Inequality Aversion, Efficiency, and Maximin Preferences in Simple Distribution Experiments*

Dirk Engelmann[†] and Martin Strobel[‡]
Humboldt-Universität zu Berlin

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Abstract

We present simple one-shot distribution experiments comparing the relative importance of efficiency, maximin preferences and inequality aversion, as well as the performance of the two competing fairness theories by Bolton and Ockenfels (2000) and Fehr and Schmidt (1999). Several of our experiments induce opposing predictions made by both theories. We find a clear influence of efficiency and maximin preferences and overall a better performance of the model by Fehr and Schmidt, which, is, however also very poor in face of Pareto-dominance.

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†Institut für Öffentliche Finanzen, Wettbewerb und Institutionen, Humboldt-Universität zu Berlin, Spandauer Str. 1, D-10178 Berlin, Germany, FAX: +49-30-2093 5787, phone: +49-30-2093 5872, e-mail: engelman@wiwi.hu-berlin.de

‡Institut für Wirtschaftstheorie III, Humboldt-Universität zu Berlin, Spandauer Str. 1, D-10178 Berlin, Germany, FAX: +49-30-2093 5704, phone: +49-30-2093 5733, e-mail: strobel@wiwi.hu-berlin.de

1 Introduction

Among the recent attempts to explain behavior observed in economic experiments that deviates from the prediction of narrow self-interest, models based on inequality aversion have achieved special attention. The attractiveness of these models is based on their ability to explain a substantial part of the most well known economic experiments based on just two motives, maximization of own payoff and inequality aversion.

The aim of this paper is on the one hand to compare the relative importance of inequality aversion, concerns for efficiency and maximin preferences in simple distribution experiments. On the other hand we compare the relative performance of two similar theories based on inequality aversion, Bolton and Ockenfels' "Theory of Equity, Reciprocity and Competition" (2000), and Fehr and Schmidt's "Theory of Fairness, Competition, and Cooperation" (1999), in the remainder of this paper denoted by ERC and F&S, respectively.

Our original approach to compare ERC and F&S recognized the potential importance of efficiency and thus balanced the influence of efficiency. However, we expected this to be a comparably minor effect. It turned out, that this was not the case (See the analysis of treatments F and E in section 4.) This finding inspired further experiments to test for the robustness of this result and to investigate to what extend inequality aversion is dominated by efficiency concerns.

The importance of concerns for efficiency as explanatory variable seems to have been given too little attention in the past. A bulk of experimental results is considered as evidence for different fairness motives like inequality aversion or reciprocity, while the decisions are simultaneously efficiency enhancing. To illustrate that ignoring efficiency may be problematic, consider the following situation. Let person 2 choose from the allocations A,B, and C on persons 1,2, and 3.

Allocation	A	B	C
Person 1	11	8	5
Person 2	12	12	12
Person 3	2	3	4
Total	25	23	21

In this situation, a theory of inequality aversion according to either ERC or F&S would predict a choice of A, whereas a dislike for inequality between others per se (without reference to the own payoff) predicts a choice of C. But A is also efficient, so deriving any conclusions from a choice of A concerning the validity of the different formulations of inequality aversion are confounded by concerns for efficiency. On the other hand consider the choice for person 2 between the following allocations.

Allocation	A	B	C
Person 1	14	11	8
Person 2	4	4	4
Person 3	5	6	7
Total	23	21	19

In this situation any formulation of inequality aversion would predict that person 2 chooses C, whereas A is efficient, so that this situation allows to differentiate between concerns for efficiency and for equality. For experimental results on these two choice situations, see treatments R and P in section 4.

Examples where the common interpretation of results may be confounded by efficiency concerns include such famous experiments like the gift-exchange game (Fehr et al., 1993, Fehr et al., 1997)[1] and the trust or investment game (Berg et al., 1995).[2] McKelvey and Palfrey (1992) classify always passing subjects in the centipede game as altruists. In this game one can not distinguish between concerns for efficiency and altruism. But the disturbing aspect of the Nash equilibrium in the centipede game is its inefficiency so that efficiency concerns should not be ignored as potential explanation. Andreoni (1995) distinguishes between confusion and kindness as explanations for contributions in public good experiments.[3] However, his treatments differ with respect to whether contributions increase efficiency. So concerns for

[1]Concerns for efficiency can explain above equilibrium effort levels of workers in the gift-exchange games, as well as above equilibrium wages in the original version of the game. However, they can explain neither the positive relation between wages and effort nor above equilibrium wages in the modified "weak reciprocity treatment" in Fehr et al. (1997). The important issue is the interaction of efficiency and fairness. We address this issue in Engelmann and Ortmann (2000). We find only very limited evidence for positive reciprocity or trust in a gift-exchange game with moderate efficiency gains.

