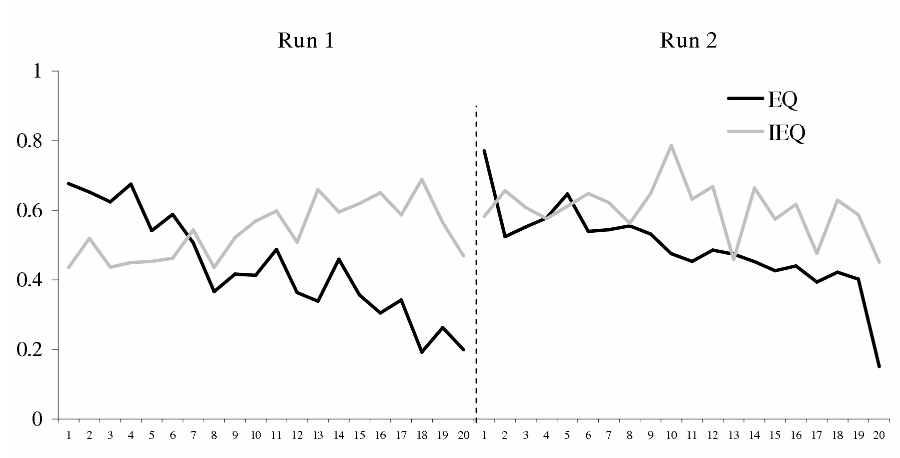
IV Experimental Results

IV.1 Aggregate Data

Figures 1 and 2 depict the evolution of average send and return rates over time. We define the 'send rate' in a particular round as the share of the investor's wealth in this round that she invests in the transaction. The 'return rate' is defined as the amount returned minus the mandatory 90% ($R-0.9S$), divided by the amount received minus the mandatory 90% ($1.2S - 0.9S$). For example, a return rate of $1/3$ implies that the trustee returns exactly the amount invested by the investor. (The dashed horizontal line in Figure 2 indicates this 'break-even line'.) For figures and non-parametrical tests the

[11] See Bolton and Ockenfels (2000), page 187, for a detailed description of the mechanics of the fairness models in the context of Berg et al. (1995)'s trust game.

FIGURE 1
Average Send Rates over Rounds



send rate averages are calculated by adding up all amounts sent in a matching group, and dividing the sum by the total wealth of the senders.[12]

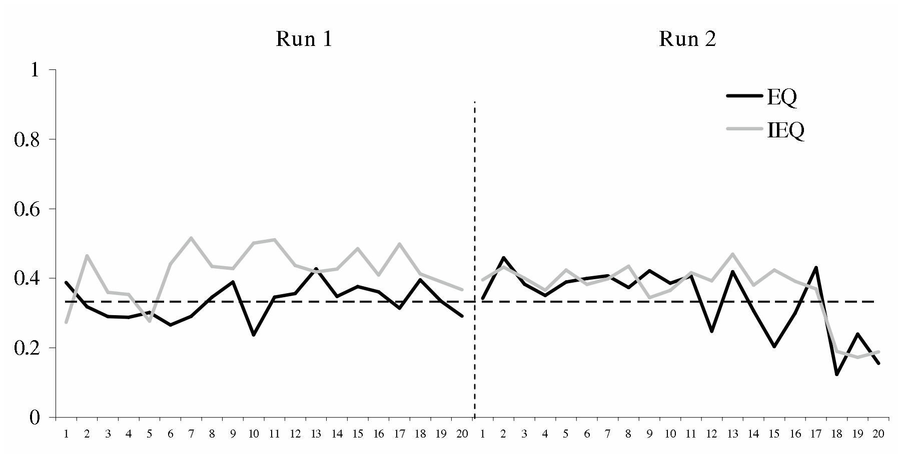
Figure 1 shows that the dynamics of trust differ markedly between the treatments. In the first round of the games, the equal distribution of wealth leads to higher trust levels (54% more, to be exact) than the unequal distribution. This finding is in line with previous empirical findings and theoretical work suggesting that inequality hampers efficiency.[13]

However, send rates in treatment EQ strongly and steadily decrease over time from 68% in round 1 to 20% in round 20 in run 1, and from 77% to 15% in run 2, while send rates in IEQ increase slightly in run 1 and decrease slightly in run 2. Correspondingly, in EQ average send rates of the matching

[12]This procedure seems appropriate since here our focus is on aggregate behavior and independent observations. However, our conclusions from statistical tests would not be different if we had used individual averages.

