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Contracts versus trust for transfers of ecosystem services: Equity and efficiency in resource allocation and environmental provision

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ABSTRACT

Managing natural-resource allocation and environmental externalities is a challenge. Institutional designs are central when improving water quality for downstream users, for instance, and when reallocating water quantities including for climate adaptation. Views differ on which institutions are best: states; markets; or informal institutions. For transfers of ecosystem services, we compare informal trust-based institutions to enforced contracts, both being institutional types we observe commonly in the field. The trust-based institutions lack binding promises, thus ecosystem-services suppliers are unsure about the compensation they will receive for transferring services to users. We employ decision experiments given the shortcomings of the alternative methods for empirical study of institutions, as well as the limits on theoretical prediction about behaviors under trust. In our bargaining game that decouples equity and efficiency, we find that enforced contracts increased efficiency as well as all measures of equity. This informs the design of institutions to manage transfers of ecosystem services, as equity in surplus sharing is important in of itself and in permitting efficient allocation.

1. Introduction

Institutions to manage natural resources and environmental externalities greatly influence welfare. Institutions to manage water, for instance, are important within economic development, climate adaptation and environmental quality. Not surprisingly, then, they are oft discussed[2] and varied forms of compensation have been heavily studied including pricing in efficient markets.[3]

Reallocation through compensated transfers has generated concerns about equity, though, based upon an apparent lack of trust in

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[2] Carbon-emissions markets given regulations of global climate externalities may become the biggest in the world. For natural resources, impacts can be enormous from, e.g., commercialization of energy stocks and minerals [28] or the securing of transferable land rights (see, e.g. [29], and [30] or [31,32] and [33].

[3] [34] review water pricing [35], residential water demand, and [36,37] water quality and quantity. Such work is longstanding, e.g. [38], consider alternative institutions for Colorado River water [39], water values for pricing [40], compare pricing with urban infrastructure [41], assessed pricing and demand-side management for agencies in California.

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markets, including their organizers [1]. Sometimes such concerns are expressed in proposals not to allow trading in allocation processes. For water, e.g. [2], document a global tendency to prevent trading of water rights, while [3] emphasize path-dependent constraints upon water institutions and [4] stress difficulties faced by institutions in evolving towards trading.

Sticking with water as the example, in the American Economic Review's very first issue [5] notes ups and downs for each approach to water reallocations in the western U.S. – including speculation and collapses resulting from market interactions around irrigation systems. A century later [6], notes that neither have state interventions easily resolved all of the incentives issues within water allocation and reallocations. Per Coman and others, Ostrom states that sometimes what works best is collective action, for which the building up of trust is critical. [7] highlights quite general gains from trust, including efficiency with limited contracts.

We compare trust-based institutions[4] to enforced contracts. This has relevance for water quantity, climate adaption, and forest conservation for both water quality and climate mitigation. Given concerns about fairness, we consider not only efficiency consequences but also equity.

We employ decision experiments, due to the shortcomings of the alternative methods for empirically studying institutions [8,9]. For all the institutional dimensions of interest, the number of institutions that we can use to sort out their influences is relatively small. Thus, comparisons among the limited number of observed institutions rarely are 'clean' enough to estimate impacts on equity and efficiency for institutional changes such as enforcing contracts. Experiments offer institutional control – even randomization – plus payoffs to mimic incentives.

Our novel experimental design decouples equity and efficiency, unlike Ultimatum games with unequal productivities, in which high efficiency necessarily yields low equity.[5] Trust games also fully decouple equity and efficiency [10,11].[6] In that game, however, the lower productivity actors initiate the interaction through the initial decision on how much to trust. In reality, higher productivity actors often initiate transfers of ecosystem services, by offering to buy. For instance, in existing ecopayments programs, downstream and state users with higher payoffs from nature's services have made offers to pay upstream suppliers to transfer ecoservices. Both parties can benefit, as agreed prices will be above upstream opportunity costs.

Yet equity tensions limit such efficient transfers. Aggregate efficiency involves moving resources from lower to higher productivity – but whether that occurs depends on the surpluses. For explicit transfers contracts, how the contracts share surpluses is critical to their acceptance. Without contracts, at least one of the parties involved is uncertain about gaining from exchange.

Uncertainty about surplus sharing, then, limits efficient and even equitable transactions. It can exist at either end of a canal, watershed or other axis of trading. In group assurance, it exists for both groups (ecopayments in Mexico in Ref. [12] – while other analyses [13,14] focus on whether downstream users trust upstream suppliers to take costly actions to raise water services downstream (being unable, by design, to compel any behaviors).

Downstream users cannot compel costly upstream supply in our bargaining game, either. Yet they do request, offer to pay for, and verify transfers of ecosystem services. They promise to more than compensate the upstream cost of supply, in order to generate surplus upstream as well. Our core question is whether upstream trusts those promises of compensation from downstream. As an example, if water is transferred to downstream users, upstream suppliers without contracts worry that surpluses will not be shared. Another example is when national actors receive carbon-based financial transfers from global climate-services users, while local conservation of forest is not always compensated. Broadly, when states plus downstream cities push land uses upstream, a supplier's net returns can be uncertain [15–17].

We believe there are many settings in which ecosystem-service transfers between parties involve the issues we highlight above. For example, upstream deforestation in Mexico (Muñoz-Piña et al., 2008 [61]) affects primary forest with high biodiversity, carbon storage and perceived impacts downstream. Disadvantaged rural populations imply tensions between agriculture and conservation, thus ecopayments may balance environmental and social goals better than protected areas. In 2003, CONAFOR, the forest agency, started a national ecopayments program to improve water quality and increase water flows via conservation and reduce upstream poverty [18]. In sites deemed to be important for ecoservices, it offers payments, conditional upon actions believed to raise flows of services (e.g., fencing, preventing illegal logging, collecting garbage, firebreaks, water infiltration ditches, retention walls to prevent soil erosion). A sub-program was started in 2008 to facilitate local agreements between downstream users and upstream land owners. Such local programs have advantages (see Ref. [19], yet the ends of the watershed need to trust each other (see Ref. [12]. For downstream users to invest in an institution, and pay, they need to be confident that upstream suppliers will provide services. For upstream suppliers to build that institution, and supply, they need to be confident of payments. We reflect these issues.

Our novel design also is relevant for natural-resource reallocations driven by shifts in the climate, societal demand or infrastructure. In the Jaguaribe-Metropolitan hydrosystem in Ceará,[7] in Northeast Brazil, a canal from the agricultural Jaguaribe Valley runs to the

[4] Per [42]: "willingness to take some risk … on the expectation that the other will reciprocate".

[5] Ultimatum proposers offers to split a fixed pot. Responders accept or reject, the latter yielding zero for both [43,44]. Ref. [45] reports mean offers of 30–40%, with modal and median offers of 40–50%. Under 20% often is rejected [46]. With unequal productivity, high-payoff proposers offer 50% and can encounter low acceptance if unequal productivity yields conflict about what is fair [47].

[6] There the first mover decides whether to give up sure payoffs for a chance to gain more, with a risk of gaining less. The first mover must trust the more productive actor, similar to the choice that our second movers make: they could refuse the initial proposal to get a certain default or, instead, trust in later sharing. In the original Trust game design, first movers send 50%–65% of their initial endowment. Second movers reciprocate by sending between 30% and 40% of earnings, depending on the conditions (reviews in Refs. [10,48]; and [42].

[7] This is the location of our experiments. As we intentionally selected locations at both ends of the large new canal, our experiments probably are best described as a form of 'artefactual' experiments, selecting from among the four options within [49] typology: mainly students, plus generic framing ('lab'); field populations with generic framing ('artefactual' or for us lab-in field, noting that most participants at our two sites are students), field populations with realistic framing ('framed'); and actual intervention in relevant field populations ('natural').

capital, Fortaleza, where water earns more in industry and tourism than it would in agriculture. We have observed that no explicit process determines water transfers via, or compensation, while local institutional history suggests participatory bargaining [20]. No explicit public commitments exist to provide water, although in 2001 some farmers were compensated for agreeing not to farm during the dry season. Quite explicit, in contrast, is the propaganda stating that everybody in this region would benefit from water transfers to the city via the new canal: the resulting rise in total output and tax revenue might lead to more investment by the state in rural development. Yet without a contract, those who cede water via the canal have to trust that propaganda. Enforced contracts for water transfers do not exist in Ceará. Still, as they are an obvious policy option, inequities due to water-markets contracts are stressed by the Catholic Church [21,22].