[2]In this game it is not clear whether first movers trust second movers or whether they care for efficiency, while due to the lack of effiiciency gains, second movers returning money (which they do only to a limited extent in the experiment) can not be attributed to efficiency concerns. In a similar experiment Van Huyck et al. (1995) show that the investment increases with the achievable efficiency gains, but do not consider concerns for efficiency explicitly.

[3]As underlying motives for above equilibrium contributions, Andreoni suggests pure

efficiency seem at least as valid an explanation as kindness.[4] On the other hand, the ultimatum game (Güth et al, 1982) provides clear evidence for fairness driven efficiency reducing behavior.

So far, some experiments provide an opportunity to compare the relative influence of different fairness considerations.[5] But few allow to compare different approaches to inequality aversion and how they relate to efficiency concerns. Bolton and Ockenfels (1998) show that the results of three-person bargaining experiments by Güth and van Damme (1998) are well in line with ERC. But the results only contradict F&S for high values of parameters for inequality aversion. (See Fehr and Schmidt, 2000.) Falk et al. (2000a) claim evidence on the basis of a prisoner's dilemma game with punishment that the measure of inequality is more appropriate in F&S than in ERC. However, this interpretation is problematic, since the F&S prediction is in line with the prediction based on intentionality, while the ERC prediction exactly opposes it. So it remains unclear whether F&S employs the better measure of inequality or whether both theories are defective in ignoring intentions and F&S just happens to be in line with more appropriate intentionality based

altruism, warm-glow, reciprocity, group ethics, and fairness.

[4] Altruism and efficiency concerns are difficult to disentangle. Taking some self-interest as given, the motive of increasing the others' payoff or the total payoff are almost identical. The distinction is more on the level of the thought process. We would see altruism to refer to a concern with others' well-being (so this implies thoughts about people), whereas efficiency concerns are directed to the total payoffs only (so this refers to thoughts about numbers). An important implication of this difference is that a choice guided by efficiency concerns should not be influenced by the number of people affected, whereas altruistic choices should be. Thus a fixed sacrifice effect as found by Selten and Ockenfels (1998) can not be reconciled with altruism but does not contradict efficiency concerns. Evidence for altruism comes from donations that do not increase efficiency as in the basic dictator game. Bolle and Kritikos (1999) claim that altruism is an important motive. However, they concede, that an important determinant of altruism is the intensity of efficiency gains. Why they do not consider efficiency concerns as a motive in itself, remains a mystery.

[5] An interesting approach to distingiush between trust and reciprocity on the one hand and other regarding preferences on the other hand, is provided by Cox (2000). He finds that the former are relatively unimportant in the trust game. This is in contrast to a similar approach by Bolle and Kritikos (1999) who find evidence for positive reciprocity, but in line with results by Bolton et al. (1998). Palfrey and Prisbrey (1997) study public good games that allow to distinguish between different motives for deviations from the dominant strategy. They find little evidence for altruism, which corresponds to efficiency concerns in their formulation. For a review of further experiments that allow to distinguish between different motives see Fehr and Schmidt (2000).

theories in this design.

In contrast, several of our treatments imply opposite predictions by ERC and F&S. In order to exclude, as far as possible, other motives like reciprocity, we chose very simple games that were completely reduced to the primary question that is considered by these theories, that of distribution. All a subject had to do was to choose one out of three allocations of money between herself and two other subjects. We applied the strategy method. All subjects had to choose an allocation, while groups of three were randomly formed later on. Subjects knew that their decision would only matter if they were assigned to be person 2 in their group.[6]

In the treatments where F&S and ERC make opposite predictions, F&S does in general better. However, when its prediction is Pareto-dominated, F&S does very poorly. Over all treatments, there is a clear effect of both efficiency and maximin preferences. Hence in our simple decision task the performance of F&S is better than that of ERC, although both theories ignore the importance that subjects assign to efficiency.

We are aware that the type of game we employ is rather unnatural and mirrors only a fraction of the reality (in particular, in seven out of ten treatments the own payoff is not affected by the choice). However, since both ERC and F&S are formulated on the basis of distributions only, this type of game seems to us the most fair and neutral playground to compare their predictive accuracy. Furthermore, we also believe that if they do not function well in this "pure" environment, which is entirely reduced to what they claim to be the relevant determinant, it should be clarified why they do not function well, and what other aspects, that a priori would be considered causes of disturbances, are, in contrast, needed to make the theories work.

Among the growing number of fairness theories, further could be applied to our setting. However, for the application of theories that explicitly take intentions into account (e.g. Rabin, 1993, Dufwenberg and Kirchsteiger, 2000, Falk and Fischbacher, 1999) assumptions about believes are required concerning the choices of other subjects, with whom one might be matched. Hence we believe that our experiments are not suited to test these theories. For the same reason, the complete model of Charness and Rabin (2000) does not seem to be testable by our experiments. But they can shed some light

[6] Apart from generating three times the data by that method it also secured that all subjects were considered to be equally entitled to the money since they had all performed the same task. It also prevented that we had to pay subjects for doing nothing.

on the basic model, relying on selfishness plus quasi-maximin preferences (maximizing a weighted sum of total and minimal payoff).