[13]Applying one-sided Mann-Whitney-U (MWU) tests to (statistically independent) individual send rates and to respective matching group data in round 1, all tests yield p-values of $p < .1$. The reason significance is rather low is the heterogeneity of subjects in treatment IEQ. More specifically, poor IEQ subjects send less in absolute terms than EQ subjects ($p < .01$), but not in relative terms, while rich subjects send less in relative terms ($p < .05$), but not in absolute terms. However, our analysis of individual behavior in the next subsection, where we control for these wealth effects, confirms the observation that initial inequality hampers efficiency on any standard significance level.

FIGURE 2
Average Return Rates over Rounds



groups are significantly and negatively correlated to the number of rounds (Pearson-R=-.586, p = .000 and Pearson-R=-.394, p = .000 for run 1 and 2, respectively) while this is not (strongly) so in IEQ (Pearson-R=.061, p = .442 and Pearson-R=-.154, p = .051 for run 1 and 2, respectively).[14]

As shown in Figure 2, average return rates are about the break-even level that makes an investment profitable, with probably a small advantage for IEQ in run 1. In fact, differences in return rates across treatments and over time are much less pronounced than differences in send rates. In the aggregate data, we find that, in the first run, average return rates are 24% lower in treatment EQ than in treatment IEQ[15] - yet the effect disappears in run 2.

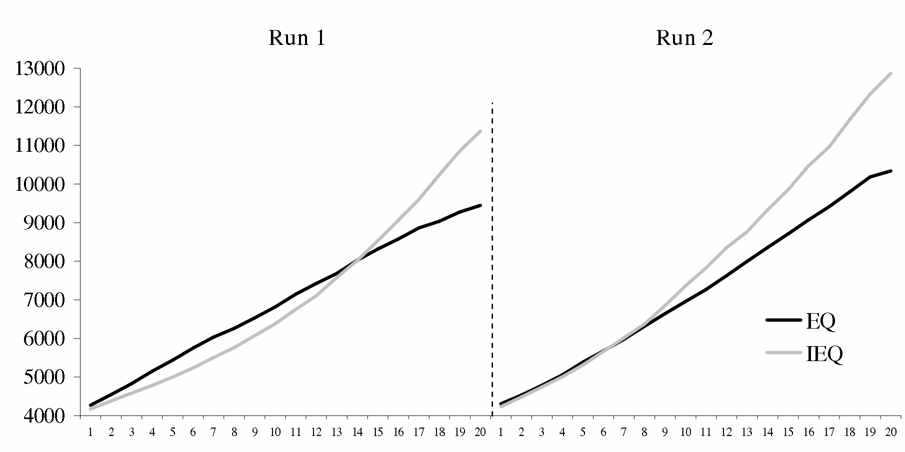
More investment directly expands overall wealth, because the latter is a cumulative measure of the former. So, the different dynamics in trust across laboratory economies are reflected in different growth rates of overall wealth. Figure 3 depicts average economy wealth over time. There are substantial

[14] Applying Wilcoxon Matched Pairs Signed Ranks (WMPSR) tests, a similar conclusion is reached when comparing matching group averages in the first and the second half of each run.

[15] A one-sided MWU test applied to independent matching group averages indicates significance with p = .011.

FIGURE 3

Average Total Economy Wealth over Rounds, in ET



efficiency gains in both treatments and runs, with total average wealth more than doubling in all runs of both treatments. Initially, wealth in treatment IEQ lags behind the one in treatment EQ. However, as average send rates remain on a relatively high level in treatment IEQ and significantly decrease in treatment EQ, the lag is eventually counterbalanced and reversed in the last few rounds.[16] In run 2 we do not observe large initial differences, and after the first few rounds treatment EQ lags behind indelibly. Accumulated wealth in IEQ finally accounts for more than 300 % of initial endowments.

