Bargaining in Climate Change Negotiations: Evidence from the Lab

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Abstract: Given the continual rise in global CO_2 emissions, the current state of affairs in international climate negotiations provides little reason for optimism. The UNFCCC approach to seeking universal participation has thus been called into question, both by policy makers and by academics who have established pessimistic theoretical predictions concerning the ability of international environmental agreements to improve upon nation states' policy decisions in the absence of such an agreement. Focusing on variations of the public goods game, game theorists have predicted that self-enforcing agreements are likely to comprise only a handful of countries committing to unambitious emissions abatement targets. Here we focus instead on the dynamics of the negotiation process by studying experimental behavior in a Nash bargaining game involving a six-player group of subjects representing heterogeneous countries. Throughout repeated rounds of negotiation, subjects bargain over the allocation of a fixed amount of (profit-generating) emissions. Each subject is potentially pivotal in determining whether the global emissions reduction target is reached, and there are significant losses associated with prolonged failure to reach an agreement. The treatments focus on wealth (and responsibility) asymmetry, as well as on the potential of preliminary side agreements among homogeneous subsets of players to ease coordination of demands in keeping with the target.

Keywords: experimental economics; bargaining game; international environmental agreements; side deals; climate change negotiations

JEL: C91, C92, Q54

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Recent developments in climate policy have reaffirmed the importance of minilateral agreements made by a small number of countries prior to engaging in large *fora* such as the upcoming Paris Conference of the Parties (COP). A growing literature, notably in international relations and political science, points to the merits and drawbacks of entering into negotiations among small-n clubs (Keohane and Victor, 2011; Ostrom, 2010; Victor, 2006). At the two ends of the spectrum, one finds bilateral negotiations and almost universal groupings like the UNFCCC COPs. Most agree that bottom-up and top-down approaches are not mutually exclusive. Indeed, it appears that some countries have resorted to bilateral deals as a stimulus for action by less motivated countries, a common reading of the U.S.-China agreement to reduce emissions that took place ahead of the Paris meeting and is so far confirmed by the Intended Nationally Determined Contribution (INDC) recently pledged by the U.S.

Will more reluctant countries commit to emissions cuts once assured of others' intentions to invest in climate change mitigation? This question is of course an empirical one, and the outcome of the Paris COP in December 2015 will provide an indication of whether such assurance matters. In the meantime, one may approach the issue with other tools, such as theoretical modeling and laboratory experimentation. We now briefly present a bargaining model that aims to capture some of the stylized tradeoffs inherent in climate change negotiations. We then present the design and results of an experiment that focuses on the role of side deals reached by a subset of negotiators in driving behavior in the subsequent "global" negotiations.

Smead *et al*. (2014) use an N-player Nash bargaining game in an agent-based model with learning dynamics to examine past failures and future prospects for an international climate agreement. Each player's strategy set is the interval [0,1] representing the range of possible reductions: 1 representing business-as-usual (BAU)—i.e. 100% emissions—and 0 representing no emissions. Besides the learning dynamics, they modify the Nash bargaining game by introducing a global reduction goal T in the interval [0,1]. Players maintain the full amount demanded from the shared resource (the "emissions pie", where a higher share translates to a higher payoff) only if the sum of all demands does not exceed T. To mimic the cost of failing to reach an agreement, the players' income is equal to a fraction δ of their demand if the aggregate demand is above the threshold.[3]

The authors find that, unsurprisingly, negotiations are more likely to be successful—i.e. players are more likely to converge on a set of demands consistent with the threshold—as δ (the "disvalue of failure") increases. Similarly, an agreement is more likely the smaller the perceived costs of implementing the reductions necessary to reach the threshold. More interestingly, and relevant to the above discussion, they also find that prior agreements among smaller players can be more important for success than similar prior agreements from larger players.

We explore the issue of negotiating on costly emissions reductions in the laboratory. The experimental literature on the avoidance of dangerous climate change has thus far focused on the provision of threshold public goods (Barrett and Dannenberg, 2012; Dannenberg et al., 2014; Tavoni et al., 2011). The underlying idea is that, in order to stay within a safe operating space and avoid probabilistic losses arising from crossing a tipping point for dangerous climate change,

[3] Departing from the standard formulation, which prescribes that out of equilibrium payoffs are constant, the out of agreement payoff in Smead *et al.* (2014) is proportional to the player's demand, such that even when agreement is not reached, a player earns more when demanding more. In our experiment, we retain the standard assumption of independence of out of equilibrium payoff from demand, as explained in the next section.

players must invest sufficient resources into a public account (Pacheco, Vasconcelos and Santos, 2014; Tavoni, 2013; Vasconcelos, Santos and Pacheco, 2013). One can view this public good as a minimum collective expenditure in climate change mitigation that ensures staying below an agreed temperature change, such as the often mentioned 2°C target. In the present paper, as in Smead *et al*. (2014), we instead frame the costly mitigation problem as a Nash bargaining game. Negotiators must divide the burden of reducing the size of the emissions pie by agreeing on sufficiently ambitious reductions relative to BAU, which in the game is represented by players' initial endowment.[4]

In addition to the experimental methodology employed, we depart from Smead *et al*. (2014) in several ways. Firstly, as noted already, failure to reach agreement induces a large loss, independent of individual demands. Perhaps more importantly, to capture the realistic feature that delay in reaching agreement over ambitious emissions reductions will result in the need to agree on even more ambitious targets in the future, we designed the game to comprise multiple rounds with increasingly stringent targets (see Methods below). Hence, while selfish motives still push in the direction of high demands in the hope that others will lead the effort, there is a critical urgency for the negotiating group to meet its target. Reaching agreement early is much less costly than reaching agreement toward the end of the game (which is still preferable to not reaching an agreement at all). Given these features of the experiment, in the Results section we will look at various measures of success, to capture the element of velocity in converging to *T*.

METHODS

Game. Our main treatments focus on asymmetric countries negotiating over a maximum of eight rounds on increasingly ambitious emissions reduction targets. In this process, four Poor Countries and two Rich Countries make successive demands relative to BAU, as depicted in Figure 1.

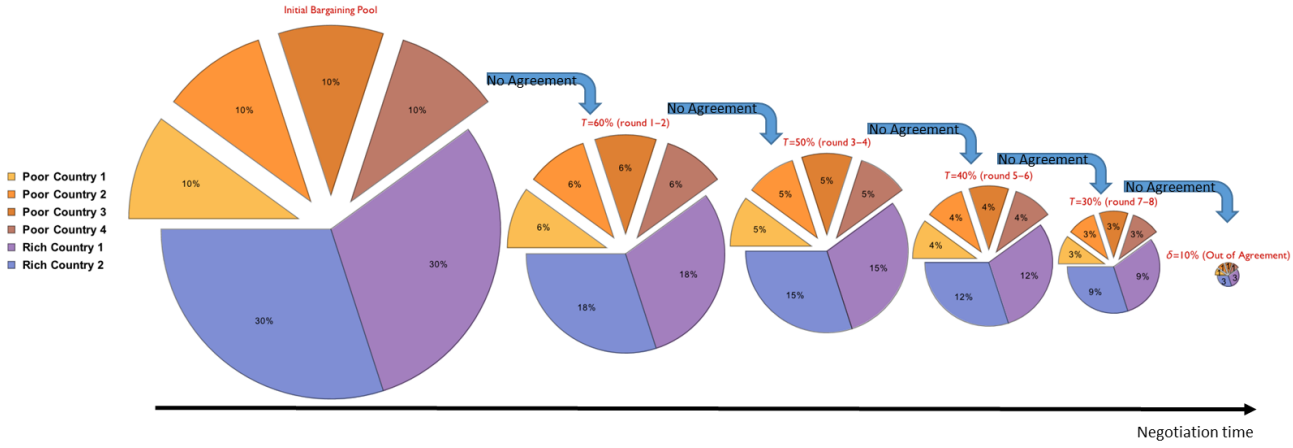

Figure 1 | Timing and dynamics of the game

[4] The underlying assumption is that emissions map one-to-one with wealth. While this assumption is undoubtedly a strong simplification of complex dynamics, it allows us to isolate important features of climate change negotiations, such as the tension between a country's incentive to keep the largest possible fraction of its emissions and the need to make concessions if the collective target is to be met. Furthermore, while historical responsibilities are not specifically modelled here, our main treatments feature wealth heterogeneity so as to capture the different implications of a given reduction commitment (e.g. -20% emissions) by rich, high-emitting countries relative to poor, low-emitting ones.