Given equity tensions, contracts that explicitly share surplus could reduce concerns about transfers – and, thereby, raise transfers and efficiency (aggregate earnings). Contracts also could raise equity, as explicit statements about sharing can be evaluated, *ex ante*, and enforced, *ex post*. Contracts' actual impacts relative to trust, however, depend greatly on the behaviors under trust.

Our experiments add a step to a bargaining game in order to permit sharing of surpluses. Surplus is generated by transfers of ecosystem services, since the actors differ in their resource productivities. For example, water is transferred from rural agriculture to more profitable urban industry, or cleaner land use upstream has a cost but that is below urban water quality benefits. Within a bargaining setting, each side likely expects to get surplus, as transfers must be agreed. Nobody dictates resource allocations, in reality due to legal restrictions or capacities to protest.

We test three institutions. Two require trust but one does not – both types being common in the set of observed institutions. In 'Trust', a downstream proposer's sharing intentions are not made explicit. Thus, upstream responders accept based solely on downstream resource requests. In 'Message', a written message also states the surplus to be shared later, if a responder accepts. That promise is not enforced. In our 'Contract' institution, the additional message is enforced.

Proposers make requests requiring trust, while responders do trust, both aiding efficiency. Breaking new ground, we find contracts raise efficiency – for two reasons. First, they require a promise. We find that in some conditions, any promise raises transfers of services. Second, the promises are binding. Responders can believe them, raising their impacts on transfers, even if greater inequality in payoffs stokes equity concerns. We also find that contracts increase equity metrics relative to trust-based institutions. Earnings for responders (i.e., lower-payoff upstream suppliers) rise with enforced contracts, as does their lower share of earnings. The frequency of 'relatively equal' earnings rises too, while the fraction of 'relatively exploited' responders falls.

Below, Section 2 describes our experimental sample as well as our experimental design. Section 3 defines efficiency and equity outcomes and then offers hypotheses for the impacts of our treatments. Next Section 4 presents our results, while Section 5 discusses their implications.

2. Sample & design

2.1. Experimental sample

Experiments were conducted in Fortaleza (FZA), which is the capital city of Ceará State, as well as in the Jaguaribe Valley, in the city of Limoeiro do Norte (LDN), with 570 participants in total (302 FZA, 268 LDN). Most (94%) of the participants were students, though the pool did feature one dimension of diversity, in that the students were from rural farming families in LDN but, in contrast, from a very urban setting in FZA. The pool also featured a few university staff, some officers from public institutions and, in LDN, also a few farmers. Table 1 summarizes the participants' characteristics overall and by location. All the experiments were conducted in rooms provided by local universities, while all the recruitment was done entirely by local contacts, who widely advertised the experiments within these two areas. Most sessions had between 20 and 30 participants, with a few under 20. The same researchers facilitated all sessions in both locations.

2.2. Experimental design

Our design builds upon the Ultimatum Game, with different earnings per unit of resource, yet our novel design adds a final surplus-

Table 1
Subject characteristics.

	#obs	Mean FZA	Mean LDN	Mean	Std. Dev.	Min.	Max.
Age (years)	568	22.4	22.6	22.5	4.8	18	54
Gender (male = 1)	570	0.45	0.61	0.52	0.5	0	1
Education (years)	570	15.8	14.5	15.2	1.9	8	18
Catholic (yes = 1)	570	0.54	0.70	0.62	0.48	0	1
Risk Averse (% chose A)	570	0.48	0.58	0.53	0.50	0	1

sharing step in order to decouple equity from efficiency. In Ultimatum, one actor offers a split of resources. The other accepts it, implementing that split, or rejects, yielding default payoffs. In our design, after acceptance, the more productive actor – who proposed the split – has the choice to send back some of the surplus that has been created.

Two randomly paired participants with randomly assigned roles allocate resources (a bag of 10 chips), given randomly assigned relative productivity (P). No matter P, a responder's chips are worth $1. Proposers, though, earn $2 per chip in the 2:1 (P = 2) sessions or $4 in the 4:1 (P = 4).

Our design has three steps: [1] downstream proposers, i.e., users, who earn more per unit, set the agenda by requesting an amount from the total 'resources'; [2] responders, i.e., upstream suppliers of natural-resource or environmental services, either accept that split or reject it – with the latter yielding $R5 for each; and [3] if an upstream responders accepts, the proposer decides whether to send back some earnings (≥0), given that surplus has been generated via acceptance. Efficiency requires that proposers get all the resources, in [1] and [2], before the sharing in [3].

We study three behaviors. First is the request (R) to split the resources: R units go to the proposer, with 10-R for the responder. Second is the responder's acceptance of a request (A = 1), or rejection (A = 0). Finally, if A = 1, we observe the proposer's decision on surplus to share (S). The responder earns ((1-A)5 + A(10-R + S)) while the proposer will earn ((1-A)5 + A(R*P-S)).

We compare the behaviors, and consequent outcomes, across three institutions that were randomly assigned across sessions. In 'Trust', the downstream proposers' sharing intentions are not explicit. Upstream responders accept or not based on the users' resource requests within [1]. In 'Message', a written message also states the surplus to be shared in [3] if a responder accepts. That promise is not enforced. In our 'Contract' institution, that additional message is enforced. Each treatment was carried out in each site (FZA, LDN) and for each of the values of P (2, 4).

In each session, after instructions, we checked understanding with a quiz and clarified all identified confusions. Responders then went to a separate room. Each subject participated in two one-shot games (we report on those played first, as the others explored designs not linked to this paper). Proposers learned the responder decisions at the end of the second game. Identities were hidden throughout. At the end of each session, participants did a risky-choice exercise,[8] as well as a survey to provide socioeconomic information. One game was chosen at random to determine payments that we made in accordance with those decisions. Average earnings were R$10.5, with a maximum of R$40, plus a show-up fee of R$10 to cover costs of transportation to the sessions.

Our experiments were framed neutrally – which was a conscious choice. Given tensions concerning water allocation, in many regions, we wanted to focus on incentives and trust issues. Also, given many types of resources for which contracts are relevant, we wanted general results. Finally, we note that while framing could make a big difference, within our pilot tests it did not.

3. Core outcomes & hypotheses

3.1. *Defining efficiency & equity*

We define efficiency (E) and fairness (F) ratios as functions of the behaviors R (request), A (acceptance) and S (sharing), given P (the productivity ratio). We ask what E and F differences are expected across treatments, leading us to predict how the behaviors vary across institutions.

3.1.1. *Efficiency ratio*

We define 'efficiency' based on realized total earnings: T = (1-A)10 + A(R*P + (10-R)). To compare across productivity ratios, we divide by maximum possible earnings (10P) to get our efficiency ratio E = T/10P. This metric reflects the outcomes of both acceptances and rejections. Maximum efficiency (E = 1) requires accepting R = 10, i.e., all chips to the more productive actor. That does not constrain sharing (S), which does not affect efficiency. Yet a critical tension arises immediately because higher requests R raise efficiency but make acceptances less likely, at least if sharing is uncertain. Rejection yields $5 earned each, or $10 total, far less efficient than $10*P.

Efficiency (E) determinants R, A, and P are the same as in asymmetric-productivity UG. There, though, efficiency implies maximum inequity. In our game, in contrast, sharing (S) allows both actors to embrace efficient outcomes. Thus, there is reason to expect efficiency in our game.

3.1.2. *Fairness ratio*

We show results for many equity metrics, including fraction of cases with equal earnings and the count of 'exploited' responders (some earn zero). For our main equity metric, we employ a fairness ratio (F) of responder's earnings ((1-A)5 + A(10-R + S)) divided by proposer's earnings ((1-A)5 + A(R*P-S)). F equals zero if a responder earns zero, i.e., proposer requests all the chips then, after acceptance, shares zero (efficiency would still be perfect (E = 1)). F rarely exceeds one. Rejections yield equal earnings, i.e., perfect fairness (F = 1). That clearly can motivate rejections.

Not surprisingly, the determinants of equity are the two 'transfers', one in each direction: the 1st is the concession of resources (R) to the more productive actor by an accepting responder; and the 2nd is the sharing of surplus (S) from the more productive actor, if any surplus is shared.