In section 2 we outline the difference between ERC and F&S that is our focus in the comparison. Section 3 presents our experimental design, followed by the experimental results in section 4. Section 5 concludes.

2 Inequality Measures in ERC and F&S

Let us briefly review the different measures of inequality in F&S and ERC. This difference between ERC and F&S is represented in the motivation or utility function. The motivation function of ERC is given by $v_i(y_i, \sigma_i)$, with y_i denoting the own payoff and σ_i the share of the total payoff, and v_i for given y_i being maximal if $\sigma_i = \frac{1}{n}$, n being the number of players. F&S assumes a utility function $U_i(x) = x_i - \alpha_i \frac{1}{n-1} \sum_{j \neq i} \max\{x_j - x_i, 0\} - \beta_i \frac{1}{n-1} \sum_{j \neq i} \max\{x_i - x_j, 0\}$ with $\alpha_i \geq \beta_i \geq 0$ and x_i the payoff of subject i.

Hence ERC assumes that subjects like the average payoff to be as close as possible to their own payoff while F&S assumes that subjects dislike a payoff difference to any other individual. Thus according to ERC a subject would be equally happy if all subjects received the same payoff or if some were rich and some were poor as long as she received the average payoff, but according to F&S she would clearly prefer the first situation. In a real life situation F&S predicts that the middle class would tax the upper class to subsidize the poor, while in an ERC world the middle class would just be satisfied. Our taxation games mimic such a situation.

3 Experimental Design and Predictions

We conducted ten experimental treatments in two sessions. Both these sessions were conducted as class room experiments at the end of the lecture in one of the first weeks of an introductory economics courses at Humboldt-Universität zu Berlin. 136 subjects took part in the first session, 68 for both treatments E and F. 240 subjects participated in the second session, 30 for each of the remaining eight treatments. We had determined a number of seats corresponding to the number of subjects desired in advance. We asked students occupying these seats by the end of the lecture to participate in the experiment or to leave to be replaced by students who were occupying other seats but wanted to participate. After all seats had been taken and all other students had left the classroom, each subject received a decision sheet with the instructions and a questionnaire, which we used to gather some biographical data and to check whether the subjects understood the task completely. The total procedure took about 20 minutes. Subjects were paid in class the following week. They were identified by codes that were noted both on the decision sheets and on attached identification sheets that the subjects kept.

The decision sheet contained three different allocations of money between three persons, of which they had to choose one. They were informed that we would randomly form groups of three later on and would also assign the three roles randomly.[7] Only the choice of that subject selected as person 2 mattered. To avoid influence by computation errors we also noted the average payoffs of persons 1 and 3 and the total payoff for each allocation in the decision sheet.[8] Sample instructions can be found in appendix A.

3.1 Taxation Games

In accordance with our motivation that the middle-class would like to tax the upper class to subsidize the poor according to F&S, while it would be satisfied according to ERC, we call games, where the decision maker (person 2) receives an intermediate payoff and can redistribute payoff between a person 1, who receives a higher payoff, and person 3, who receives a lower payoff, taxation games. These are our original treatments F and E as well as treatments Fx and Ex. The crucial property is, that the allocation, where the distance between the payoffs of person 2 and each of the other persons was minimal, was such that the distance to the average payoff was maximal and vice versa. Thus ERC and F&S predict the choice of exactly opposing allocations, since the former implies that a disutility is caused by a difference

[7] Careful readers might have noticed that it is impossible to divide 68 subjects in groups of 3 in treatments E and F. We used one person per treatment a second time as a dummy subject to fill a group, without paying twice. Hence the decision of two of our subjects either mattered for two groups (if the dummy subject was person 2) or mattered only for one other person (if the dummy was not person 2). We chose this procedure since in recruiting the subjects in the classroom, we focused on having equal subtreatments sizes, i.e. multiples of four. This slight dishonesty was avoided in the other treatments since keeping the same number of subjects for each of the six subtreatments per treatment implied multiples of three for each main treatment.

[8] Actually, this implied that ERC was getting a pretty fair shot.

between the own payoff and the average payoff, while the latter is based on a dislike for any payoff difference to other individuals. Since both theories include self-interest, we kept the payoff of person 2 constant over all allocations to insure opposite predictions. Compared to treatments F and E, in Fx and Ex the relative payoff differs much more between the allocations and is exactly $\frac{1}{3}$ in the ERC prediction to make the deviations from the optimum according to ERC more salient. The allocations for treatments F, E, Fx and Ex are presented in Table 1 in section 4 along with the average payoff of persons 1 and 3, the relative payoff of person 2, and the total payoff. We also marked which allocation is predicted by ERC and F&S, which maximizes the minimal or the total payoff, as well as the results in absolute and relative numbers.