Each treatment consists of up to eight rounds of a Nash bargaining game framed as climate change negotiations, where the negotiation terminates if the group meets the prescribed "global" target in a given round. The global target becomes more difficult to attain as the game progresses, beginning at 60% of global wealth and reducing by 10% every two rounds. If the group does not meet the target by the end of Round 8, group members receive 10% of their initial endowment (regardless of their demands in that round) as an unavoidable consequence of "dangerous" climate change.

In each round, group members—each acting as a delegate representing one country in the negotiation—engage in what we term the Global Negotiation stage. In this stage, each delegate demands to keep a proportion of her country's endowed wealth, which is perfectly correlated with her country's emissions in the game. If the group's total demand does not exceed the corresponding global target level in a given round, the target is met and each subject in the group receives the proportion she demanded in that round. If the target is not met, there is no payout and negotiations continue to the next round (see Figure 1).

All group's aggregate endowments are £100. In treatment SYM, all countries begin with a symmetric endowment of £16.67. All other treatments (ASYM, PSD, RSD, ASD) are characterized by asymmetry in the distribution of endowments (and corresponding impact on global CO_2 emissions). In these treatments, four Poor Country delegates receive an endowment of £10 and two Rich Country delegates receive an endowment of £30.

While different in terms of endowment, both SYM and ASYM feature eight single-stage rounds, as depicted in Figure 1. In each of these rounds, delegates independently and simultaneously decide on individual (i.e. country-level) demands. Subsequently, the software computes the demand of the group and displays both group and individual demands in a subsequent screen in absolute and percentage terms. In treatments containing side deals (Poor Side Deal, or PSD; Rich Side Deal, or RSD; and All Side Deal, or ASD), a set of delegates forms a Side Deal prior to the Global Negotiation stages on a given target. Accordingly, these side deals take place prior to Rounds 1, 3, 5, and 7. In each side deal, delegates representing Poor Countries (in PSD), those representing Rich Countries (in RSD), or both subgroups simultaneously (in ASD) implement a binding upper bound on the amount of individual wealth that each of them may demand in the upcoming two Global Negotiation stages. The outcome of a side deal, the Agreed Maximum Demand, applies only to countries who took part in the side deal, though it is visible to all subjects in a group prior to the subsequent Global Negotiation stages (see Figure 2 for details on the stages and Figure S.5-S.8 in the Supporting Information for details on how the Agreed Maximum Demand is determined).

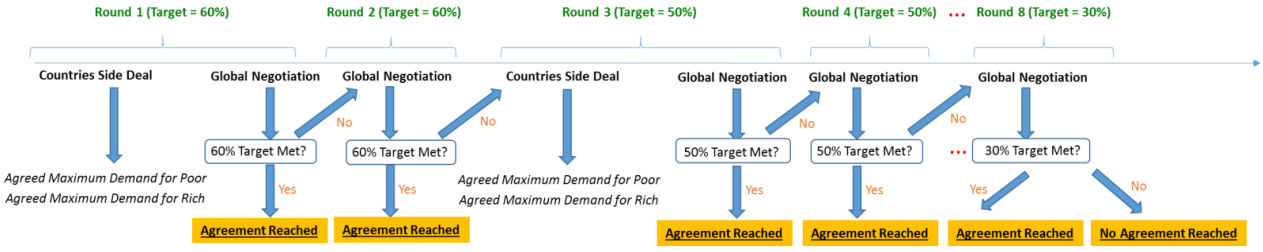

Figure 2 | A schematic representation of the stages in treatment ASD. In even-numbered rounds there is only one stage (Global Negotiation), while in odd-numbered rounds that stage follows a Side Deal stage. The same applies to PSD and RSD, except that the side deal in those treatments can only be made by Poor and Rich Countries, respectively.

We employ an experimental design that allows for both within-subject and between-subject analysis. Each subject participates in two sessions of up to eight rounds. The design allows us to test for learning and for order effects. The most relevant within-subject combinations are those in which ASYM precedes PSD, RSD, or ASD, since side deals have not been historically prevalent. To avoid reputation effects, we use a stranger matching design in which we reshuffle the group composition in between sessions, though we ensure that subjects maintain the same role as "Poor" or "Rich" in both.

Once all subjects finish both sessions, they are asked to complete a brief questionnaire to assess motivation, strategic decision-making, and demographic heterogeneity. Additionally, each subject answered a risk-preference elicitation question equivalent in structure to the standard question used in Eckel & Grossman (2008; EG, hereafter), with payoffs scaled down to 10% of those used in EG.

At the beginning of the experiment, subjects received both written and oral instructions (see Supporting Information). At the end of the experiment, a coin toss determined which session would pay out, and individual coin tosses for each subject determined the outcome of the EG gamble the subject chose to play. Subjects privately received their experimental earnings in cash, in addition to a £5 show-up fee, totaling £16.80 on average. All experimental decisions were made on a computer screen using the experimental software Z-Tree.[5]

Subjects. A total of 336 student (undergraduate and postgraduate) and non-student subjects volunteered to participate in 20 experimental sessions, most comprising three groups of six subjects (four sessions contained only two groups). The experiment took place at the London School of Economics (LSE), though experimental participation is not restricted to LSE students.

RESULTS

In the table below we show some descriptive statistics on group performance across treatments. In terms of speed, the most successful treatment group is the one allowing for side deals among the Poor (PSD), where on average they coordinated on the threshold shortly after the second round. By contrast, RSD, where only the Rich engaged in preliminary side deals before entering the global negotiation stage, was the treatment where agreement was most delayed (3.5 rounds on average; see Table 1).

Table 1 | Average round in which agreement was reached (Agreement Round) and number of groups that failed to reach an agreement (No Agreement), by Treatment

	SYM	ASYM	PSD	RSD	ASD
Agreement Round	2.5	3.1	2.3	3.5	3.1
No Agreement	0	2	1	0	0
Groups	11	14	10	10	11

[5] Fischbacher, U. (2007). "z-Tree: Zurich toolbox for ready-made economic experiments," Experimental Economics, Springer, vol. 10(2), 171-178.

Figure 3 provides a visual representation of the above statistics in addition to the demand dynamics across treatments. The downward trend is clear, as is the tendency of average group demands to respond to the declining values of the global target *T* (from 60% to 30%) by clustering, although with some variance, around these values.

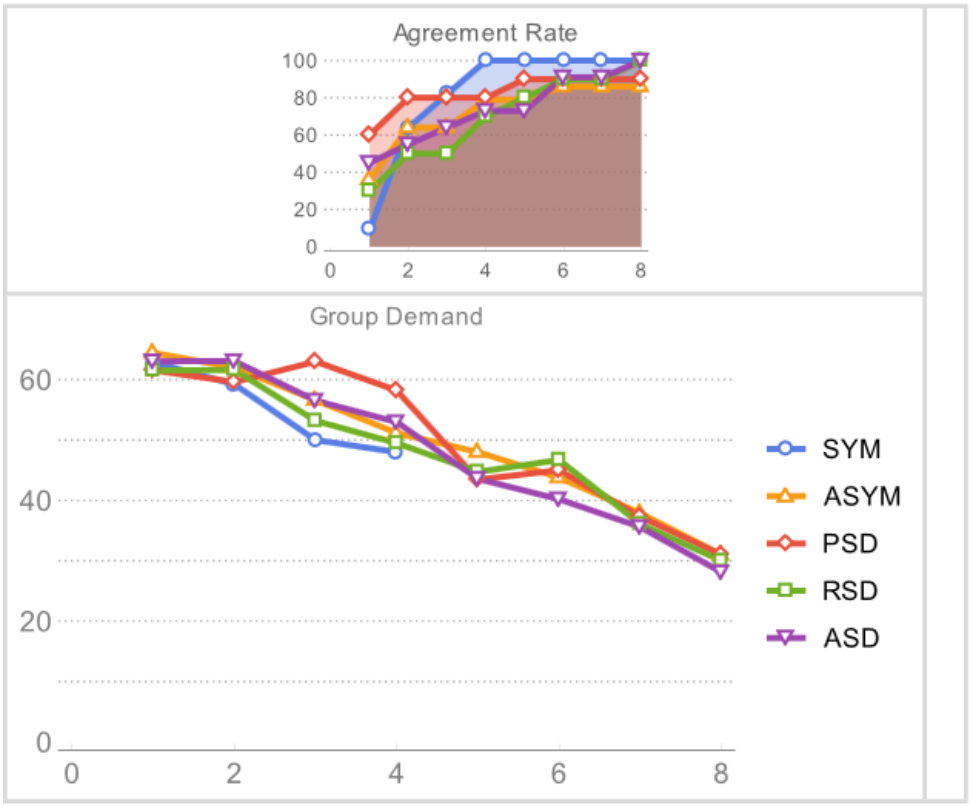

Figure 3 | Group demand over time (and rate of agreement in the inset).