[8] Our risk-aversion measure is from a risky-choice task like the one designed by Ref. [50]. At the end of the experiment, each participant chose between A, which yielded R$10 for sure, and B, a lottery with a 10% chance of R$0, a 20% chance of R$5, a 40% chance of R$10, a 20% chance of R$15, and a 10% chance of R$20. Note that B's expected value equals A's. We randomly selected one person and paid out according to her decisions.

3.2. Institutional hypotheses

We do not believe there are theoretical predictions for efficiency or equity for any pair of participants or even for the averages. We expect significant preference heterogeneities among the individuals in their: aversion to risk; aversion to inequity; and, generally, other-regarding views. We can, though, predict average differences in outcomes across randomly assigned institutions, starting by predicting average differences in the key behaviors of interest across our treatments.

The key difference between our institutions is information responders have on proposers. Our three institutions offer proposers the same information about responders, but not vice versa. In our trust-based institutions, responders must form expectations about sharing (S) by proposers. Expectations surely will respond to requests (R), which can affect beliefs about proposers' types. Surely they also might respond to sharing promises or messages (M). However, that might not be the case in Message, where the promises are not binding (i.e., messages could be lies in the sense that actual sharing could be less than was promised, i.e., S < M) – unlike in an enforced contract. Within our Contract institution, if a responder accepts she can be certain about sharing (S = M).

3.2.1. Acceptances

Our first hypothesis (H1) is that in Trust, i.e., without any messages at all on sharing (S), acceptance should fall as the request (R) rises. It is possible that a responder will read a high R as signaling higher sharing after acceptance. However, explicit sharing messages seem more likely to shape expectations of sharing, in particular for Contract, where that message is binding. Thus, our second hypothesis (H2) is that for any request (R), acceptance should rise with message (M) because a message may be perceived as informative, even when there is a chance that it is a lie[9]; and our third (H3) is that acceptance will rise with message (M) more in Contract than Message.

Beyond one's expected earnings, a different motivation for acceptance is a concern about fairness or equity. For any given request (R) and sharing (S), equity is very likely to be lower for 4:1 than for 2:1 because the asymmetry in the earnings per unit of resources is even greater. That can be addressed by a sharing message (M), in particular within an enforced contract. Thus, our fourth hypothesis (H4) is that, for given request (R) and message (M), 4:1 will lower acceptance; and our fifth hypothesis (H5) is that, relative to Trust, Contract fares better in 4:1 than Message.

3.2.2. Requests

When considering whether to raise their requests – and, thereby, their own earnings if a request is accepted – proposers must keep in mind the effects of higher requests on acceptances. Thus, we can generate hypotheses for the requests based upon our hypotheses about acceptances. Our sixth hypothesis (H6) is that, since messages are perceived as informative, requests will rise with the message. This is not a causal prediction but instead describes a proposer's strategy, e.g., belief that if she sends a higher message (M), then her request (R) is more likely to be accepted. Further, following the above, our seventh hypothesis (H7) is that requests are higher in Contract.

3.2.3. Sharing

The third behavior for which we have predictions is the sharing (S), after any acceptance. Again, we do not have any basis for predicting the average level of sharing in any one institution. However, we can ask if sharing might be higher in Message, in which there is a sharing message, although it is not binding and from prior studies we know that such messages could be lies. Thus, while it could be that sharing – e.g., as a fraction of requests – will be higher in Message, we do not believe there is a clear hypothesis. In contrast, in our Contract institution the sharing message not only is required up front, i.e., is evaluated by the responder, but also is binding. Thereby, our eighth hypothesis (H8) is that Contract raises the amount of sharing (S) for any given request (R) relative to our Trust institution, which has no sharing message to be evaluated by the responders.

3.2.4. Efficiency

Acceptances raise efficiency, in that they allow some growth, relative to default payoffs (which sum to the number of chips). Thus, as per above, the sharing messages (M) could help in efficiency, relative to Trust, and confidence in the sharing message in Contract could help more. Yet proposers may exploit the lower perceived uncertainty due to a message by asking for more, i.e., higher R in Message and Contract. That raises efficiency unless it lowers acceptance rates – in particular in 4:1, if there are significant equity concerns, which apply especially for Message. Thus, our ninth hypothesis (H9) is that Contract raises efficiency, at least relative to Trust; and our tenth hypothesis (H10) is that 4:1 will reduce efficiency less for Contract than for Message.

3.2.5. Equity

Greater sharing (S) for a given request (R) raises equity. Rejections raise equity too, as in the default proposers and responders get the same earnings – which otherwise is rarely achieved. That equality of defaults has a particular equity implication in our game. The very success of the contracts predicted above for raising efficiency, via acceptance, could push downward on equity, countering the effect upon equity of another predicted success from contracts, in raising sharing. Reasoning similarly, albeit in reverse, our Message institution may lower equity if the existence of a promise raises acceptance but that is followed by actual sharing which is considerably lower than promised. On the other hand, if the risk of that outcome leads to rejections, it raises equity.

[9] Concerning written communication [51], report written promises raise cooperation to 12%–30% in social dilemmas. Ref. [52] find that free-form 'promises' raise trustworthy behavior. Ref. [53] find that communications raise trust and, in turn, trustworthiness. Yet [54]; in comparing enforced contracts with an unenforced "bonus", find lying for the latter. Enforcement helps. Ref. [55] find agents are unhappy when not trusted yet respond to trust by not choosing high effort levels.

Table 2
Descriptive Statistics: behaviors, efficiency (ratio E) and equity (including ratio F).

	ALL OBSERVATIONS						ACCEPTED OBSERVATIONS						
	#	(1)	(2)	(3)	(4)	(5)		(6)	(7)	(8)	(9)	(10)	(11)
		Accept Rate (A = 1)	Request Level (R)	Message Level (M)	Effic. Ratio (E)[a]	Fair. Ratio (F)[b]	#	Request Level (R)	Message Level (M)	Sharing Level (S)	Fair. Ratio (F)[b]	Min. of Earn	% Equal Earn
2:1 Trust	44	70%	6.57	–	0.71	0.82	31	5.87	–	2.45	0.74	4	26%
2:1 Message	42	88%	7.09	4.00	0.81	0.65	37	6.97	3.91	2.84	0.61	0	11%
2:1 Message (Offer ≥ 5)	39	90%	6.97	4.13	0.81	0.67	35	6.88	4.02	2.97	0.63	0	11%
2:1 Message (Offer ≥ 5 & Request = 10)	6	83%	10	7.7	0.92	0.61	5	10	8	6	0.53	0	40%
2:1 Contract	52	69%	8.27	5.21	0.77	0.88	36	7.97	5.94	5.94	0.83	5	36%
2:1 Contract (Offer ≥ 5)	41	88%	8.15	6.07	0.85	0.85	36	7.97	5.94	5.94	0.83	5	36%
2:1 Contract (Offer ≥ 5 & Request = 10)	20	85%	10	9.10	0.93	0.89	17	10	9.11	9.11	0.88	6	33%
4:1 Trust	44	86%	6.61	–	0.65	0.59	38	6.13	–	4.79	0.52	0	13%
4:1 Message	49	73%	6.90	8.26	0.60	0.65	36	6.36	8.36	5.92	0.52	4	11%
4:1 Message (Offer ≥ 5)	48	75%	6.85	8.39	0.61	0.64	36	6.36	8.36	5.92	0.52	4	11%
4:1 Message (Offer ≥ 5 & Request = 10)	8	62%	10	16	0.72	0.84	5	10	16.6	16.2	0.74	10	60%
4:1 Contract	54	80%	7.83	8.96	0.72	0.71	43	7.84	10.12	10.12	0.63	5	28%
4:1 Contract (Offer ≥ 5)	52	83%	7.83	9.23	0.74	0.70	43	7.84	10.12	10.12	0.63	5	28%
4:1 Contract (Offer ≥ 5 & Request = 10)	16	94%	10	15.5	0.95	0.73	15	10	16	16	0.72	10	16%

[a] Recall, the efficiency ratio (E) = total earnings realized by the pair of participants divided by the total potential earnings.
[b] Recall, the fairness ratio (F) = the earnings realized by the responder divided by the earnings realized by the proposer.