Our treatments differed by the effect the choice had on the total payoff. In treatments F and Fx the allocation predicted by F&S maximized the total payoff (and that is why they are called treatments F and Fx). In treatments E and Ex the choice predicted by ERC maximizes total payoff. Thus in the treatments taken together, we have balanced a possible effect of concerns for efficiency in favor of any of the two theories.[9] Neither ERC, nor F&S, nor the maximization of total payoff predicts that the intermediate allocation will ever be chosen.

In all taxation games the F&S prediction coincides with the maximin allocation. Thus one might object, that although we have balanced the effect of efficiency, we have not, but should have also balanced the influence of maximin preferences. However, this objection is misplaced. Whereas F&S and ERC are in general neutral concerning efficiency, with respect to maximin preferences, only ERC is. F&S is in general in line with maximin, since increasing the minimal payoff either means increasing the own payoff or reducing the difference to a poorer subject. Hence F&S will only deviate from maximin preferences in case that increasing the difference to the poorest payoff is the price for the reduction of other payoff differences (that are either of larger magnitude or disadvantageous), as is the case in our other treatments. Thus it is a natural consequence of the model, that F&S is rather in line with maximin preferences and not a coincidence that has to be

[9] The preferable way to prevent interference by efficiency would have been that all allocations yielded the same total payoff. However, if the own payoff is fixed, ERC only yields a clear prediction if the average and thus the total payoff of the other subjects differs in the three allocations.

balanced.

Each of the treatments E and F was also divided into two subtreatments that only differed by the order in which the allocations were presented on the decision sheet.[10] All other treatments were divided into six subtreatments, one for each permutation of the allocations.

3.2 Envy Games

Treatments F and E showed a major influence of efficiency. This inspired to expose both theories of inequality aversion to a more severe test, where they predict decisions that are Pareto-dominated. This situation is represented by treatment N, where the payoff to person 2 is again intermediate and kept constant. In this treatment F&S predicts a choice of C, which is Pareto-dominated by the ERC prediction B, which is in turn dominated by allocation A.(See Table 2.) We call these games envy games, because envy could lead the middle-class to take money from the poor, only to be able to take more from the rich. However, we want to stress that we do not claim that the motivation that leads to subjects behaving in that way, is in fact envy. It only seems a likely influence in this class of games, so that it may serve as a name.

We also used this treatment as a baseline to test the robustness of our results in the face of monetary incentives for person 2. To test whether subjects were willing to give up own payoff for their desire to increase efficiency or to reduce inequality, we let the payoff of person 2 vary across allocations in the treatments Nx, Ny, and Nyi. (See Table 2.) Since both F&S and ERC also take maximization of own payoff into account, their predictions depend on the weight assigned to selfishness relative to inequality aversion. In treatment Nx, ERC predicts a choice of A (which strictly Pareto-dominates B and C) or B, whereas F&S predicts a choice of A or C. In treatments Ny and Nyi ERC predicts a choice of B or C, whereas F&S predicts a choice of C, whereas A is efficient (though no longer Pareto-dominant). We do not intend to measure precisely the value subjects attach to either efficiency or equality with these treatments. The primary purpose is to test whether our results

[10] This was done to avoid some conceivable influence of a preference for the center or right allocation. The allocation with intermediate payoffs was always presented on the left, since we considered this to be the most prominent position but it was the allocation we were not really interested in.

in the other treatments might be artifacts of the irrelevance of the choice for the own decision in the sense that the motivations we consider important are dominated by selfishness.

3.3 Rich and Poor Games

In the preceding eight treatments person 2 always obtained an intermediate payoff. Our last two treatments R and P study situations where either the person with the highest or the lowest payoff decides upon the allocation (hence not the games are "rich" or "poor", but the decision maker), again with a constant payoff for this person.(See Table 3.) Since F&S aggregates over all persons richer or poorer than one self, it predicts the same as ERC in these situations. So these treatments do not allow to distinguish between these two theories. However, they allow to contrast efficiency and inequality aversion and to test for different kinds of inequality aversion. In treatment R (the "rich" game) person 2 receives the highest payoff and can choose for the other subjects payoffs that are relatively equal (C) or which are maximal in sum (A). Both F&S and ERC predict a choice of the efficient allocation A, but inequality aversion that is directed towards the payoffs of others per se and not in relation to the own payoff, would lead for a preference for C, as would maximin preferences. In contrast in treatment P (the "poor" game) person 2 receives the lowest payoff. Inequality aversion, whether in the form of ERC or F&S or not in relation to the own payoff, predicts a choice of the least efficient allocation C. The important aspect of treatment P is that the minimal payoff is constant, so that maximin preferences can not influence the results. Hence this treatment allows to contrast efficiency and inequality aversion in a frame neutral to maximin preferences.