An interesting question pertains to the behavior of the two different subgroups in the asymmetric treatments: is there evidence of redistribution from the Rich to the Poor, in the sense of lower demands by the wealthy? If there are differences, do they persist over time? We tackle these questions in Figure 4. Interestingly, there are differences in initial demands, but they are not large. The 60% target appears to be salient for both groups across treatments, with the Rich not deviating far from it, and the Poor demanding somewhat above the threshold. Furthermore, the evolution of demands differs. While the trend is negative in both groups, the Poor display more variance across treatments, especially in the final rounds. The treatments where Poor subjects are most willing to reduce demands are ASD and RSD. Conversely, the opposite takes place for the Rich: PSD, followed by ASYM, is the treatment in which the Rich demand the least in the second half of the game, averaging only about 20% demand in the last round.[6] Note also that for the Poor, PSD is the treatment where demands are highest toward the end (close to 50% in round 8), while for the Rich it is RSD that averages the highest demands (slightly above 30%).

[6] It is important to note that the sample size declines as negotiations progress, since groups who successfully reach agreement cease negotiating once agreement is reached.

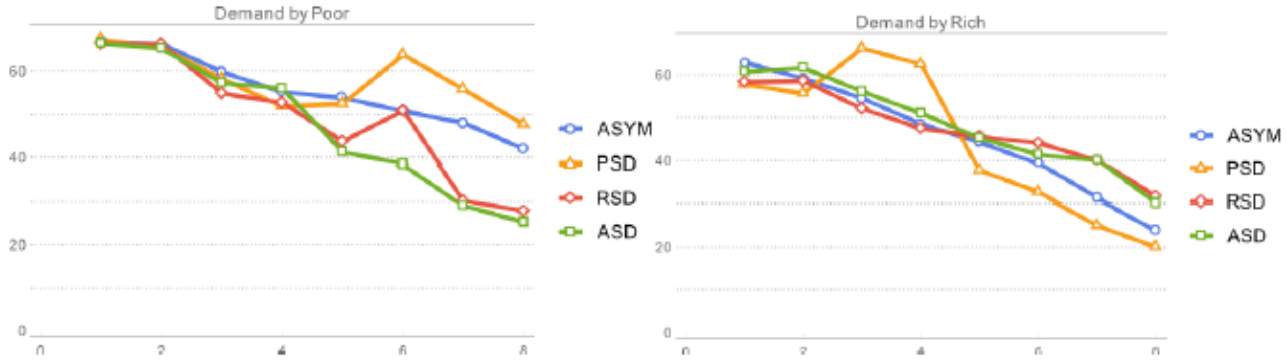

Figure 4 | Demands over time by treatment, for the Poor (left panel) and for the Rich (right panel).

The above observation raises further questions. Why is it that negotiators belonging to a given wealth group respond more cooperatively when the side deals take place in the other group? Is it a conditional cooperation argument, where the Poor (Rich) feel reassured about selflessly demanding less when the Rich (Poor) signal willingness to tie their hands in the upcoming negotiations?
We investigate the evidence for conditional cooperation through regression analysis in the tables below. Table 2 shows a weakly significant negative effect of past cooperation by the Poor on the groups' demand: the Poor reduce demand by approximately 3% for every additional Poor country that cooperated in the previous round (by demanding at or below the target in that round).

Table 2 | Evidence of conditional cooperation by the Poor

	Rich Demand
Rich Cooperated	0.032
	(2.349)
Poor Cooperated	-2.840*
	(1.738)
Constant	59.228***
	(6.157)
Groups	104
Subjects	356
Controls	Gender, Annex 1, Motivation, Treatment

The dependent variable in this regression indicates the demand over the course of negotiation by Poor countries only. The independent variables represent the number of Rich and Poor country representatives (respectively) who cooperated in the prior round by demanding less than or equal to the global target level. Robust errors are clustered at the group level. Standard errors are reported below estimates in parentheses. *significant at 10%; **significant at 5%; ***significant at 1%.

Interestingly, conditional cooperation does not appear to take place among the Rich, as shown in Table 3. Here the effect is positive, and of similar magnitude of the one observed for the Poor. That is, the Rich *increase* demand by about 2.3 percentage points for every additional Poor country that cooperated in the prior round. Conversely, the behavior of Rich countries in the previous round does not have an effect on the behavior of either the Rich or the Poor.

Table 3 | Evidence of free-riding by the Rich

	Rich Demand
Rich Cooperated	0.934
	(2.720)
Poor Cooperated	2.289**
	(1.147)
Constant	48.788***
	(2.726)
Groups	52
Subjects	172
Controls	Gender, Annex 1, Motivation, Treatment

The dependent variable in this regression indicates the demand over the course of negotiation by Rich countries only. The independent variables represent the number of Rich and Poor country representatives (respectively) who cooperated in the prior round by demanding less than or equal to the global target level. Robust errors are clustered at the group level. Standard errors are reported below estimates in parentheses. *significant at 10%; **significant at 5%; ***significant at 1%.

SIDE-DEALS AND SUB-AGREEMENTS

In a companion paper, which appears in the same issue, we took a different methodological approach to the same topic of cooperation in climate change negotiations. There, we elicited the views of negotiators and parties to the COPs, by asking for their views on the merits and drawbacks of the existing negotiation platform. One question is particularly salient for the present analysis, so we report it below:

"When considering packaging issues […] in several distinct sub-agreements (instead of having a comprehensive approach), how confident are you about the success of narrower sub-agreements with respect to the following aspects?"[7]

In sum, we find that the respondents believe, with a fair amount of confidence, that breaking the negotiation into smaller sub-agreements dealing with specific issues, would increase agreement success. The results are summarized in Figure 5.

[7] The issues are: Comprehensive quantitative targets for a reduction in global GHG emissions; Quantitative GHG emission reduction targets for individual economic sectors or single GHG; R&D and technology transfer; Geo-engineering; Land-use change and reforestation; Adaptation measures.

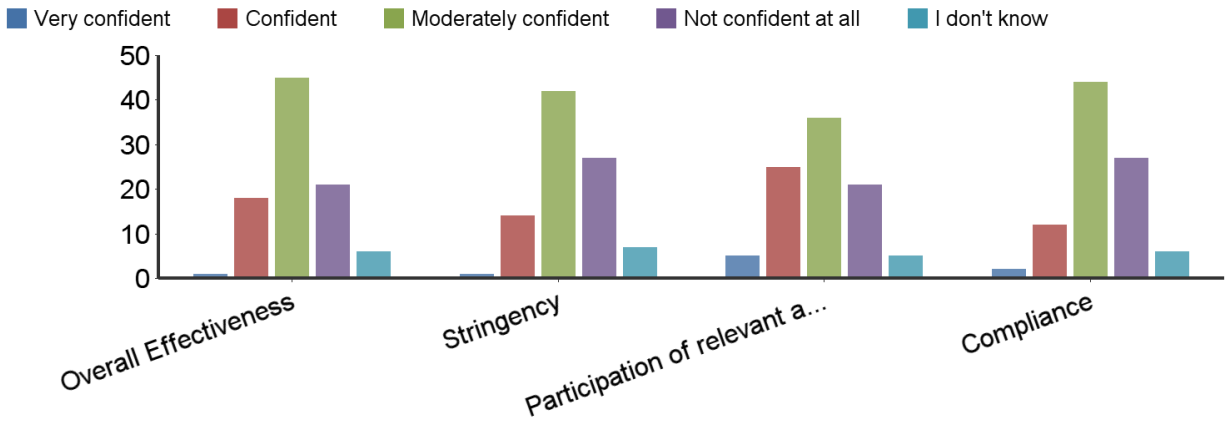

Figure 5 | Negotiators' perceptions on the importance of bundling issues into sub-agreements. Numbers indicate percentage of respondents.