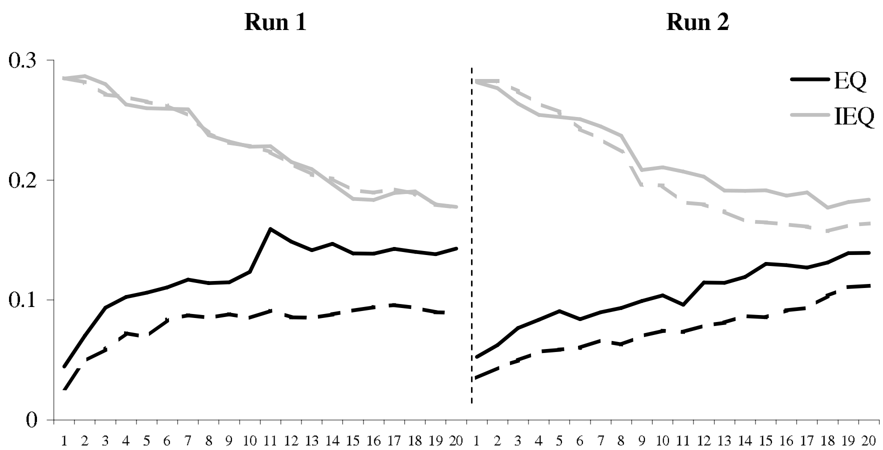
Not only efficiency gains but also the distributions of wealth in our laboratory economies evolve endogenously through sending and returning decisions. We use Gini coefficients to analyze the dispersion of individual wealth levels.[17] Figure 4 shows average matching group Gini coefficients in treatments EQ and IEQ (solid lines). We observe that Gini coefficients strongly

[16]Statistically, the wealth of IEQ economies in rounds 1 to 5 is significantly lower than in EQ (p=0.030, one-sided MWU test). Final wealth levels are not significantly different from each other.

[17]The Gini coefficient as a measure for disparity takes the value of zero if the income is equally distributed among the subjects and $(n-1)/n$ if all wealth is concentrated on only one subject. Here, the maximum value of the Gini coefficient is 7/8, as the number of subjects per experimental matching group is $n = 8$).

FIGURE 4

Observed and Simulated Gini Coefficients over Rounds



Note: Solid lines refer to observed, dashed lines to simulated values.

and significantly decrease (increase) in treatment IEQ (EQ).[18] Furthermore, the values for the Gini coefficients tend to converge to each other towards the end of a run. In the last round of a run, IEQ and EQ Ginis are not or only weakly significantly different (MWU, $p = .252$ and $p = .053$ for run 1 and 2, respectively).

Redistribution in our setting might have two different sources: on the one hand, it could be the result of random, homogenous interaction, in the sense that rates are not conditioned on individual wealth states or wealth comparisons. Because, for a given rate, richer subjects send more in absolute terms than poorer subjects, unconditional behavior moves the economy towards more equality when starting with unequal endowments. On the other hand, redistribution could be the result of send and return rates which systematically depend on own and probably others' wealth in the current state. Depending on the nature of conditional behavior (which will be analyzed in subsection IV.2) and the heterogeneity of the behavioral patterns, the re-

[18]One-sided WMPSR tests applied to matching group averages for rounds 1-10 and rounds 11-20 of each run yield $p = .004$ for treatment IEQ (both runs) and $p = .027$ and $p = .004$ for treatment EQ (run 1 and run 2, respectively).

sulting system behavior may increase or decrease equality relative to what can be expected from unconditional homogenous interaction.

In order to isolate the effects of these two mechanisms, we simulate Gini coefficients for unconditional, homogenous behavior. More specifically, simulations are based on the same role and group matchings as implemented in our experiment. Additionally, we assume that in every round all participants in a matching group behave identical – like the group average.[19] If actual behavior is unconditional with respect to wealth levels and differences, simulations and actual behavior cannot differ.

The average simulated Gini coefficients (see the dashed lines in Figure 4) follow the same general pattern as the observed ones. In treatment IEQ, simulated and observed Gini curves are nearly the same (run 1) or differ only slightly (run 2).[20] Consequently, we find no differences between observation and simulation Gini values in round 20 (WMPSR, $p = .371$ and $p = .191$ for run 1 and 2, respectively). In treatment EQ, observed Gini values are constantly higher than the simulated values,[21] yielding (weakly) significant differences of final Gini values (WMPSR, $p = .012$ and $p = .055$ for run 1 and 2, respectively).

Thus, on the aggregate level, we find little evidence for systematic and deliberate redistributive behavior from rich to poor in treatment IEQ. Contrary, inequality rises faster than expected in treatment EQ, suggesting that there are indeed heterogeneous behavioral patterns that systematically affect wealth distribution – as studied in the next subsection.

IV.2 Individual Decisions

We regressed the individual send and return rates on a number of independent variables in order to investigate the determinants of individual behav-

[19] This procedure yields the same economy growth rates in the simulation as in the experiment.