4 Experimental Results

4.1 Results for Taxation Games

The results for treatments F, E, Fx, and Ex are presented in Table 1. The results for the subtreatments of treatments E and F can be found in Table 4 in appendix B.[11] In both treatments F and E there is virtually no difference

[11] For the other treatments we do not report results for the subtreatments, since the number of subjects in each of the subtreatments was only five, and since we completely

Treatment	F			E			Fx			Ex		
Allocation	A	B	C	A	B	C	A	B	C	A	B	C
Person 1	8.2	8.8	9.4	9.4	8.4	7.4	17	18	19	21	17	13
Person 2	5.6	5.6	5.6	6.4	6.4	6.4	10	10	10	12	12	12
Person 3	4.6	3.6	2.6	2.6	3.2	3.8	9	5	1	3	4	5
Total	18.4	18	17.6	18.4	18	17.6	36	33	30	36	33	30
Average 1, 3	6.4	6.2	6	6	5.8	5.6	13	11.5	10	12	10.5	9
Relative 2	.304	.311	.318	.348	.356	.364	.278	.303	.333	.333	.364	.4
Efficient	A			A			A			A		
ERC pred.			C	A					C	A		
F&S pred.	A					C	A					C
Maximin	A					C	A					C
Choices (abs.)	57	7	4	27	16	25	26	2	2	12	5	13
Choices (%)	83.8	10.3	5.9	39.7	23.5	36.7	86.7	6.7	6.7	40	16.7	43.3

Table 1: Allocations (in DM), predictions by ERC and F&S, maximin and efficient allocations, and decisions for the taxation games

between the two subtreatments. Hence we can conclude that the results are not driven by a preference for either the middle or the right column and we pool the data from the respective subtreatments.

The results for treatment F are very clear. 83.8% of subjects chose the allocation that led to a maximization of utility according to F&S and also to a maximization of total payoff. On the other hand, only 5.9% chose the allocation predicted by ERC, and 10.3% the intermediate allocation. The three allocations were not chosen with equal probability ($p_{ABC} < .001$), in particular the F&S allocation was chosen significantly more often than the ERC allocation ($p_{AC} < .001$).[12]

For treatment E the results are more dispersed. While 39.7% of subjects chose the allocation predicted by ERC that also maximized total payoff, 36.7% decided according to the prediction by F&S and 23.5% chose the in-

balanced possible preferences for certain positions by using all permutations of the allocations.

[12] In the following p_{ABC} will always denote the level of significance for a multinomial test of the hypothesis that all allocations are chosen with the same probability, whereas p_{XY} will denote the level of significance for a (two-sided) binomial test of the hypothesis that allocations X and Y are chosen with the same probability taking the number of choices for the third allocation as given.

termediate allocation. The hypothesis that all three allocations were chosen with equal probability can not be rejected ($p_{ABC} > .2$). In particular, there is no significant difference between the probabilities with which the two extreme allocations were chosen.

Since the two treatments balance the influence of efficiency concerns, we can consider both of them together. Aggregated, 60.2% of subjects chose the allocation predicted by F&S, whereas 22.8% decided in line with ERC and 16.9% chose the intermediate allocation ($p_{ABC} < .001$, $p_{F\&S,ERC} < .001$).

Of the 136 choices in both treatments, 61.8% are in line with the maximization of total payoffs while 21.3% are opposite to it. A binomial test shows that this difference is significant ($p < .001$). Hence opposed to the assumption made by both ERC and F&S that efficiency does not matter we find a clear influence.

The results for treatments Fx and Ex almost exactly match the results of treatments F and E. In treatment Fx 86.7% decided according to the F&S prediction and 6.7% both for the ERC prediction and the intermediate allocation. Again all allocations were not chosen with the same probability ($p_{ABC} < .001$) and the F&S allocation was chosen significantly more often than the ERC allocation ($p_{AC} < .001$). In treatment Ex the F&S prediction has a marginal advantage over the ERC allocation (43.3% vs. 40%), with a non-negligible fraction of 16.7% deciding for the intermediate allocation. The differences are not significant ($p_{ABC} > .133$, $p_{AC} = 1$). In both treatments together significantly more subjects chose the F&S allocation than the ERC allocation ($p < .001$) and significantly more subjects maximized than minimize efficiency ($p < .003$).

In treatments Fx and Ex the difference of the relative share of person 2 from the optimum according to ERC is much more salient than in treatments F and E. Since the results changed only marginally (and not in favor of ERC), we conclude that the poor performance of ERC in our original treatments was not an artefact of non-salient differences in relative payoffs. Arguably, these are still not huge, but if non-salience was the issue, than the performance of ERC should improve at least somewhat compared to E and F.