This finding is consistent with the experimental evidence presented in the Results section, that reducing the complexity of an agreement (in the experiment by allowing for preliminary negotiations among subsets of countries) is beneficial for cooperation.

CONCLUSIONS

We find that "tying your hands" via side deals ahead of the inclusive negotiations promotes cooperation. Poor countries, perhaps surprisingly, are instrumental in catalyzing conditional cooperation (or free-riding). The two effects go in opposite directions, offsetting each other in aggregate terms.

Furthermore, we find that negotiations are sensitive to initial demands: early action, in the form of initial demands that are close to the target, increases the likelihood of an agreement forming (results not shown).

The above evidence suggests that not only the timing, but also the infrastructure around which the climate change negotiations revolve, is crucial to the success of the agreement. Under the right conditions, minilateral side deals can facilitate the bargaining process.

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SUPPORTING INFORMATION

Instructions and control questions for participants of the ASD treatment:

Bargaining in Multilateral Negotiations: Experimental Instructions

Welcome to the experiment!

In this experiment, you can earn money. In addition to your earnings from the experiment, you will receive a £5 show-up fee. During the course of the experiment, please do not talk to other participants.

We will now read the experimental instructions aloud. Once we have finished reading, raise your hand if you have questions and we will be with you shortly to answer them. At the end of Part A of the instructions you will find some questions that are meant to ensure that you understand the rules of the experiment. Please answer all questions and signal us by raising your hand when you have finished, so that we may check your answers.

Background: Climate change

Climate change is viewed as a serious global environmental problem. The vast majority of climate scientists expects the global average temperature to rise by 1.1-6.4°C before 2100, where a rise of 2°C is generally considered to be dangerous climate change. There is hardly any disagreement that mankind largely contributes to climate change by emitting greenhouse gases, especially carbon dioxide (CO_2). CO_2 originates from the burning of fossil fuels such as coal, oil, or natural gas in industrial processes and energy production, as well as from combustion engines of cars and lorries.

CO_2 is a *global* pollutant—that is, each unit of CO_2 emitted has the same effect on the climate regardless of the location where the emissions occur. Dangerous climate change will result in significant global costs, which get worse over time if agreement is not reached.

International climate change negotiations involve yearly meetings where delegations representing different *countries try to strike a global agreement on emissions reductions* that are consistent with the goal of avoiding dangerous climate change. Here you will be asked to negotiate such costly emissions reductions on behalf of the Country to which you will be assigned. Your choices, together with those of the other 'Countries', will determine your payout from the experiment.

Rules of play

Now we will introduce you to a game simulating international climate change negotiations. In total, six Countries are involved in the global negotiation. That is, in addition to you, there are five other negotiators in your negotiation group, and each of you represents one Country. The six Countries account for *all* global wealth and CO_2 emissions (for simplicity, we disregard other greenhouse gases in the experiment). While excessive emissions impose global costs, individual Countries rely on productive processes which create emissions in order to generate wealth: for every 1 billion tons of CO_2 'emitted' in the game, you receive £1. Hence, reducing emissions is costly.

Your decisions in the experiment are anonymous. To guarantee anonymity, you will be randomly assigned to one type of Country (Rich or Poor), and you will be identified by one of the following names: Rich Country 1, Rich Country 2, Poor Country 1, Poor Country 2, Poor Country 3, Poor Country 4. Your name will appear on the lower left side of your screen once the experiment begins.

At the beginning of the experiment, you will receive a sum of money that represents your Country's wealth. This wealth mirrors your Country's CO_2 emissions. Therefore, throughout the instructions and the experiment, we will refer to wealth and emissions interchangeably.

The current situation in your negotiation group can be summarised as follows:

- **Two Rich Countries** each emit 30 billion tons of CO_2 and earn **£30** in doing so;
- **Four Poor Countries** each emit 10 billion tons of CO_2 and earn **£10** in doing so;
- The resulting Global Emissions amount to **100 billion tons of CO_2** (2×30 billion tons of CO_2 + 4×10 billion tons of CO_2)
- Hence, **Global Wealth** is equal to **£100** (2×£30 + 4×£10)

Due to the threat of dangerous climate change, the goal is to agree on an aggregate level of Global Emissions that does not exceed a given Global Target. In the following experiment, you will participate in up to 8 rounds of climate change negotiations, where the global costs from *not* reaching agreement increase every 2 rounds.

Accordingly, the Global Target decreases every two rounds, as follows:

- Rounds 1-2: **60% of current emissions** (60 billion tons of CO_2)
- Rounds 3-4: **50% of current emissions** (50 billion tons of CO_2)
- Rounds 5-6: **40% of current emissions** (40 billion tons of CO_2)
- Rounds 7-8: **30% of current emissions** (30 billion tons of CO_2)

To be clear, since current global emissions are 100 billion tons of CO_2, an agreement is only reached if total negotiated emissions are at most 60 billion tons of CO_2 in the first two rounds. Equivalently, Global Wealth must be reduced from an initial level of £100 to a target level of £60 if the Global Target is to be met in the first two rounds. This target becomes more difficult to meet as the negotiations move forward, as outlined above.

Every Country faces a similar decision-making problem. In each round of the global negotiation, all six Countries will be asked simultaneously:

"What percent of YOUR COUNTRY's emissions/wealth do you demand to keep?"

If the required Global Target is met, then your group has reached an agreement; negotiations terminate and each Country receives its demand from that round. If agreement is not reached, the negotiation continues to the next round.

If an agreement is not reached by the end of the 8th Round of negotiations, dangerous climate change becomes unavoidable and economic costs for all Countries ensue. Each Country will then receive **10% of its initial wealth** (£3 for Rich Countries, £1 for Poor Countries).

Example 1. Imagine that you are part of a negotiation group that makes decisions as follows.

> In **Round 1** (Global Target=60%), all Countries demand to keep 90% of their emissions/wealth. If the Global Target were to be met, Rich Countries would receive £27 in payout and Poor Countries would receive £9 in payout.

See **Figure 1** below, for the screen that will be seen by Poor Country 1:

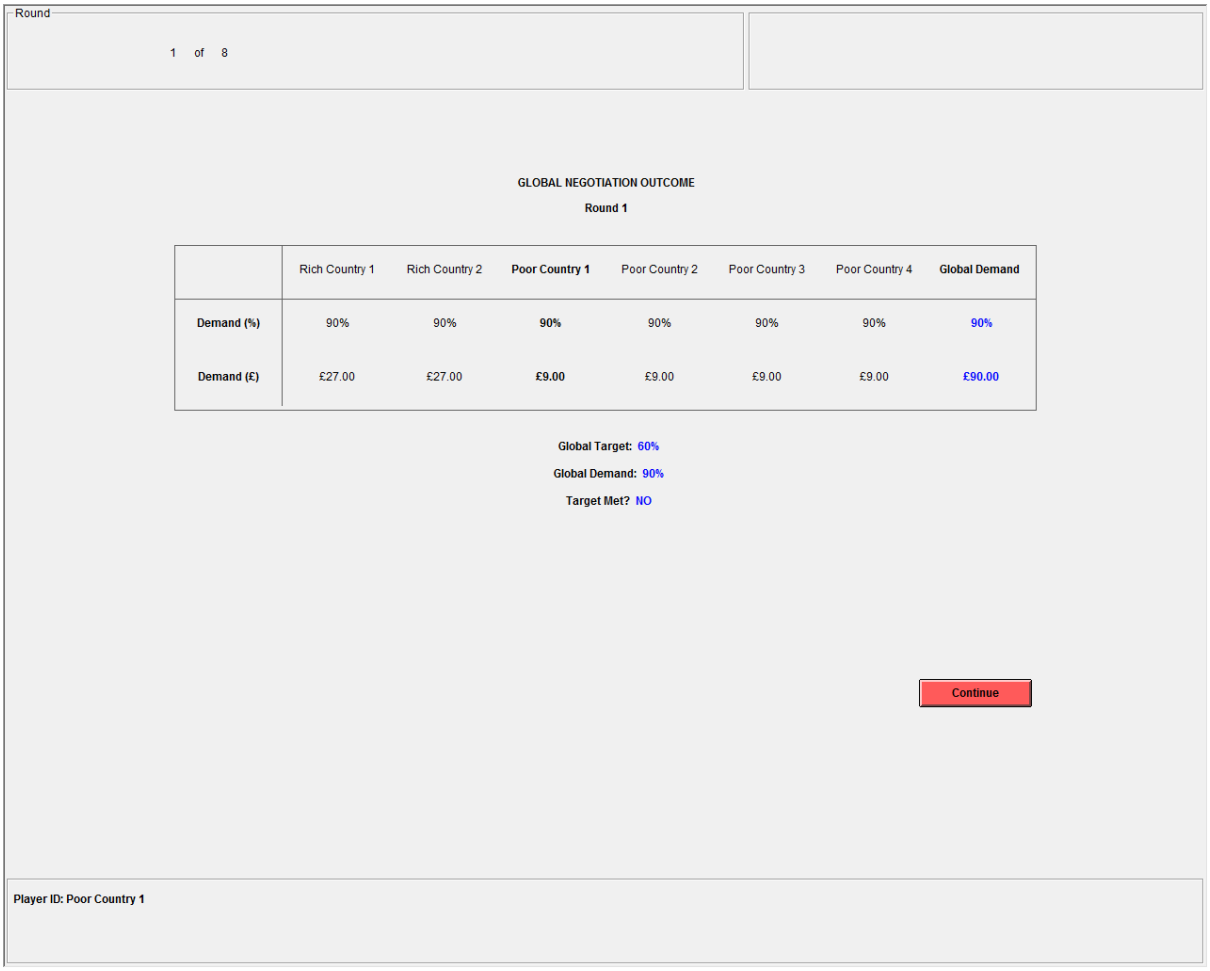

Figure S.1

However, the Global Target is NOT met and negotiations continue to Round 2.

In **Round 2** (Global Target=60%), demands are as follows:

- Rich Country 1 and Poor Country 1 each demand to keep 50%. If the Global Target were to be met, Rich Country 1 would receive 50% of its initial wealth (£15) and Poor Country 1 would receive 50% of its initial wealth (£5).

- Rich Country 2 and all remaining Poor Countries (2,3,4) each demand to keep 80%. If the Global Target were to be met, Rich Country 2 would receive 80% of its initial wealth (£24) and Poor Countries 2, 3, and 4 would receive 80% of their initial wealth (£8 each).

See **Figure 2** below:

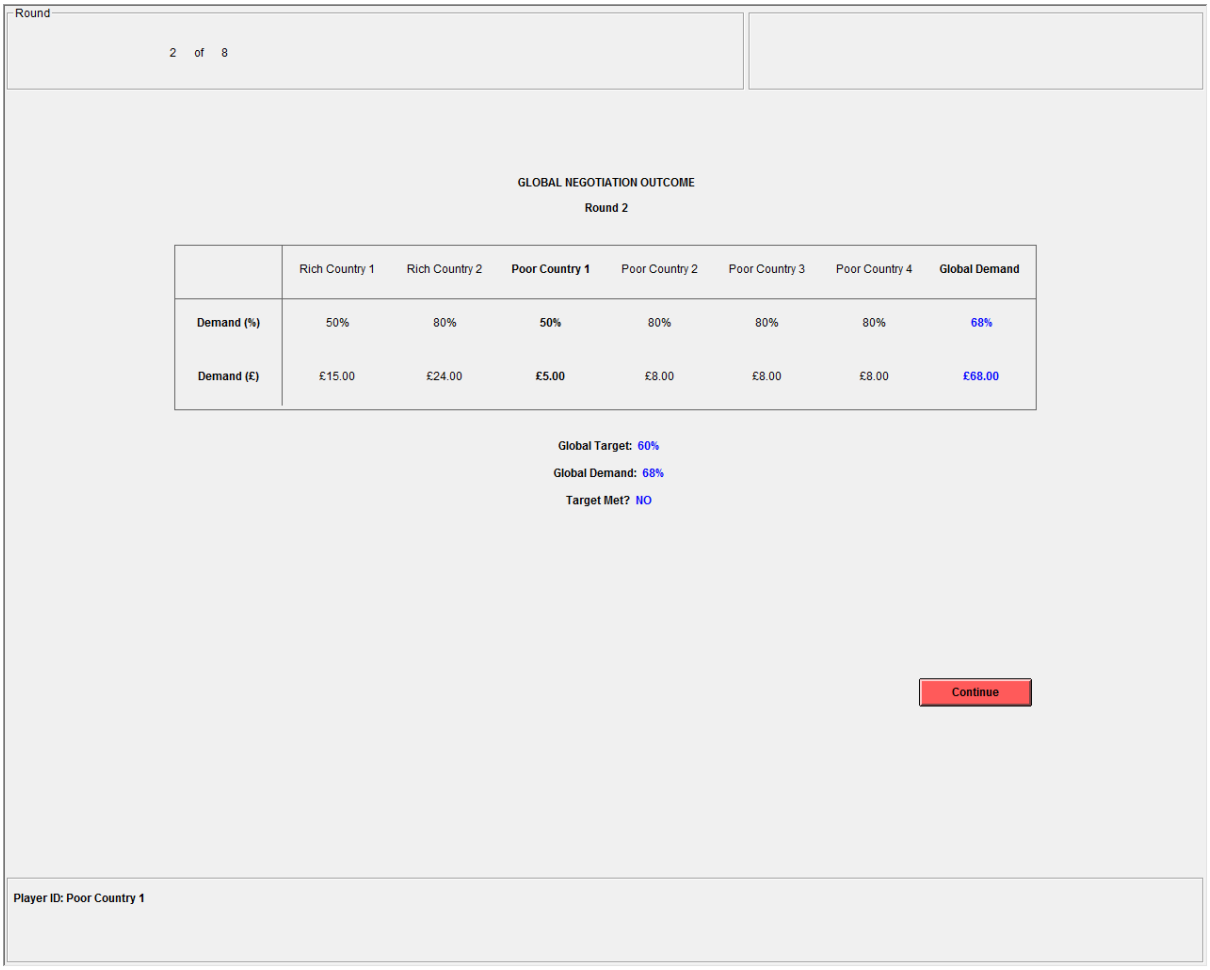

Figure S.2

However, Global Demand=68% > Global Target = 60%, so the Global Target is not met and negotiations continue.

Now imagine that the negotiation group continues to demand to keep emissions/wealth above the target level until the 7th Round, when the relevant Global Target is 30% of emissions/wealth.

In **Round 7**, demands are as follows:

- Rich Country 1 and Poor Country 4 demand to keep 32% each.
- Rich Country 2 and Poor Countries 1, 2, and 3 demand to keep 20% each.