In sum, as noted above, impacts of contracts versus trust depend on behaviors under trust. Should responders trust in Message, that would raise efficiency, yet it could well reduce equity. At some intermediate level of trust, it could be that contracts would raise efficiency and equity.

4. Results

Table 2 presents descriptive statistics for all treatments and some particular subsets of the observations – e.g., when all of the chips are requested, which if accepted maximizes efficiency. For a 2:1 productivity ratio, we had 44 pairs in the Trust treatment, 42 in Message treatment and 52 in Contract treatment. For a 4:1 ratio we had 44, 49, and 54 pairs for those same treatments.

Table 2 provides data for all observations, in five columns to the left, and for only all the accepted observations, in six columns to the right. Columns present behavioral metrics relevant for efficiency, equity or both. Below, concerning all of the hypotheses (H1-H10) laid out above, we report Table 2's descriptive statistics and regression analyses from Tables 3–5. Table 3 reports Logit and OLS models for responder acceptances (1a, 1b) and proposer requests (2a, 2b). Table 4 reports OLS models for a sharing-request ratio (1a, 1b) and responder earnings (2a, 2b). Table 5 reports OLS models for an efficiency indicator, i.e. total over possible earnings (1), and an equity indicator, i.e., responder over proposer earnings (2a-2c). In all, we have dummies for institutional and 4:1-productivity treatments, plus controls for the participants' characteristics.[10]

4.1. *Behaviors (acceptances, requests, sharing)*

4.1.1. *Acceptances*

For H1 – *in Trust, acceptance will fall as requests rise* – averages by treatment in Table 2 cannot say much. Table 3 Model 1a, though, offers support. In this model, the omitted treatment is Trust, thereby the Request coefficient provides the desired test. It is negative and significant.

For H2 – *acceptance will rise with any message* – we can look at Table 2's column (1) at the differences in acceptance across the rows (and in particular the upper rows, since we consider 4:1 separately below). For 2:1, it is clear that on average, treatments with messages have higher rates of acceptance. What Table 2 cannot tell us is the role of the sizes of individuals' requests.

[10] We also test for effects of site and non-student participant. We find no significant effects or shifts in other results.

Table 3
Regressions for acceptances & requests.

	(1a) Logit	(1b) Logit	(2a) OLS	(2b) OLS
	Acceptance	Acceptance	Request	Request
Treatment = Contract	−3.886**	1.446	1.606***	0.787***
	(1.897)	(2.541)	(0.421)	(0.219)
Treatment = Message	−0.402	default	0.466	default
	(2.038)		(0.441)	
Treatment = Trust	default	dropped	default	dropped
Request	−0.741***	−0.844***	–	–
	(0.190)	(0.225)		
Request* Contract	0.578**	−0.580	–	–
	(0.231)	(0.374)		
Request* Message	0.258	default	–	–
	(0.249)			
Promise	–	0.209**	–	0.258***
		(0.0830)		(0.0238)
Promise * Contract	–	0.605***	–	
		(0.174)		
Productivity Ratio 4:1	1.657**	−1.868***	0.0347	−1.304***
	(0.717)	(0.532)	(0.431)	(0.238)
Productivity4* Contract	−1.191		−0.336	
	(0.864)		(0.587)	
Productivity4* Message	−2.821***	default	−0.147	default
	(0.943)		(0.610)	
*				
constant	5.381**	7.388***	8.752***	7.217***
	(2.098)	(2.653)	(1.254)	(1.134)
#obs	283	195	285	197
R2			0.123	0.455

Standard errors are presented in parentheses & * = $p < 0.1$, ** = $p < 0.05$, *** = $p < 0.01$.
*Controls for Age, Gender, Education, Risk Averse and Catholic are included but not reported here.
Responder characteristics are included in 1a, 1b with proposer characteristics in 2a,2b.

That can be learned in Table 3. In its Model 1a, we cannot control for the message's size (as there are no messages in Trust). We can see that the interaction effects between the requests and the treatments that include messages are positive, though, and significantly so for Contract. Moving to Model 1b, which also uses acceptances as dependent variable but considers solely the Message and Contract institutions (with the former omitted), the message – called Promise here to distinguish it from a Message treatment – has a positive and significant effect on acceptances. That supports H2. Further, H3 – *acceptances will rise with the message more in Contract than in Message* – is clearly supported by a positive interaction of Promise with the Contract treatment.

For H4 – *given request and message, 4:1 will lower acceptance* – we start with statistics from Table 2. They are ambiguous, as some treatments rise and some fall in acceptances for 4:1. Table 3 is not ambiguous, however. Lacking a message, in Trust, responders clearly expect more sharing in 4:1. Thus acceptances rise for a given request. If there exists any sharing message (M), then effectively “the offer” (we call it O equaling 10 - R + M) has been offered to the responder. Once R and M are fixed, and thus so is the offer (O), 4:1 lowers acceptance in Model 1b, where 4:1 is negative on average for treatments with messages – versus the positive in (1a), for Trust. Within Table 3 Model 1a we can also see support for H5 – *Contract fares better in 4:1 than does Message* – in that the 4:1 interaction with Contract is over twice as large and also is significant.

4.1.2. Requests

For H6 – *proposers will raise the requests and messages together* – comparing Table 2's columns 2 and 3 supports this hypothesis based on average differences by treatment (and subset). Further, Table 3 Model 2b, which uses requests as the dependent variable, provides a direct test for the treatments that involve messages. The coefficient on the Promise is both significant and positive, supporting H6. Table 3 Model 2b also supports H7 – *Contract requests will be higher* – and thus the importance of binding promises that the proposers know the responders can believe. Table 3's Model 2a essentially blends H6 with H7, since the Trust treatment is included, so that the Promise variable is dropped and thus its effects are included in the effects of the institutions.[11]

[11] Based on all our controls (simply listed in Table 3), the only significance is that risk-averse proposers ask for less. That is intuitive as is an additional small result that the Contract treatment eliminates the effect of this characteristic. From field experiments in Peru [56], suggests trust in ‘investment’ games measures propensity to gamble. Ref. [57] report a positive correlation of risk attitudes with trust if a ‘social value orientations measure’ [58] is neither strongly pro-social nor strongly pro-self. Ref. [59] say participants “are much more willing to take risk when the outcome is due to chance than when it depends on whether another player proves trustworthy”. Ref. [50] explore trust and risk and find that no risk measure correlates with trust: “subjects do not think of trust decisions and financial gambles as similar” (p. 464). Ref. [60] find no link between individual risk-aversion and the trust that is expressed by responders.

Table 4
Regressions for surplus sharing & Responder's earnings.

	(1a) *OLS*	*(1b)* *OLS*	*(2a)* *OLS*	*(2b)* *OLS*
	Sharing (S) /Request	Sharing (S) /Request	Responders' $ Earnings	Responders' $ Earnings
	2:1	4:1	2:1	4:1
Treatment = Message	0.029	0.071	−1.011**	1.160
	(0.078)	(0.140)	(0.495)	(1.158)
Treatment = Contract	0.321***	0.520***	1.207**	3.523***
	(0.080)	(0.951)	(0.511)	(1.044)
*				
constant	0.433	1.173	7.694***	6.434
	(0.283)	(0.662)	(2.337)	(6.432)
#obs	104	117	103	117
R2	0.244	0.203	0.245	0.202

Standard errors are presented in parentheses & * = p < 0.1, ** = p < 0.05, *** = p < 0.01.
* Controls for Age, Gender, Education, Risk Averse and Catholic are included but not reported here.
Proposer characteristics are included in 1a, 1b with both proposer and responder characteristics in 2a, 2b.

Table 5
Regressions for efficiency (E) & equity (F).

	(1) OLS	(2a) OLS	(2b) OLS	(2c) OLS
	Efficiency (E) *{all observations}*	Equity (F) *{accepted obs.}*	Equity (F) *{all observations}*	Equity (F) *{all observations}*
Treatment = Message	0.106**	−0.0752	−0.0524	−0.186***
	(0.0484)	(0.0531)	(0.0473)	(0.0666)
Message x P.Ratio 4:1	−0.158**	–	–	0.259***
	(0.0674)			(0.0929)
Treatment = Contract	0.0920**	0.102**	0.0897**	0.0677
	(0.0467)	(0.0510)	(0.0453)	(0.0643)
Contract x P.Ratio 4:1	−0.0207			0.0509
	(0.0649)	–	–	(0.0894)
Productivity Ratio 4:1	−0.0448	−0.170***	−0.136***	−0.234***
	(0.0475)	(0.0412)	(0.0370)	(0.0654)
*				
constant	0.626***	0.721***	0.937***	0.979***
	(0.177)	(0.269)	(0.241)	(0.244)
#obs	283	220	283	283
R2	0.119	0.138	0.098	0.127

Standard errors are in parentheses & *** = p < 0.01 ** = p < 0.05 * = p < 0.1.
*: Controls for Age, Gender, Education, Risk Averse and Catholic are included but not reported here.
For both proposers and responders in all models.