[20] WMPSR tests yield no significance comparing average observed and simulated Ginis for whole runs or 10 round intervals, except for rounds 11-20 in run 2 with $p = .098$.

[21] Differences are significant at $p < .01$ with one-sided WMPSR tests applied to whole runs and 10-round intervals.

ior.[22] Besides the *Round* number (1-20), and two dummies for *Treatment* (0 for EQ, 1 for IEQ) and *Run* (0 for 1st, 1 for 2nd run), we include the relative wealth standing of the sender (W_{SDR}) and the responder (W_{RSPR}) prior to the current transaction. Both variables are derived by dividing the respective decision maker's wealth by the average wealth in her economy (matching group). For the regression of the return rate we also include the send rate of the counterpart. To account for group-specific as well as for subject-individual characteristics, we use Mixed Effects models. Due to the rather complex dynamic nature of our game, we cannot exclude any interaction effects between the independent variables, which poses a model selection problem that we addressed in the following way: in our main regressions, we start with the full factorial set of potential interaction effects. We then iteratively throw out insignificant effects. After two iterations we ended up with the models presented in Table 1. Note that, by construction, all included interactions effects are significant. As a second approach we ran regressions on the complete 2-factorial set of interaction factors. The results are presented in Table 2 in the Appendix and basically confirm the analysis discussed here.

The model for investor decisions, presented in the left column of Table 1, shows that wealth positions influence trusting behavior in treatment EQ, but are of only minor importance in treatment IEQ. In treatment EQ, the effect of both direct wealth variables is negative. That is, participants send less the richer they are and the richer the responder is. However, the positive interaction effect indicates that the more equal sender and responder are, the less pronounced are the wealth effects. The lowest send rates are found for poor senders towards rich responders, and vice versa. Contrary, in treatment IEQ all these three effects are mitigated (see the interaction effects of *Treatment* with W_{SDR}, W_{RSPR}, and $W_{SDR} * W_{RSPR}$). These observations are consistent with the simulation results of the Gini coefficient dynamics. While the trust decisions in EQ systematically affect the wealth distribu-

[22] We had to exclude 6 and 314 observations in the models on the send rate and return rate, respectively, because the send rate is only defined for positive wealth of the investor, and the return rate is only defined for positive amounts sent.

TABLE 1

Regressions of individual send and return rates

Dependent Variable	Send Rate		Return Rate	
	Coefficient	(StdErr)	Coefficient	(StdErr)
Round	-0.017**	(0.001)	-0.005**	(0.001)
W_{SDR}	-0.950**	(0.152)	-0.080**	(0.023)
W_{RSPR}	-0.922**	(0.145)	0.029	(0.030)
$W_{SDR} * W_{RSPR}$	0.662**	(0.142)		
Treatment	-1.255**	(0.198)	0.075*	(0.033)
Treatment*Round	0.013**	(0.002)		
Treatment*W_{SDR}	0.929**	(0.160)		
Treatment*W_{RSPR}	0.892**	(0.151)		
Treatment*$W_{SDR} * W_{RSPR}$	-0.631**	(0.147)		
Run	0.036**	(0.011)	0.016	(0.033)
Run*W_{SDR}			-0.077*	(0.038)
Run*$W_{SDR} * W_{RSPR}$			0.063*	(0.027)
Send rate			0.154**	(0.015)
Constant	1.866**	(0.173)	0.275**	(0.050)
Random Effects				
Group StdDev	0.186	(0.045)	0.0001	
Subject StdDev	0.264	(0.019)	0.174	(0.013)
Residual StdDev	0.272	(0.004)	0.246	(0.004)
No. of obs.	2554		2246	
Wald χ^2	305.10		249.81	
Log-restricted likelihood	-529.993		-207.612	

Note: Standard errors are given in parentheses. * and ** denote significance on the 5% and 1%-level, respectively. Regression models are derived by starting with a full factorial set of interaction effects and iteratively throwing out insignificant effects.

tion in the economy beyond what can be expected from non-conditional, homogenous trust patterns, this is not the case in IEQ.

The effect of the repetition of the game (Run) is positive and corresponds to an increase of average send rates in the second run of the game, across treatments. With respect to the evolution of investments over time, we find a negative effect of the number of rounds for treatment EQ, whereas in

IEQ the effect of time is somewhat mitigated. Finally, the coefficient of the treatment dummy is large and highly significant, pointing out a negative effect of *initial* inequality introduced by the variation of endowments.[23]

The model for trustee decisions indicates that return rates are generally higher in treatment IEQ, and shrink over time. We find that participants reciprocate high investments, as the coefficient for the send rate is positive and significant: The more of his wealth the investor sends, the higher his expected profit margin. Rich senders can expect to earn less from their trusting decisions than poor senders, while there seems to be no clear effect of the wealth of the responder herself. Also, there are no significant interaction effects between treatment and the relative wealth indicators.