See **Figure 3** below:

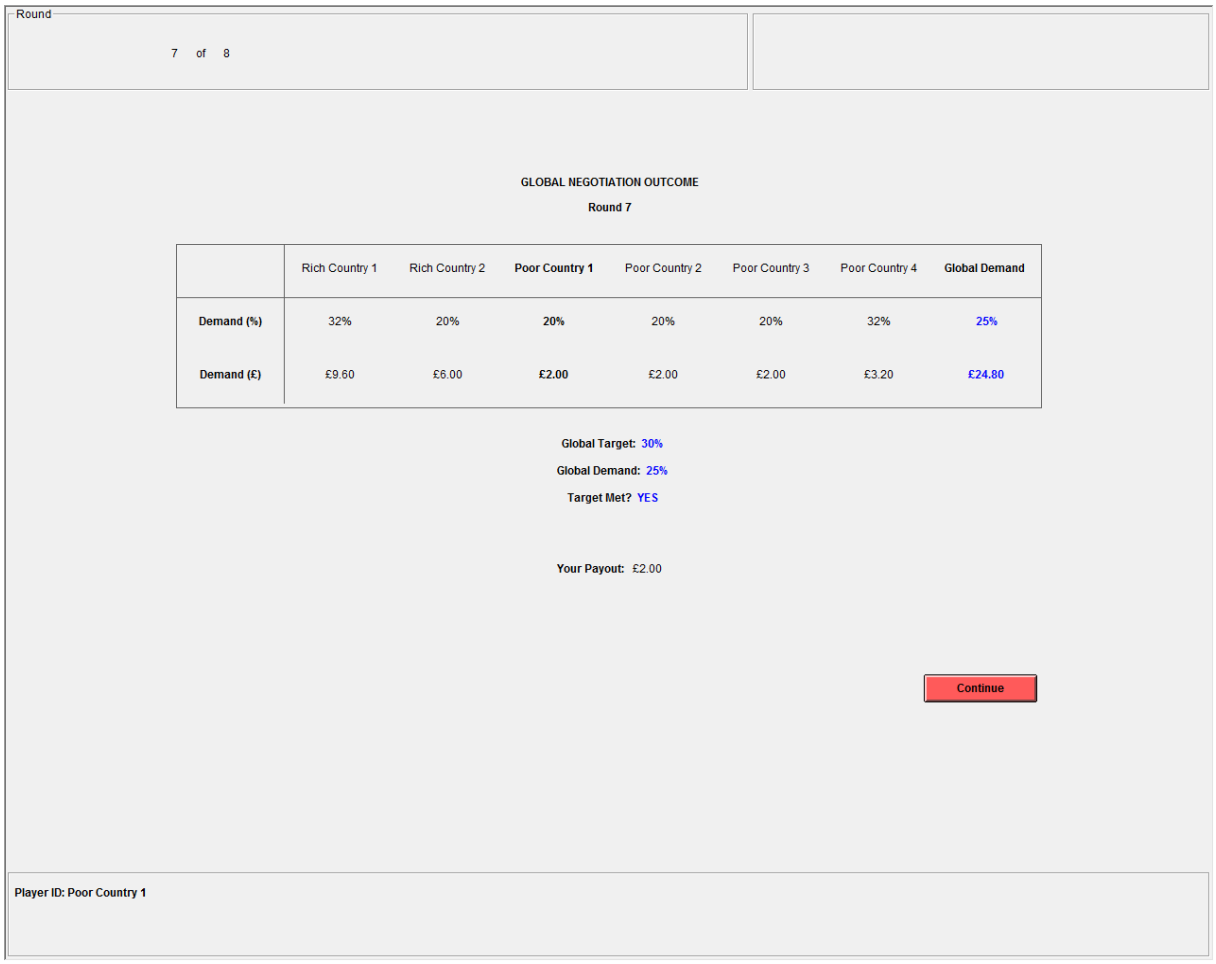

Figure S.3

- Hence, Global Demand = 25% ≤ Global Target = 30%. The Global Target is met.
- Rich Country 1 receives 32% of its initial wealth (£9.60), Rich Country 2 receives 20% of its initial wealth (£6), Poor Countries 1, 2, and 3 each receive 20% of their initial wealth (£2 each), and Poor Country 4 receives 32% of its initial wealth (£3.20).

Please take a brief moment to review and understand the rules, then continue to the next page to test your understanding.

Test your understanding: *For the questions below, please check the box of the correct answer or fill in your answer on the line provided. For convenience, we summarised the main rules below:*

Global Target
Rounds 1-2: **60%**
Rounds 3-4: **50%**
Rounds 5-6: **40%**
Rounds 7-8: **30%**

Country Initial Wealth
Rich Country 1, Rich Country 2: **£30**
Poor Country 1, Poor Country2, Poor Country 3, Poor Country 4: **£10**

1. In Round 4's global negotiation, all members of your negotiation group demand to keep 60% of their initial emissions/wealth. What happens next?

- ☐ *We've met our Global Target; each of us receives 60% of our initial wealth.*
- ☐ *Our Global Target has not been met; we continue to Round 5.*

2. In Round 3's global negotiation, all Rich Countries demand to keep 50% of their original emissions/wealth. If two Poor Countries demand to keep 40% and the other two Poor Countries demand to keep 60%, is agreement reached?

- ☐ Yes
- ☐ No

If yes, how much does each Country receive (without show-up fee)? If no, please leave blank.

Rich Countries: £_____each

Poor Countries that demanded 60%: £_____each

Poor Countries that demanded 40%: £_____each

3. In the final Round's global negotiation (i.e. Round 8), one Rich Country demands to keep 20% of its initial emissions/wealth and the other Rich Country demands to keep 30%. If two Poor Countries demand to keep 30% each and the other two Poor Countries demand to keep 75% each, is agreement reached?

- ☐ Yes
- ☐ No

How much does each Country receive as their final payout (without show-up fee)?

Rich Country that demanded 20%: £_____

Rich Country that demanded 30%: £_____

Poor Countries that demanded 30%: £_____each

Poor Countries that demanded 75%: £_____each

Please raise your hand when you have answered all questions, and we will come to check your answers.

Side Deals

Recall that the Global Target changes every two rounds. Before global negotiations on a new target begin, both groups of Countries (the 4 Poor and the 2 Rich) will simultaneously enter into separate side deals, as follows.

(i) Side Deal for Poor Countries:

Prior to the global negotiations in Rounds 1, 3, 5, and 7, each Poor Country will enter its preferred 'Maximum Demand', i.e. the desired maximum percentage of emissions/wealth that each *Poor Country* may demand to keep in the two upcoming global negotiations.

The average of these four Maximum Demands will determine the 'Agreed Maximum Demand for Poor', which cannot be exceeded by each Poor Country in the two upcoming global negotiations.

(ii) Side Deal for Rich Countries:

At the same time, and prior to the global negotiations in Rounds 1, 3, 5, and 7, each Rich Country will enter its preferred 'Maximum Demand', i.e. the desired maximum percentage of emissions/wealth that each *Rich Country* may demand to keep in the two upcoming global negotiations.

The average of these two Maximum Demands will determine the 'Agreed Maximum Demand for Rich', which cannot be exceeded by each Rich Country in the two upcoming global negotiations.

Should a global agreement *not* be reached within the first two rounds, a new target will apply to Round 3 (Global Target=50%) and a new Agreed Maximum Demand will be determined by both Poor and Rich Countries for the two upcoming rounds (Rounds 3 and 4). This process will continue until Round 8 so long as a global agreement is not reached.

Please refer to the timeline in **Figure 4** for a recap on the various stages of the game.

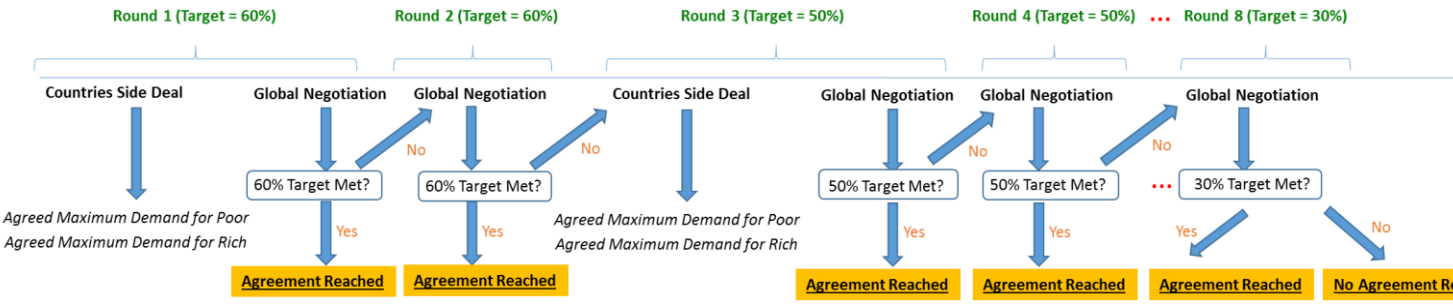

Figure S.4

<u>Example 2</u>. Imagine that you are <u>Poor Country 1</u> and that you have entered into a side deal with the other Poor Countries. In the experiment you will see the following screen:

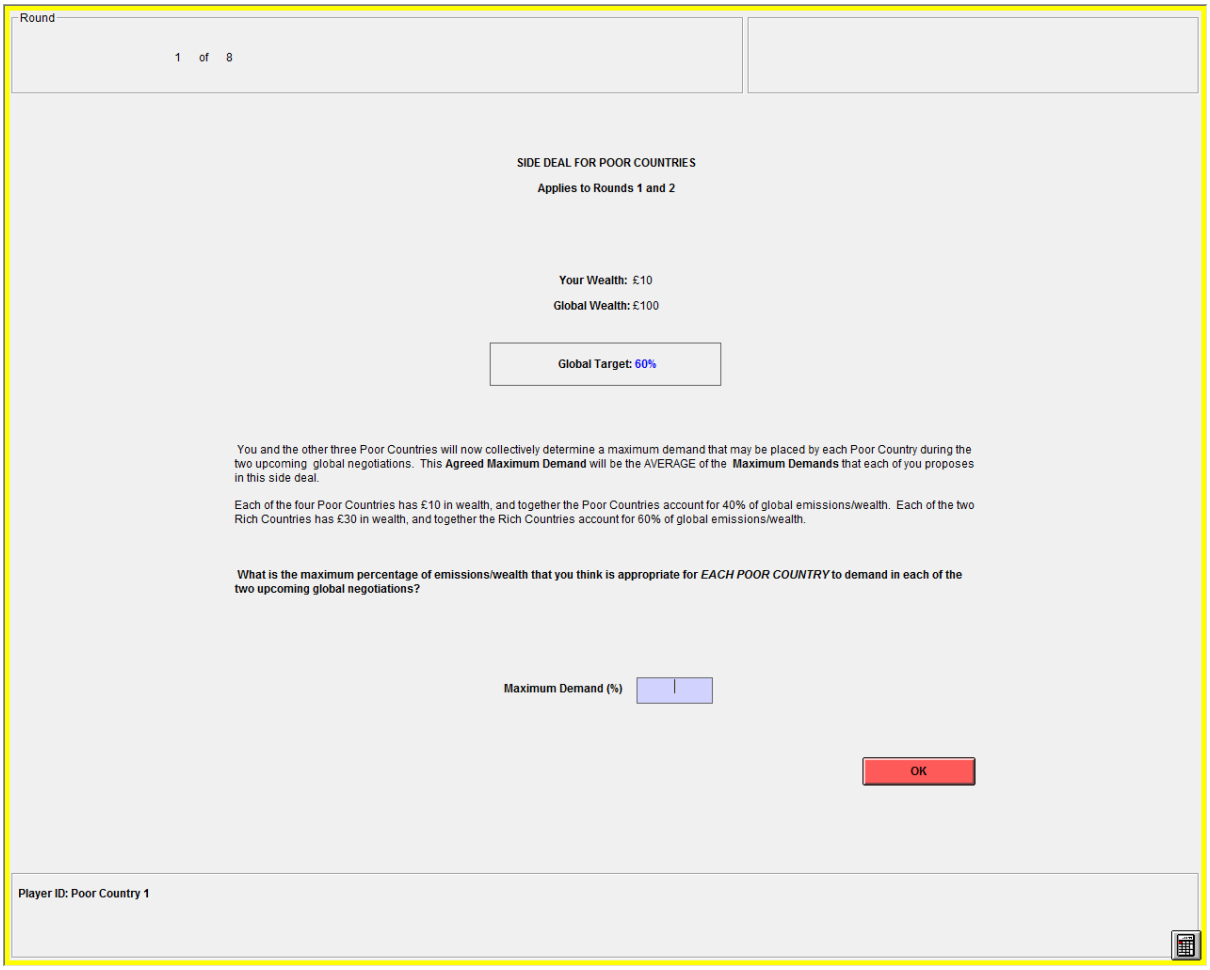

Figure S.5

The choices from the Side Deal for Poor Countries are shown at the top of **Figure 6**, which we have highlighted with a box:

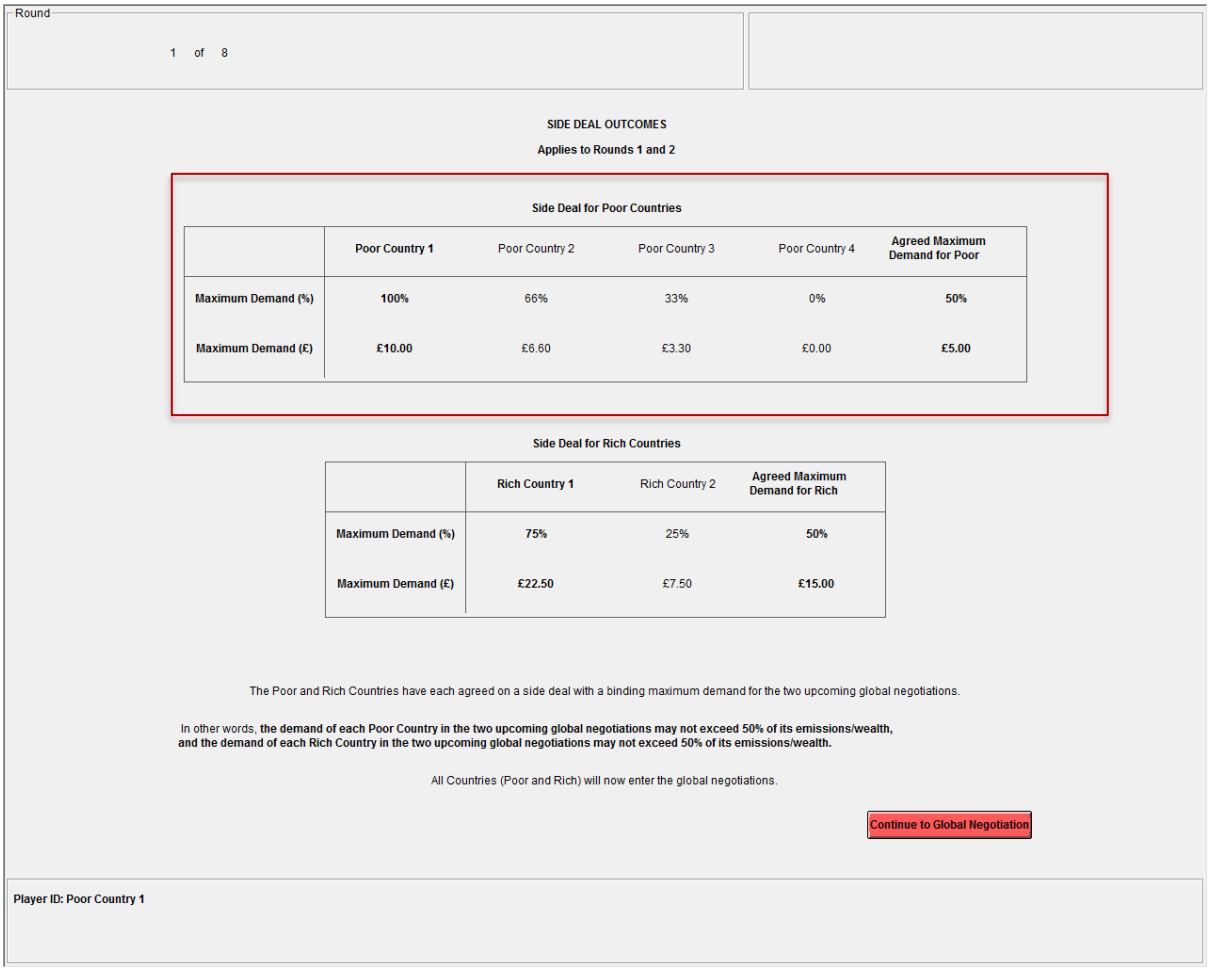

Figure S.6

- Poor Country 1 (you) chooses Maximum Demand = 100%
- Poor Country 2 chooses Maximum Demand = 66%
- Poor Country 3 chooses Maximum Demand = 33%
- Poor Country 4 chooses Maximum Demand = 0%

The resulting agreed side deal is that each Poor Country cannot exceed 50% demand in the two upcoming global negotiations, i.e. the Agreed Maximum Demand = 50%.

(Note that the outcomes of the Side Deal for Rich Countries, which took place at the same time, are also shown in **Figure 6**. All Countries see these outcomes.)