In the explanation given for their decisions, in treatments E and F 18 subjects explicitly referred to fairness. 17 of them chose according to F&S, including 8 subjects who also referred to the maximal total payoff. The remaining subject chose the intermediate allocation. Of 12 subjects who stated the reason for their decisions was maximization of total payoff (without explicit reference to fairness), 8 were in treatment F and thus chose the allocation predicted by F&S, the other four in treatment E chose according to ERC. Only one subject referred to the relative payoff but opposed to ERC aimed at maximizing the positive difference between the own and the average payoff. Thus among the subjects who explicitly mentioned fairness as a motivation, F&S did much better than ERC and a substantial part of subjects explicitly stated efficiency concerns.

Thus we conclude for the taxation games, that F&S outperforms ERC and that efficiency has a clear influence. Since the F&S prediction is always the maximin allocation, maximin preference explain a substantial part of the data. Furthermore, since those which are not in line with maximin preferences are to a large part efficient (the ERC allocation in treatments E and Ex), quasi-maximin preferences can explain about 85% of the data, if one allows for heterogeneity of subjects. However, this is not too surprising, given that they can explain both extreme allocations in treatments E and Ex.

4.2 Results for Envy Games

In treatment N, the payoff of person 2 is constant and allocation A Pareto-dominates the ERC prediction B, which in turn Pareto-dominates the F&S prediction C. 70% chose the Pareto-efficient allocation, 26.7% the ERC allocation and only 3.3% the F&S allocation. ($p_{ABC} < .001$) Hence ERC clearly outperforms F&S, but with the aid of Pareto-dominance ($p_{BC} < .04$). Fehr and Schmidt (1999) do not claim that all subjects are inequality averse, but only a substantial fraction.[13] But 1 out of 30 is not a substantial fraction.

In the other envy games we only altered the payoff to person 2. In treatment Nx we added 1 DM in allocation A and subtracted 1 DM in allocation C. As expected, this increased the number of choices for the Pareto-dominant allocation A (83.3%) and decreased that for allocation B (13.3%), with again 3.3% for allocation C ($p_{ABC} < .001$, $p_{BC} > .3$). In treatments Ny (Nyi), we subtracted 1 DM (.5 DM) in allocation A (so it is no longer Pareto-dominant) and added 1 DM (.5 DM) in allocation C. As expected, this shifts choices somewhat towards allocation C, to 10% (23.3%). However, the majority of 76.7% (60%) stayed with allocation A, whereas also the choices for allocation B reduced to 13.3% (16.7%) (Ny: $p_{ABC} < .001$, $p_{AB} < .001$, $p_{AC} < .001$, Nyi: $p_{ABC} < .011$, $p_{AB} < .011$, $p_{AC} < .044$). Thus the results in these treatments

[13] On the basis of ultimatum games they estimate this fraction to be about 70%.

Treatment	N			Nx			Ny			Nyi		
Allocation	A	B	C	A	B	C	A	B	C	A	B	C
Person 1	16	13	10	16	13	10	16	13	10	16	13	10
Person 2	8	8	8	9	8	7	7	8	9	7.5	8	8.5
Person 3	5	3	1	5	3	1	5	3	1	5	3	1
Total	29	24	19	30	24	18	28	24	20	28.5	24	19.5
Average 1, 3	10.5	8	5.5	10.5	8	5.5	10.5	8	5.5	10.5	8	5.5
Relative 2	.276	.333	.421	.3	.333	.389	.25	.333	.45	.263	.333	.436
Efficient	A			A			A			A		
ERC pred.		B		A or	B			B or	C		B or	C
F&S pred.			C	A	or	C			C			C
Maximin	A			A			A			A		
Choices (abs.)	21	8	1	25	4	1	23	4	3	18	5	7
Choices (%)	70	26.7	3.3	83.3	13.3	3.3	76.7	13.3	10	60	16.7	23.3

Table 2: Allocations (in DM), predictions by ERC and F&S, maximin and efficient allocations, and decisions for the envy games

are qualitatively very well in line with the constant own payoff treatment N and deviations are as expected by standard economic theory (although the effect should be larger in treatment Ny than in Nyi). This provides substantial support for the claim that our results in the other treatments are not plain artifacts of the constancy of the payoff of the decision maker. Some of the decision makers reacted to small variations in the own payoff (and in an expected way) but by far not the majority. Hence the process by which decisions were made does not seem to be entirely overruled by concerns for the own payoff. In contrast the own payoff was just another influence of non-negligible but non-dominating importance.

Note that Ny and Nyi are the only treatments where F&S makes a unique prediction (C) for all subjects, including those which are not inequality averse, since the own payoff is maximal and inequality minimal. But this prediction only covers one sixth of decisions in both treatments ($p_{AC} < .001$ for Ny and Nyi aggregated).