V Discussion and Conclusions

We analyze the behavioral dynamics of economic inequality and trust. In our laboratory economies, participants start with either equal or unequal endowments. They then repeatedly play an investment game and, by accumulating their payoffs, endogenously create growth and wealth distributions. In each round, both transaction partners are informed about the current wealth of their opponent.

Initially, investments are higher in economies starting with equal endowments (EQ) compared to the economies starting with unequal endowments (IEQ). However, in EQ cooperation deteriorates over time, while trust remains stable in IEQ. As a result, EQ economies initially grow faster, but are ultimately outperformed by the IEQ economies in terms of efficiency. With respect to the distribution of wealth, IEQ economies become more equal, while EQ economies become more unequal, such that the distributions of wealth are converging to each other over time.

[23] Several robustness checks have been conducted with respect to the results of our regressions. First, Tobit Random Effects models controlling for censored send and return quotas yield the same results as described above. Second, our main result - the conditioning of trust on sender and responder wealth - is robust against inclusion of a 'personal experience' variable (the average return rate a sender experienced in previous rounds), and is also present when comparing send rates from rich/poor senders to rich/poor responders using non-parametric WMPSR tests on the economy level, not controlling for other factors as in the regression above.

The different dynamics of EQ and IEQ at the aggregate level are mirrored by two differences at the individual level. First, there is generally less trust in IEQ. Second, trust in the EQ economies is conditioned on the investor's and the trustee's wealth, while no analogous effects can be identified in IEQ. Conditional trust appears to be the main reason for the downward trend in EQ.

We speculate that the differences are partly due to the fact that relative wealth has a different information value and source in EQ compared to IEQ economies. A large relative wealth in EQ is a rather reliable signal for not having been trustworthy in the past: unfair agents become richer. A large relative wealth in IEQ, on the other hand, is not only the result of relatively selfish behavior but also of the exogenously imposed unequal endowments.[24] Both, models of strategic and social behavior, are then in line with the observed patterns of (conditional) trust. Because a higher wealth tends to suggest lower trustworthiness in EQ (but not in IEQ), richer people should be trusted less in EQ (but not in IEQ). Moreover, a number of studies (see, for example, Bolton, Brandts and Ockenfels, 2005; Frey, Benz and Stutzer, 2004) suggest that people are more tolerant towards inequitable outcomes if inequality is the result of a procedurally fair allocation mechanism. Thus, to the extent that high wealth exogenously and randomly imposed in IEQ economies is perceived as fair while high wealth endogenously resulting from selfish behavior is perceived as unfair, inequality in EQ may invoke a different social response than inequality in IEQ. Modeling the strategic and social roots of the dynamic interaction of distribution and efficiency is left to future research.

Our results suggest that the relationship between inequality and growth through the transmitter trust is not as linear and straightforward as sug-

[24]This reasoning is supported by the data. Results of Pearson correlations of average return rates and final wealth in half-runs of treatment EQ are R=-.358, p=.004 and R=-.479, p=.000 for rounds 1-10 and rounds 11-20 in run 1, and R=-.397, p=.001 and R=-.309, p=.013 for rounds 1-10 and rounds 11-20 in run 2, respectively. Contrary, in treatment IEQ half-run correlations between average return rates and wealth are low or insignificant; R=-.142, p=.262 and R=-.048, p=.704 for rounds 1-10 and rounds 11-20 in run 1, and R=-.240, p=.056 and R=-.152, p=.231 for rounds 1-10 and rounds 11-20 in run 2, respectively.

gested in the related empirical literature (reviewed in Section II). Specifically, our results provide evidence that the source, timing and dynamics of inequality (changes) within a society may have explanatory power for its behavioral impact on prosperity and growth.

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Appendix

A Instructions

Below we include the instructions used in the first run of treatment IEQ, translated from German. Instructions for the other runs and treatments were worded analogously.