4.1.3. Sharing

For H8 – *Contract raises sharing relative to Trust (and Message if messages are lies)* – again we can start with the descriptive statistics within Table 2. Actual sharing is in column (8), for the accepted observations. For 2:1, the sharing in Message is just above the sharing in Trust (2.84 versus 2.45), while sharing in Contract (5.94) is about twice as high. The promises in the written messages were not as different across institutions though – as seen in column (7) – which implies that written promises in Message includes lies, as seen in comparing columns (7) and (8). Further, this story holds for 4:1 sessions, as seen in the same comparisons but for the lower rows.

We also find support for H8 in our regressions. Consider Table 4 Model 1a for 2:1,[12] with sharing per request as dependent variable (Model 1b is 4:1). Insignificance in the top row shows no effect of Message relative to Trust, while the second row conveys significantly higher sharing in Contract. These coefficients are increases in sharing-to-request ratios and are significant gains. Finally, heading into equity, Table 4's Models 2a and 2b show that the sharing behaviors imply higher earnings in the Contract treatment for the responders, i.e., those who generally earn less.

[12] Table 4 is for accepted offers only. Since responders accept then proposers share and pairs are randomly assigned, accepted cases – when sharing is observed – do not imply bias. For any given level of request, proposers assigned to the types of responders willing to accept such a request should not differ from those proposers who were rejected.

4.1.4. Behaviors suggesting confusion?

In Message and Contract, responders receive a sharing promise (M) and know what they are being offered (10 – R + M). Yet Table 2 shows offers lower than the default that a responder earns by rejecting. Those low offers do not seem like rational behaviors on the part of proposers. Instead of arbitrarily dropping observations, our tables feature results using all the observations but we check that the effects of dropping the few 'irrationally low' offers were inconsequential.

4.2. Efficiency

Recall that our H9 was that Contract will raise efficiency, at least relative to Trust, while our last hypothesis, H10, is that 4:1 (P = 4) will reduce efficiency less for Contract than Message. Both of these hypotheses are supported by the evidence within our statistics and our regressions.

4.2.1. Statistics

With respect to efficiency, particularly striking in Table 2, and fully rational in Contract, are acceptances of requests for all 10 chips. That is maximally efficient and occurs for Contract more than for our trust-based institutions. As to why such requests can be acceptable, Table 2's column (3) shows that promises for Contract are higher. Also, of course, they are more credible.

Table 2's column (4) presents averages for our efficiency ratio (E), i.e., the total earnings divided by the maximum potential earning, i.e., total earnings when a request for ten is accepted. Contract and Message are similar in 2:1 ($p = 0.22$)[13] with each of them being above Trust ($p = 0.00$, noting that these tests are for the rows that make use of all of the observations). In 4:1, Message's efficiency is no longer above Trust ($p = 0.41$) while Contract is above them both ($p = 0.04$ in Trust, $p = 0.01$ in Message). Fig. 1 shows full distributions for E for each institution, blending 2:1 and 4:1, with some clear difference in the frequencies of the low efficiencies. For instance, Contract has fewer observations than Trust with $E \leq 0.5$ (16% versus 27% which is significant ($p = 0.07$)). However, it is the frequencies of the higher efficiency ratios that most separate these institutions. For E above 0.66 or 0.75 or 0.90, Contract's fraction of observations is significantly higher than both trust-based institutions ($p = 0.00$ for five of the six comparisons; $p = 0.02$ for the other test).

4.2.2. Regressions

Table 5's Model 1 summarizes our main results for the impacts of institutional treatments on our efficiency ratio (total over maximum possible earnings), which is the dependent variable. We note that sociodemographic characteristics of proposers, and responders, are not significant. Significant coefficients show impacts of Message and Contract, relative to the Trust institution.

The coefficient for Message is positive and is significant, consistent with Table 2. Thus, even though the sharing promises in Message are non-binding, still they may induce efficiency since responders may interpret them as informative and, thereby, increase efficient acceptance. Yet also consistent with Table 2, the interaction of Message with 4:1 is negative and significant. Thus, there is an efficiency gain from Message relative to Trust for 2:1, yet no such gain for 4:1. This lower efficiency gain from non-binding promises in 4:1 is consistent with equity concerns driving the lowered acceptance for any given request in Table 3, which drives down efficiency.

The coefficient for Contract also is positive and significant. While its magnitude is below the effect for the Message institution, statistically they are not different at a 10% level ($p = 0.77$). The big difference between those institutions is in their interactions with a 4:1 productivity ratio. For Contract, that is not significant. Thus, binding promises in Contracts always raise efficiency. Put another way, that sharing is enforced in Contracts appears to lower the concern about equity.

4.3. Equity

Recall that we did not have equity hypotheses. We hypothesized and found that Contract raises sharing per unit request. That raises equity. We also hypothesized and found that Contract raises acceptance. That increases efficiency but it reduces equity, as rejections' payoffs are equal. Putting these together, we can still hypothesize that Contract raises equity in the accepted cases.

4.3.1. Statistics

Table 2's columns (5) and (9) shows a fairness ratio (F), with values in the 0.5–0.9 range, for all observations in (5) and accepted observations in (9) – noting that rejections raise fairness. Interpreting this fairness ratio (F) is easier given some benchmarks: a 60-40% split of earnings, as is typical of UG, implies $F = 0.66$; and splitting resources equally, as is typical in asymmetric productivity UG, yields fairness values inverse to productivity ($F = 0.5$ for 2:1 and 0.25 for 4:1).

Contracts raise the fairness (F) indicator overall and for accepted observations, especially versus Message. In Message, some promises are lies ($M > S$), which cannot happen in Contracts. Comparing Table 2's top (2:1) and bottom (4:1) halves suggests that a 4:1 productivity lowers F. The surplus sharing in the final step appears to rise less than proportionately with total earnings.

4.3.1.1. Equal and relatively equitable earnings. Another equity metric is how often the earnings are equal. In Table 2, within column (11), in all cases Contract's fractions are clearly above, e.g., the average of the trust-based institutions. For 2:1 or 4:1, Contract's fraction of cases of equality is on the order of double the trust average. Table 2 also shows this equity result is robust within the set of cases of

[13] If it is not noted otherwise, all p-values reported in this Results section are from t-tests of the equality of means. Some conclusions are consistent with such tests, then supported by regressions, while others require regressions.

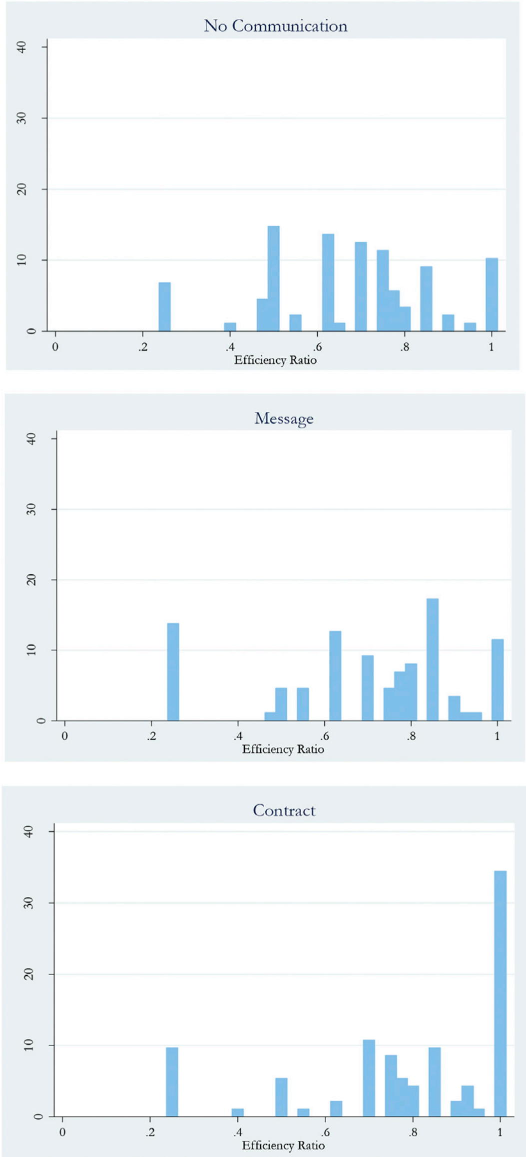

Fig. 1. Efficiency ratio (E) by treatment.

requests for all 10 chips; thus, equity is not explained by timidity of proposers – efficiency and equity both can be maximal. Comparing Trust with Message on this metric for 2:1, Messages yield only half as many cases of equality as in Trust. However, in 4:1 Trust's cases of equality fall to Message's level ($p = 0.78$).