<u>Example 3</u>. Imagine that you are Rich Country 1 and that you have entered into a side deal with Rich Country 2. In the experiment you will see the following screen:

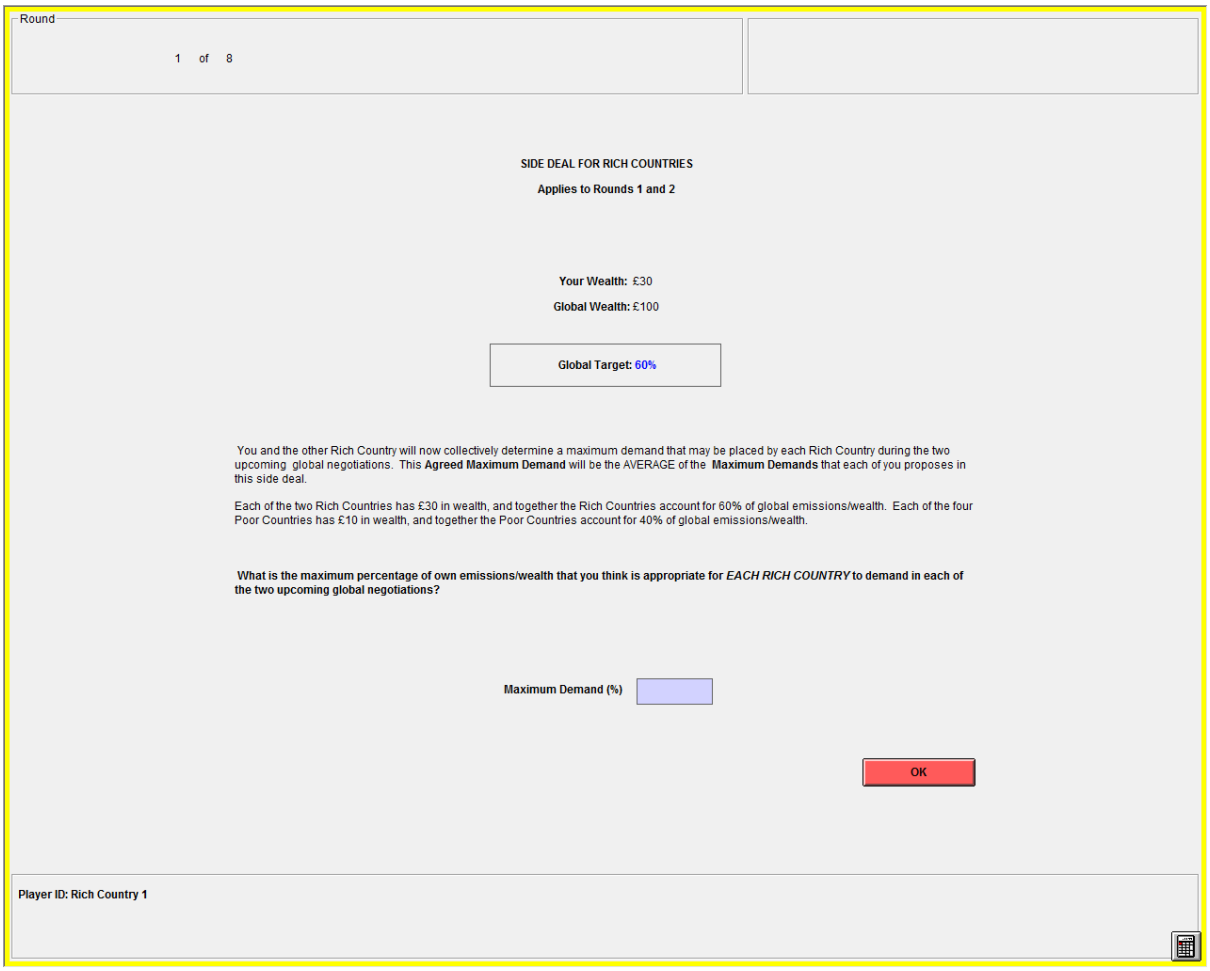

Figure S.7

The choices from the Side Deal for Rich Countries are shown at the bottom of **Figure 8**, which we have highlighted with a box:

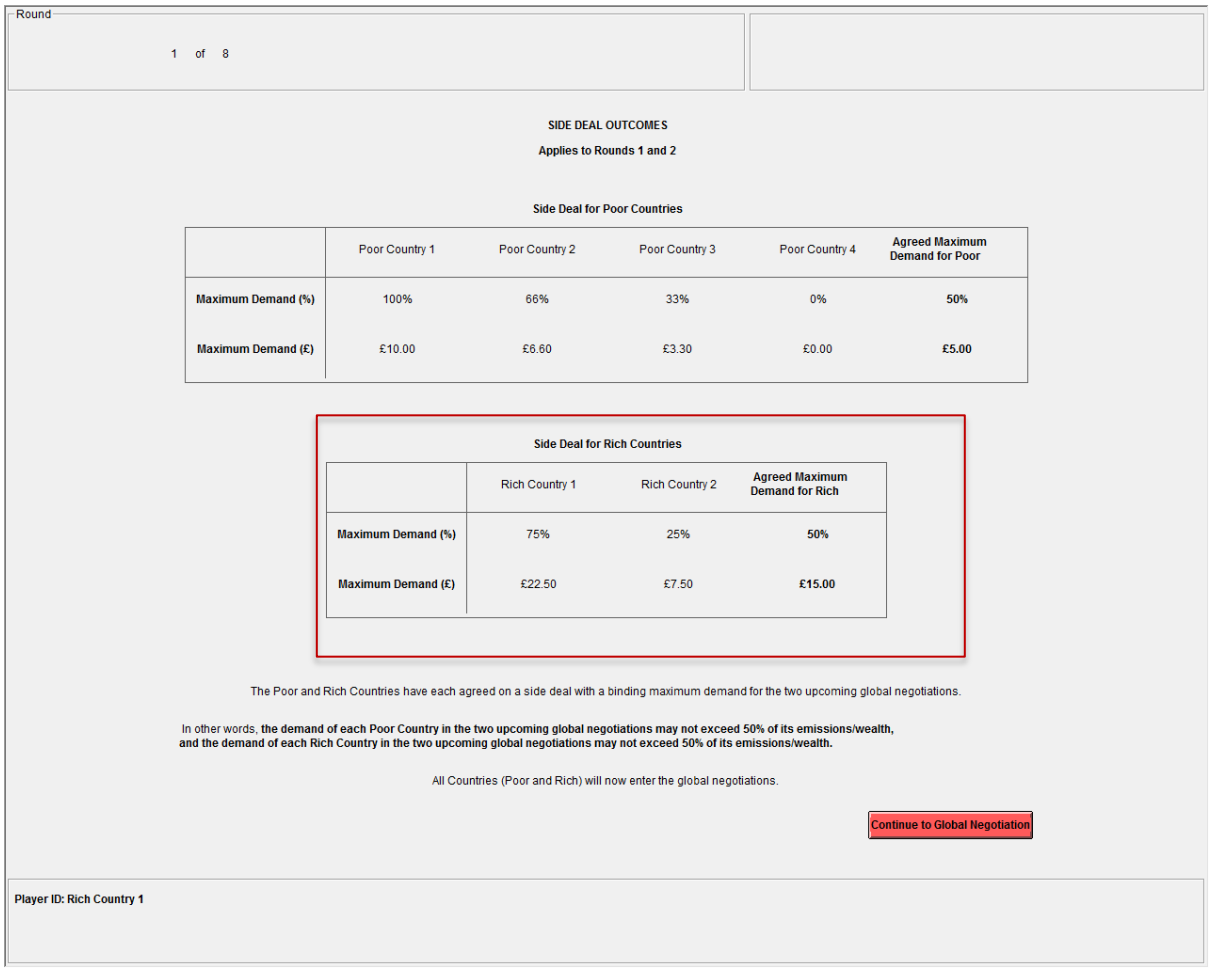

Figure S.8

- Rich Country 1 (you) chooses Maximum Demand = 75%
- Rich Country 2 chooses Maximum Demand = 25%

The resulting agreed side deal is that each Rich Country cannot exceed 50% demand in the two upcoming global negotiations, i.e. the Agreed Maximum Demand = 50%.