We conclude for the envy games that F&S performs poorly in the face of Pareto-dominance and that ERC does somewhat better but not well. In addition they provide an example that the predictive power of F&S can in some cases substantially be improved by abstracting from the linear form.

A non-linear version of F&S could also explain choices of allocation B. Of course, this comes at some cost. However, the cost of e.g. a quadratic disutility from inequality might be outweighed by the benefits (although this implies the problem of not being neutral to scaling).

Furthermore, the envy games emphasize the importance of efficiency if it comes in the strong form of Pareto-efficiency. However, even Pareto-efficiency is not completely dominating inequality aversion. Maximin preferences are in line with efficiency, so the results provide (weak) support for their importance.

4.3 Results for Rich and Poor Games

At a first glance, the results in treatments R and P may seem to be a puzzle. The results in the taxation and envy games indicate that both efficiency and (to a lesser extent) inequality aversion are important determinants of behavior. Now in treatment R where both ERC and F&S predict the efficient allocation A, only 26.7% of the choices were in accordance, whereas 53.3% of the subjects chose allocation C. ($p_{ABC} < .08$, $p_{AC} > .15$). In contrast, in treatment P, where both ERC and F&S predict allocation C, 60% of the subjects chose the efficient allocation A ($p_{ABC} < .001$, $p_{AC} > .18$), i.e. far more subjects chose the efficient allocation when it is not minimizing inequality compared to the case when it does ($p < .08$).

The result of treatment R alone could be considered an indication that some subjects might be averse towards inequality among others, but do not compare others' payoffs to their own. This would predict a choice of C since the difference between persons 1 and 3 is minimal, although their average difference to person 2 is maximal. However, in treatment P it predicts allocation C, as do F&S and ERC, and only 33.3% chose this allocation, which contradicts the importance of inequality aversion in this form. An alternative interpretation for the choice of C in treatment R would be spite or competitiveness. But these motivations also imply the choice of C in treatment P, and are thus rejected as well.

We consider the crucial difference between treatments R and P to be the role of maximin allocations. In treatment R the minimal payoff is maximized in allocation C, which was chosen by the majority of subjects, whereas in treatment P the minimal payoff is constant, so maximin preferences have no influence. This treatment thus allows us to compare the impact of ef-

Treatment	R			P		
Allocation	A	B	C	A	B	C
Person 1	11	8	5	14	11	8
Person 2	12	12	12	4	4	4
Person 3	2	3	4	5	6	7
Total	25	23	21	23	21	19
Average 1, 3	6.5	5.5	4.5	9.5	8.5	7.5
Relative 2	.48	.522	.571	.174	.19	.211
Efficient	A			A		
ERC pred.	A					C
F&S pred.	A					C
Maximin			C	A	B or	C
Choices (abs.)	8	6	16	18	2	10
Choices (%)	26.7	20	53.3	60	6.7	33.3

Table 3: Allocations (in DM), predictions by ERC and F&S, maximin and efficient allocations, and decisions for the rich and poor games

ficiency and inequality aversion (measured in any reasonable way) without conflicting influence by maximin-preferences. The results indicate a larger influence of efficiency concerns (though not significant) since the majority of subjects chose the efficient but inequality maximizing allocation. Comparing the results in both treatments leads us to conclude that maximin-preferences are important and that, in the most neutral environment efficiency outperforms inequality aversion. This is of particular relevance since the inequality in treatment P is disadvantageous to the decision maker, which is generally considered to weigh heavier. However, treatment P also shows the limits of quasi-maximin preferences, since for any positive weight on efficiency quasi-maximin preferences imply a choice of A, which was chosen by only 60% of the subjects. Inequality aversion seems to matter more for a third of the subjects.

5 Conclusion

Let us begin the concluding remarks with a disclaimer. There are a couple of things we did neither attempt nor claim to have achieved. We did not show that inequality aversion does not matter. Neither did we present a general and ultimate proof that F&S is the best formulation of inequality aversion. What we did do is to take two nice and tractable models, that are based on inequality aversion, at face value and expose them to what would then be the natural and neutral playground for them to show that they work and which of them works better. The games focus on the distribution of payoffs, which is the only concern in both theories. In addition, as far as possible, we kept away or balanced factors that would seem to be disturbing, in particular repeated interaction, intentionality, reciprocity, and efficiency concerns. Bolton (1998) suggests three building blocks to explain behavior in games: motivation, learning and strategic reasoning. In our game, learning and strategic reasoning are not important. Thus we have a pure test for the motivation block and inequality aversion does not seem to be the major part in it.