Less extreme metrics, albeit still indicating the high end for equity, also support Contract. As suggested visually in Fig. 2, Contract has 56% of cases with F above two-thirds and 45% above three-quarters, well above the trust-based average of 44% having F above two-thirds with 30% above three-quarters (two-sample proportions tests find $p = 0.04$ and $p = 0.01$ respectively).

4.3.1.2. Zero and relatively inequitable earnings. We also consider worst-off responders. For the Trust and Message institutions, Table 2's column (10) reveals that some responders earned zero: they let a proposer have all the resources, then got zero funds back. Trust can be exploited. In Contract, responder earnings are never lower than the default earned from rejection. Exploitation of trust is more than responders getting zero, though. For all cases, 2:1 and 4:1, Contract has 26% with F under one-half and only 6% with F under one-third, well below the others' average of 45% under one-half and 21% under one-third (two-sample proportions tests yield $p = 0.01$ for under one-half and $p = 0.00$ for under one-third).

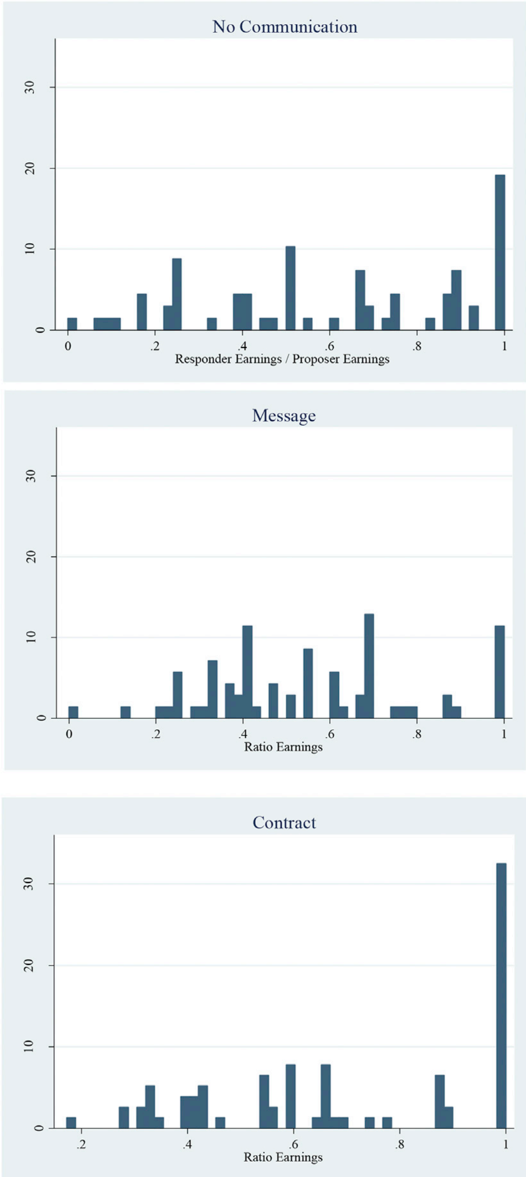

Fig. 2. Fairness ratio (F) by treatment.

Exploitation of trust also is implied by lies in Message, a weakness of implicit contracts. In more than forty percent of the observations in the Message institution, the sharing message is greater than the actual funds sharing – and that holds for both the 2:1 and 4:1 productivity ratios. Further, that is not just for larger requests. Lying occurs for almost every level of initial request.

4.3.2. Regressions

Table 5's Models 2a-2c summarize our results for the equity impacts of these institutions, again controlling for proposers' and responders' characteristics that in general are not significant. Models 2a and 2b employ the same specification, for accepted cases then for all observations. Contracts raise equity versus Trust, while Messages might lower it (the latter is not significant).

Table 5's Model 2c is helpful to further consider Message's effects upon equity, in that it includes the treatments interacted with the productivity ratio. That matters for Message results.[14] For 2:1, Message does considerably worse for equity than does the Trust

[14] We suspect that with more data, our Contract institution would still have significant effects with the interactions – and what the (2c) coefficients suggest makes sense, i.e., that binding promises can do better with more resources. With limited observations, estimating the interaction term raises standard errors with consequences for significance. Interactions for only accepted cases (less data) yield the same for Messages and higher standard errors for Contracts.

institution: non-binding sharing promises, which may well be lies, apparently can lure responders into unrequited trust. However, an interaction term shows the difference for those treatments vanishes for the 4:1 case.

As to why 4:1 gets Message's equity back in line with Trust, we find responder earnings rise in 4:1 in all treatments but less in Trust. Further, rejection for equity in 4:1 bolsters equity in Message (while lowering efficiency). We emphasize higher equity in Contract – overall or for accepted cases (Contract > Message ($p = 0.00$)). This indicates that uncertainty about sharing in trust-based institutions leads responders to accept proposals they would reject if fully spelled out.

5. Discussion

Given significant debate on institutions for natural resource allocation and management of the environment, and limits on the evidence from comparisons of observed institutions, we examined efficiency and equity consequences of enforcing compensation promises in contracts for voluntary transfers of ecosystem services, relative to the lack of binding promises under trust. We used decision experiments in Northeast Brazil, with populations at the ends of a large canal. While trust outperforms neoclassical predictions for efficiency (total earnings), as expected, we show efficiency is limited by concern about equity, while enforced contracts improve them both.

Contracts with binding compensation promises significantly raised all measures of equity. That is because the participants trusted. They took risks by making transfers that were efficient but created vulnerabilities. Under trust, transfers to higher payoffs were not rewarded with much surplus. Thus, contracts offered protection to upstream suppliers by enforcing promised sharing. This adds to literature about natural resources and development [23,24], while providing a new game that extends Ultimatum and Trust games.

Beyond specific contexts, our results inform possible institutional adjustments for many transfers of ecosystem services – which could support aggregate development, yet are limited by equity concerns. Contracts as we model them describe regional or individual resource rights or, instead, slots in a resource queue [25]. As [26] suggests, local parties can contract creatively to reflect relevant all local knowledge. That point can be applied globally.

For instance, among a growing suite of ecopayments programs, many involve quality and quantity dimensions of hydroservices that can be transferred downstream, or not. Our results are relevant for water reallocations with varied motivations, including adaptation to shifts in climate. The basic logic of these contracts, formal or informal, very much fits what we have studied here: upstream actors incur costs for various types of activities that improve on contracted dimensions, generating benefit downstream that is greater than costs incurred to provide ecosystem services. Often, it is high-payoff actors downstream who initiate exchanges by requesting improvements, e.g., suggesting transfers. Sometimes such suggestions are couched within power relationships (economic, political or violent) that lower upstream returns or raise uncertainties about returns. While not every setting is focused on upstream welfare, results suggest that when contracting can make upstream surplus explicit and enforced, more upstream actors will join in such programs.

Broadening across topics, voluntary exchanges involving upstream forest management can assist within climate mitigation. This could be on top of local transfers, e.g., in 'stacking': if upstream land uses raise local water quality while lowering global emissions, upstream suppliers can sell water and carbon to different markets, receiving higher payment based on two sources [12] note that this can raise efficiency and environmental quality for ecopayments). Such links to 'the broader downstream' exist for Mexico [27], as federal actors have facilitated local actors' interactions with carbon demand outside of Mexico.