Welcome to this experiment! In this experiment you can earn money. How much money you earn depends on your decisions and the decisions of the other participants.
From now on, please do not communicate with other participants. If you have a question concerning the experiment, please raise your hand! We will come to your place and answer your question privately. If you do not comply with these rules, we will have to exclude you from the experiment and all payments.
In the experiment, we will use ET ("Experiment-Taler") as the currency. At the end of the experiment, your payoff will be converted into Euros and will be paid out in cash. The exchange rate is 150 ET = 1 Euro. In the experiment, all amounts in ET are rounded to whole numbers.
The experiment consists of several parts. The payoff of only one of these parts will be paid out at the end of the experiment. When the experiment is finished, a die will be used to determine which part will be used for payment.
The following instructions refer to the first part of the experiment. After the first part is finished you will receive new instructions.
In this part all participants receive an initial endowment. Half of the participants receive an initial endowment of 800 ET, the other half receive an initial endowment of 200 ET. It will be determined by chance which participant receives which initial endowment.
This part consists of 20 rounds. In each round pairs are formed randomly, each pair consisting of participant A and participant B. It is guaranteed that you do not interact with the same participant in two consecutive rounds. The roles A and B within the pair are assigned randomly in every round.

The identity of the participant you are interacting with is secret, and no other participant will be informed about your identity. In this sense, your decisions are anonymous.
Every round proceeds as follows:

- At the beginning of the round both participants are informed about their roles (A or B), the current round (1-20), their own current wealth and the current wealth of the other participant.
- Then participant A decides how much of his/her wealth he/she wants to send to participant B.
- The amount sent by participant A is multiplied by 1.2. This means participant B not only receives the amount sent, but 120 % of the amount sent (1.2*amount sent).
- Then participant B decides how much he/she sends back to participant A. He/she must send back at least 90 % of the amount sent (0.9*amount sent). The upper limit for the amount sent back is the wealth of participant B.

After that the round is over. Wealth at the end of the round is calculated as follows:

- Participant A: Wealth at the end of the round = wealth at the beginning of the round - amount sent + amount sent back (at least 0.9*amount sent)
- Participant B: Wealth at the end of the round = wealth at the beginning of the round + 1.2*amount sent - amount sent back (at least 0.9*amount sent)

Wealth at the beginning of a new round is equal to wealth at the end of the preceding round. The payment for this part in case it is selected is given by the wealth at the end of the last round of this part.

B Additional tables

TABLE 2
Regressions of individual send and return rates, including 2-factorial set of interaction effects

Dependent Variable	Send Rate		Return Rate	
	Coefficient	(StdErr)	Coefficient	(StdErr)
Round	-0.012*	(0.005)	-0.011*	(0.005)
W_{SDR}	-0.375**	(0.076)	-0.239**	(0.072)
W_{SDR}*Round	0.000	(0.003)	0.006	(0.003)
W_{RSPR}	-0.243**	(0.065)	0.010	(0.082)
W_{RSPR}*Round	-0.005	(0.003)	0.004	(0.003)
W_{RSPR}*W_{SDR}	0.069*	(0.035)	0.067	(0.037)
Treatment	-0.629**	(0.130)	0.075	(0.099)
Treatment*Round	0.013**	(0.002)	0.000	(0.002)
Treatment*W_{SDR}	0.308**	(0.065)	0.063	(0.047)
Treatment*W_{RSPR}	0.253**	(0.043)	-0.058	(0.062)
Run	0.120*	(0.056)	0.065	(0.063)
Run*Round	-0.003	(0.002)	-0.006**	(0.002)
Run*W_{SDR}	0.025	(0.033)	-0.027	(0.033)
Run*W_{RSPR}	-0.082*	(0.032)	0.076*	(0.032)
Run*Treatment	0.014	(0.022)	-0.059**	(0.021)
Send rate			0.293**	(0.074)
Send rate*Round			-0.003	(0.002)
Send rate*W_{SDR}			-0.013	(0.040)
Send rate*W_{RSPR}			-0.095*	(0.046)
Send rate*Treatment			0.039	(0.031)
Send rate*Run			-.0.038	(0.027)
Constant	1.190**	(0.123)	0.330**	(0.120)
Random Effects				
Group StdDev	0.171	(0.040)	0.000	(0.000)
Subject StdDev	0.265	(0.019)	0.173	(0.012)
Residual StdDev	0.272	(0.004)	0.243	(0.017)
No. of obs.	2554		2246	
Wald χ^2	301.43		299.70	
Log-restricted likelihood	-500.302		-155.981	

Note: Standard errors are given in parentheses. * and ** denote significance on the 5% and 1%-level, respectively.