We find that in this neutral playground the majority of decisions can be better explained by concerns for efficiency and maximin preferences, which amounts to the basic model in Charness and Rabin (2000). This is well in line with their results for similar simple distribution games. It seems that in order for the theories of inequality aversion to work, some of the factors, which should rather be considered causes for deviations, are indeed needed, e.g. interaction. We conclude that theories which are based on distributions should, in general, carefully clarify when they are appropriate.

We admit that our games are very special and reflect only part of the (economic) reality. Thus our results do not discard inequality aversion as a motive in general. But since the theories based on inequality aversion do not do so well where we they should work best according to their formulation, one needs to determine the conditions under which the motive of inequality aversion is important. Part of this work is done. Fehr and Schmidt (2000) review evidence that efficiency concerns are important in dictator game situations, that for payoff increasing actions efficiency and inequality aversion are more important than reciprocity, whereas reciprocity seems to play an important role for payoff reducing behavior[14] (which could be interpreted again that subjects care for efficiency, since they need a good reason to reduce efficiency). The latter is only partly in line with treatment N, where 30% of subjects reduce both of the other persons' payoffs.

We are able to provide further answers. The taxation games, which we

[14]In contrast Falk et al. (2000b) find that intentions are also important for payoff increasing behavior.

consider the fairest playground for the comparison of F&S and ERC, show a better performance of F&S than of ERC, but also an important influence of efficiency. The rich and poor games very vividly illustrate that maximin preference have a major influence, and that efficiency matters more than inequality. But they show as well that there are limits to efficiency and quasi-maximin preferences. The results in the poor game can be reconciled with the claim by Fehr and Schmidt that a substantial fraction (1/3) is inequality averse, if one concedes, that the whole rest seems to be guided by efficiency.[15] The envy games show that inequality aversion does poorly in the face of Pareto-efficiency, but also that even Pareto-efficiency is not everything. In addition these games show that although our games are very specific, our results can not be attributed to the constancy of the decision maker's payoff only. Variations in the decision makers' payoff do not substantially alter the results.

Our experiments highlight some simplifications in F&S and ERC. The latter ignores that subjects might be concerned about differences in payoff among other subjects. Both ignore that subjects might care about efficiency. A further problem our experiments keep purposely silent about, is that both do not take intentions explicitly into account. It seems to us, that in plain distribution situations subjects are rather guided by simple motives like concerns for efficiency and maximin preferences while in interactive decisions reciprocity comes into play, while it depends on the specific situation which motive dominates. Inequality might not be the dominating motive behind the decision in either case but may still lead to good predictions in many cases since it tends to be in line with both the simpler and the more sophisticated motives.

We believe that our results also have implications for experimental economics in general. Given the importance of efficiency concerns and maximin preferences, we believe that in interpreting experimental results one should keep these motives in mind as alternative explanations. Many results that are readily interpreted as evidence for different kinds of fairness concerns can

[15] In the basic form, F&S predicts nothing for the subjects that are not inequality averse in this treatment, so one could assume that they randomize. Any positive number of inequality averse subjects would imply a majority of choices for the inefficient allocation. This prediction is clearly rejected by the data, which indicates that the predictive accuracy of F&S can significantly be increased by admitting other motives than selfishness for the subjects which are not inequality averse.

as well be explained by them. Discussing bargaining and dilemma games Bolton (1998, p. 258) states that "The precise relationship between concepts like fairness, altruism and reciprocity has always been a bit unclear." How they relate to efficiency is not considered an issue. Deviations from game theory tends to be interpreted that subjects are "better" (i.e. altruistic or fair) people, but maybe they are just better economists. It is surprising that for economists the goal in designing economic mechanisms is to maximize efficiency, while as experimentalists, when designing economic experiments, they tend to ignore that subjects might share this goal.

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A Instructions

These are sample instructions for treatment Fx (subtreatment ???). The instructions for all other treatments were parallel, except for that in treatments F and E the person with the lowest payoff was called person 1 and that with the highest payoff person 3.

	A	B	C
Person 1	18 DM	17 DM	19 DM
Person 2	10 DM	10 DM	10 DM
Person 3	5 DM	9 DM	1 DM
Average 1 and 3	11.50 DM	13 DM	10 DM
Total 1,2,3	33 DM	36 DM	30 DM

B Results for Subtreatments of Treatments F and E

Table 4 presents the detailed results for our initial treatments E and F.

Treatment	ERC	F&S	inter
Fn	2(6%)	29(85%)	3(9%)
Fh	2(6%)	28(82%)	4(12%)
F	4(6%)	57(84%)	7(10%)
En	14(41%)	12(35%)	8(24%)
Eh	13(38%)	13(38%)	8(24%)
E	27(40%)	25(37%)	16(24%)
total	31(23%)	82(60%)	23(17%)

Table 4: Number of subjects choosing the allocations predicted by ERC (ERC), predicted by F&S (F&S), and the intermediate allocation (inter), by treatment and by subtreatment