When upstream ecoservices suppliers interact with a powerful downstream user demand, however, it is not always clear that the interventions of federal actors help to raise local returns or lower their uncertainty. Within the Brazilian Amazon, for instance, smallholder uses of land in forests affect local water quality and global carbon storage. The Amazon Fund – with significant Norwegian funding – has offered a form of 'carbon transfer', seemingly conditioned on forests, yet national politics currently may not prioritize upstream gains from costly conservation actions. Yet past significant federal actions rewarded standing forest, e.g., with credit availability, while state programs (such as Bolsa Floresta) have engaged forest smallholders to maintain forest. Our results suggest that more clarity about local returns can raise equity plus efficient carbon storage.

Our design could be extended. Bargaining often is characterized by repeated interactions, which affect efficiency and equity due to punishment of prior unfair behavior, although whether that leads to efficient cooperation remains an empirical matter. Our contracts also were costless and perfectly enforced. The importance of institutions to manage resources and externalities, and the significance of the challenges for establishing contracts in many relevant contexts, including developing frontiers, motivate both applications and various relevant extensions of these results.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.wre.2018.04.001.

APPENDIX – SAMPLE OF INSTRUCTIONS

General

We want to thank you all for accepting our invitation to participate in these research exercises. Before we begin, I will give to each of you 10R to cover your transportation costs (*give*). Now, with that taken care of, I'd like to make some comments about what we will be doing today.[15]

These exercises are part of a scientific research project conducted by Brazilian and international researchers with international research funding and the support of both local and international universities. We have three researchers helping with the exercises: XXX.

Our objective is to understand how people make decisions. We will learn from what you decide. Please note that all of the decisions you make during these exercises, and any other information you communicate to us, will remain confidential. The only people who will see that information are the project researchers and we will not divulge your individual information to anybody.

You could earn money. How much depends on your decisions and also the decisions of others. We do not know how much you will earn but it will be between R$5 and R$40. We pay you to make these exercises more like real situations in which your decisions earn or cost you money. Any money you win in these exercises is yours to keep. Nobody will know what you earned.

These exercises may be different from other exercises in which members of your community might have participated in the past. Therefore, any comment that you might have heard about the exercises may well not be relevant to the exercises in which you will participate today.

We want to emphasize that your participation is voluntary. You are free to leave at any time. However, to get paid you will need to stay until the end of the exercises. Today's exercises may take two to 3 h. If you think you will not able to stay that long, please let us know now.

Again, at any point you can choose to leave. These exercises involve no risk to you. They are likely to provide benefits, specifically the earnings you can keep. **Are you willing to participate?**

(If end up with an odd number of people, randomly choose one to leave)

We will now explain you how to participate. Please pay a lot of attention to the instructions. We will explain how your decisions affect what you earn. If you understand the instructions, you will be able to make better decisions during the exercises. Please, remain seated and do not speak with other participants. If you have a question, raise your hand. We will answer questions in private.

If anybody talks about the exercise with others in the group we won't be able to continue today. Please, everybody, be sure to follow this rule since is possible for one person to spoil the game.

(MODERATOR: pause here and ask if that is clear?)

You will each participate in 2 different exercises. At the end of both exercises we will select one exercise and pay everybody what they earned based on their decisions in that exercise. The exercise will be selected at the end by blindly choosing one of these envelopes in front of all the participants *(show two envelopes)*. If number 1 is selected, then exercise number 1 will determine your payments. If number 2 is selected, then exercise number 2 will determine your payments.

In each exercise, you are matched with somebody to make a pair. In each exercise we will randomly determine the pair. Your earnings will be affected only by you and other person in your pair. You will not know who it is your pair. The researchers do know but they will never tell anyone. Today we have XX pairs participating at the same time.

Each pair is made up of a **Participant A** and a **Participant B**. You will be the same type (A or B) in each exercise. Your type (A or B) will be determined by the letter you select from this envelope. Together with your type, you will receive an identification number. (*DO: type letter & ID number on the paper they select-explain the papers*).

Now let me explain the first exercise. The first exercise has 2 steps. And the general idea is the following:

In the first step, each pair has a bag of 10 chips. Participant A decides how many chips to ask for and offers what is left in the bag to Participant B. Then Participant B rejects or accepts this offer. That completes the decisions in the first step.

If Participant B rejected the offer, then both participants get 5 REAIS each, and the exercise is over. In this case, there won't be

[15] These are instructions for the Message treatment (a 2:1 productivity ratio). Note that for the Trust treatment, the responders had to accept without any promise at all, while in Contract the responder knew promises were binding.

a second step at all.

If Participant B accepted the offer, then Participant A gets the chips he asked for and Participant B gets the rest of the chips in the bag. In this case, a second step takes place with another decision only by Participant A.

If Participant B accepted the offer, a second step occurs and chips are converted to REAIS. Then, Participant A has to choose how many REAIS he wants to send to Participant B from the REAIS that he earned from the division of the chips. This could be some, all or none of the REAIS earned from the chips received in the first step. After Participant A has made this decision, the exercise is over. Participant B doesn't have to make a decision in the second step.

As I said before, chips are converted to REAIS if the second step occurs. Importantly, any chip will earn more for Participant A than for Participant B. For Participant A, each chip is equivalent to 2 REAIS. For Participant B, each chip is equivalent 1 real.

Any questions?. Now, let me explain in detail the exercise.

I will start with the first step.

In the first step, we will not use real chips but imagine a bag with chips like this one (*show bag w/stuff*). The bag has 10 chips.

In the first step, in each pair, Participant A must decide how many chips to ask for and offer what is left in the bag to Participant B. Since the most possible chips in the bag are 10, Participant A must ask for any whole number no lower than 0 and no higher than 10.

A the same time with the offer, Participant A must send a message to Participant B stating how many reais he is planning to send to Participant B in the second step. Participant A could state that he will send some, all or none of the reais earnings from the chips he received in the first step.

Recall, that any chip will earn more for Participant A than for Participant B. For Participant A, each chip is equivalent to 2 REAIS. For Participant B, each chip is equivalent 1 real.

However, the transfer stated in the message won't be enforced, that is, Participant A could change his mind in the second step without consequences.

To communicate his offer, Participant A will fill a format similar to this poster (*show poster*) and will make a circle around the offer for Participant B in a sheet similar to this poster. He will also fill a message format like this one:

If Participant B accepts the offer, I will send him _____ reais in the second step.

Remember that the message won't be enforced, that is, Participant A could change his mind in the second step without consequences. For example, if Participant A writes 2R in the message format, Participant A could choose in the second step to send the exact 2R, more, or less. The final transfer will be subtracted from Participant A earnings.

After Participant A has made his decisions about what to ask for and what message to send about a future transfer, Participant B then accepts or rejects the bag minus what Participant A asks for. That is, Participant B must write an X in accept or reject to respond to for Participant A's offer, in a sheet similar to this poster. Sheets will be given to all Participants B.

For example:

Example 1:

If participant A offers the bag minus 8 chips and send a message about a future transfer, Participant B decides if he wants to accept or reject this offer. If accepts, writes X in Accept; and if rejects writes an X in Rejects.

If participant A offers the bag minus 3 chips and send a message about a future transfer, Participant B decides if he wants to accept or reject this offer. If accepts, writes X in Accept; and if rejects writes an X in Rejects.

(show table poster)

After all Participant Bs have made their decision for the first step, we will check if the offer made by Participant A was accepted or rejected by Participant B.

If Participant B rejected the offer made by Participant A, both participants get 5 reais each and the game is over.

If Participant B accepted the offer, then Participant A will get the chips that he asked for and Participant B will get the chips that remain in the bag. In this case, a second step takes place.

I will explain the second step in a moment, but for now, let me give you some examples for the first step, given that the bag has 10 chips *(READ POSTER and give copies of this):*

- Participant A asks for 8, offering Bag Minus 8 to Participant B; Participant B accepts the offer; Participant A gets 8 chips; Participant B gets 2 chips.
- Participant A asks for 8, offering Bag Minus 8 to Participant B; Participant B rejects the offer; thus both participants get 5 reais and the game is over.
- Participant A asks for 3, offering Bag Minus 3 to Participant B; Participant B accepts the offer; thus Participant A gets 3 chips while Participant B gets 7.
- Participant A asks for 3, offering Bag Minus 3 to Participant B; Participant B rejects the offer; thus both participants get 5 reais and the game is over.

(MODERATOR: GIVE ONE TABLE TO EACH PARTICIPANT and explain how to read it)

Recall, together with the offer, Participant A will send a message to Participant B stating how many reais he is planning to send in the second step. Participant A could state that he will send some, all or none of the reais earnings from the chips he received in the first step. However, this message is not enforceable, that is, Participant A could change his mind in the second step without consequences.

So, in sum, if Participant B rejects, both participants get 5 reais. If Participant B accepts, this table shows the chips each participant will receive in the first step:

Offer	Total Chips = 10	
	Participant A	Participant B
Bag Minus 10	10 Chips	0 chips
Bag Minus 9	9 Chips	1 chips
Bag Minus 8	8 Chips	2 chips
Bag Minus 7	7 Chips	3 chips
Bag Minus 6	6 Chips	4 chips
Bag Minus 5	5 Chips	5 chips
Bag Minus 4	4 Chips	6 chips
Bag Minus 3	3 Chips	7 chips
Bag Minus 2	2 Chips	8 chips
Bag Minus 1	1 Chips	9 chips
Bag Minus 0	0 Chips	10 chips

Any questions?. Recall, a chip earns a different amount for Participant A than for Participant B. For Participant A each chip is equivalent to 2 reais. For Participant B, each chip is equivalent to 1 real. The tables that you are receiving now summarize the earnings for each participant before the second step:

(MODERATOR GIVES ONE EARNING TABLE TO EACH PLAYER)

PARTICIPANT A.

Chips	0	1	2	3	4	5	6	7	8	9	10
Reais	0	2	4	6	8	10	12	14	16	18	20

PARTICIPANT B.

Chips	0	1	2	3	4	5	6	7	8	9	10
Reais	0	1	2	3	4	5	6	7	8	9	10

Now I will explain the second step where Participant A has to make a final decision.

After the initial distribution of chips, if Participant B accepts the offer, the second step starts after converting the chips into reais. Then, Participant A has the option to send to Participant B some, all or none of the reais earned from the chips received in the first step. This decision will determine the final earnings if this exercise is selected to determine your payments. This is money for you to keep and nobody else will know your earnings.

Note that the message sent in the first step does not limit Participant A's choice in the second step. Whatever the message was, Participant A could send that, less or more.

To communicate his final decision, Participant A will fill a format similar to this poster (SHOW POSTER):

PARTICIPANT A:

Step 2- I send $R______ to participant B.

Step 2- Final Earnings: Participant A earnings $R_____ Participant B earnings $R______

Example 1: in the first step, Participant A asks for 8, offering Bag Minus 8 to Participant B and sends a message that the transfer will be 4R; Participant B accepts the offer; thus Participant A gets 8 chips while Participant B gets 2; in reais Participant A earns R16 = 8 * 2 and Participant B earns R2 = 2 * 1. Then, in the second step, Participant A has the option to send to Participant B some, all or none of the R16 earnings:

- IF Participant A sent 4R to participant B, then Participant A finals earnings are 12 = 16–4 and Participant B final earnings are 6 = 2 + 4.
- IF Participant A sent 0R to participant B, then Participant A finals earnings are 16 = 16–0 and Participant B finals earnings are 2 = 2 + 0.
- IF Participant A sent 10R to participant B, then Participant A finals earnings are 6 = 16–10 and Participant B finals earnings are 12 = 2 + 10.

Example 2: in the first step, Participant A asks for 8, offering Bag Minus 8 to Participant B and sends a message that the transfer will be 3R; Participant B rejects the offer. Participant A and Participant B get 5 reais and the exercise is over.

Example 3: in the first step, Participant A asks for 3, offering Bag Minus 3 to Participant B and sends a message that the transfer will be 3R; Participant B accepts the offer; thus Participant A gets 3 chips while Participant B gets 7; in reais, Participant A earns R6 = 3 * R2; Participant B earns R7 = 7 * R1. Then, in the second step, Participant A has the option to send to Participant B some, all or none of the R6 earnings:

- IF Participant A sent 3R to participant B, then Participant A finals earnings are 3 = 6–3 and Participant B finals earnings are 10 = 7 + 3.
- IF Participant A sent 0R to participant B, then Participant A finals earnings are 3 = 3 + 0 and Participant B finals earnings are 7 = 7 + 0.

Note that the more chips Participant A gets in the first step, the bigger are the total earnings for the two participants summed together, since the chips earn more REAIS for Participant A. However, the final distribution of REAIS between Participants A and B depends not only in the first step division of chips but also in the final transfer by Participant A, which could be some, all or none of the REAIS that Participant A received for his chips.

Yet Participant B accepts or rejects Participant A's proposal to divide the chips knowing that the message sent in the first step does not limit Participant A's choice in the second step. Whatever the message was, Participant A could send that, less or more.

Before we start, we will like to make some questions to make sure everybody understood the exercise:

QUIZ: (MODERATOR GIVES ONE TO EACH PARTICIPANT)

- - In the first step, Participant A asks for 7, offering Bag Minus 7 to Participant B and sends a message that the future transfer will be 2R; Participant B accepts that offer; thus Participant A gets ___ chips while Participant B gets ___; in reais Participant A earns R___ and Participant B earns R___. In the second step, Participant A faces the decision about whether to send REAIS to Participant B; IF Participant A sent **R2** to participant B, then Participant A finals earnings are R____ and Participant B finals earnings are R______.
- In the first step, Participant A asks for 4, offering Bag Minus 4 to Participant B and sends a message that the future transfer will be 1R; Participant B rejects that offer; thus Participants A and B both earn ___ and ____.

Now we are ready to start. Participant As will make the decision first. So I will ask all the Participant Bs to go with XXX to the room next door. Please do no talk with other participants about the exercise.

PARTICIPANT A. All of you are Participant As. Each of you will be paired with a Participant B who is in the room next door. The pairs will be randomly selected. You don't know who is your pair.

Recall, the bag has 10 chips and that each chip earns different amounts of REAIS for Participant A and Participant B. For Participant A each chip is equivalent to 2 REAIS. For Participant B, each chip is equivalent to 1 real.

Recall, if Participant B rejects the offer with the message you make in the first step, both participants get 5 REAIS and the exercise is over. If Participant B accepts your offer, then you will get the chips you asked for and Participant B will get the chips that remain in the bag. Also, if Participant B accepts you offer, you will have the option to send or not any positive amount in REAIS from your earnings to Participant B in the second step. Whatever was the message that you sent to Participant B in the first step, you could send that, less or more.

Note that your decisions are final once you write them down, no matter the Participant B's decisions.

In the small form, please write (*give form*) your identification number and also how many chips you are asking for. In the big form please make a circle around the offer for Participant B.

Finally, please fill the message format.

Now, we will ask for the Participant Bs' decisions. Each participant B will blindly select one of these envelopes to determine the pair, and will answer accordingly to your offer.

PARTICIPANT B. All of you are Participant Bs. Each of you will be paired with a Participant A who is in the room next door. Each Participant A's offer is written on these envelopes. There is one envelope here for each of you. Your pair will be determined by the envelope you will blindly select. Please choose one of these envelopes but do not open it yet.

Recall, the bag has 10 chips and that each chip earns different amounts of REAIS for Participant A and Participant B. For Participant A each chip is equivalent to 2 REAIS. For Participant B, each chip is equivalent to 1 real.

Recall, if you reject the offer with the message made by Participant A in the first step, both participants get 5 REAIS. If you accept the offer, then Participant A will get what he asked for and you will get the chips that remain in the bag. After Participant A learns your decisions, if you accept the offer, Participant A has the option to send or not any positive amount in REAIS from his earnings to you in the second step. Whatever was the message that you sent to Participant B in the first step, you could send that, less or more.

Note that your decisions are final.

Now, please open the envelope: In the big form, write your identification number and an X in accept or reject for the Participant A's offer. Participant A's offer has a circle around it. Then, in the small form, please write down your reais earnings and Participant A's reais earnings for the first step.

(After everybody finish)

Now, we will inform participant A of your decision. Please wait while Participant A makes the decision for the second step.

(go to the room with participant A after collecting third form and start second exercise)

Participant A

Participant B made a decision by accepting or rejecting your offer. Please open your envelope and if participant B accepted the offer, please decide if you want to send or not any positive amount in REAIS to Participant B. If Participant B rejected the offer you don't have to make any decision.

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