Supplementary Appendix to

Rich Communication, Social Preferences, and Coordinated Resistance against Divide-and-Conquer: A Laboratory Investigation (2013)

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In the text, before proceeding to our experimental design, we first discuss how rich communication may affect the behavior of victims and beneficiaries. As background for this discussion, we informally sketch in the text a model developed in Cason and Mui (2013) that was designed to study how incomplete information about social preferences and non-binding restrictive communication (in the form of a binary message) affect behavior in the repeated CR game. We then informally explain how the model can be used to demonstrate that the presence of heterogeneous social preferences transforms the subgame following a DAC transgression (the DAC subgame) into a game of incomplete information. We also state that it can be shown that an informative equilibrium exists in the CR game with social preferences and non-binding restrictive communication, in which restrictive communication can help coordinate resistance between the victim and the (*SP*-type) beneficiary.

This appendix sketches the model that we discussed informally in the text. Detailed discussion of the model and proofs of results are reported in the Technical Appendix of Cason and Mui (2013) that is available at http://users.monash.edu.au/~vlmui/CR_app.pdf.

Consider a model in which all agents are of two types. With probability p an agent has standard preferences, and with probability $(1\text{-}p)$ the agent has social preferences. An agent's type is her private information. Cox et al. (2007) assume that in a (two-player) sequential move game, when a second-mover with social preferences makes her decision after observing the action chosen by the first-mover, the second-mover's marginal rate of substitution between her income and the income of the first-mover depends on her emotional state toward the first-mover. Following this approach, and for simplicity we assume that the only emotional reaction that can be triggered in the CR game is the negative reaction toward a transgressing leader by the responders. Qualitatively, our main results hold for any social preferences models in which a social preference type beneficiary prefers that DAC be defeated.[1]

If agent *i* is a Social Preferences type (hereafter the *SP*-type) and a responder, she regards a DAC transgression by the leader as undesirable, modeled with the utility function

$$U_i\left(y_L, y_i, y_j\right) = \begin{cases} \frac{1}{\alpha}\left[y_i^{\alpha} + \theta y_L^{\alpha})\right], & \theta \in (-1,0) \text{ if } a_L \in \{TAB, TA, TB\} \\ & \theta = 0 \text{ if } a_L = NT \end{cases} \qquad (1)$$

Here, y_i is agent *i*'s income, y_L is the leader's income, y_j is the income of the other responder, θ is the (conditional) emotional state variable, and $\alpha \leq 1$ (and $\alpha \neq 0$) is an elasticity of substitution parameter. TAB denotes transgression against both responders, NT denotes No Transgression, and TA and TB denote divide-and-conquer transgression against A and B, respectively. If an agent is a Standard type (hereafter the *S*-type), then regardless of whether she is a leader or a responder, she has a utility function

$$U_i\left(y_i\right) = \frac{1}{\alpha} y_i^{\alpha}. \qquad (2)$$

Because the only emotional reaction we focus on is the negative reaction by a responder towards a transgressing leader, an *SP*-type leader will also have a utility function of $U_i\left(y_i\right) = \frac{1}{\alpha} y_i^{\alpha}$.

Result 1: If $|\theta| > \left(9^{\alpha} - 7^{\alpha}\right)/8^{\alpha}$ and $p < \left(7^{\alpha} - 2^{\alpha}\right)/\left(7^{\alpha} - 1\right)$, then each of the three following strategy profiles constitutes a Bayesian Nash Equilibrium in the DAC subgame with social preferences:

(i) Both the *S*-type victim and the *SP*-type victim acquiesce, and both the *S*-type beneficiary and the *SP*-type beneficiary acquiesce.

[1] Note that given the chosen parameter values, introducing simple inequity aversion, such as that captured in Fehr and Schmidt's (1999) well-known model, does not affect the beneficiaries' dominant strategy to acquiesce. A beneficiary challenging a transgression reduces the disutility from earning more than the transgression victim. But he also reduces his material payoff and increases his disutility from earning more than the leader when the resistance succeeds. Therefore, acquiescing remains a dominant strategy for the beneficiary. Furthermore, one can show that this implies that a leader with inequity aversion still prefers DAC transgression to no transgression. Therefore, incorporating inequity aversion does not change the conclusion that "no transgression against any responder" cannot be supported as part of an equilibrium. Inequity aversion could change the set of equilibria for other payoff parameters, however, such as the lower leader payoffs used in Weingast's (1997) original version of the game.

(ii) Both the *S*-type victim and the *SP*-type victim challenge. The *S*-type beneficiary always acquiesces, and the *SP*-type beneficiary challenges.

(iii) The *S*-type victim challenges with a probability $\beta = \frac{(1-p)(9^\alpha + \theta 8^\alpha - 7^\alpha) + p(9^\alpha - 8^\alpha)}{p(7^\alpha - 8^\alpha - \theta 8^\alpha)} \in (0,1)$, and the *SP*-type victim always challenges. The *S*-type beneficiary always acquiesces, and the *SP*-type beneficiary challenges with a probability $\gamma = \frac{2^\alpha - 1}{(1-p)(7^\alpha - 1)} \in (0,1)$.

Result 1 shows that when social preferences are sufficiently strong and that there is a sufficiently high probability that a beneficiary is an *SP*-type, then social preferences transform the DAC subgame into a stag-hunt game for the responders, with multiple (and Pareto-ranked) equilibria. The model also implies that victims will challenge more than beneficiaries, which is consistent with the empirical findings in Cason and Mui (2007). Although joint resistance can be supported as an equilibrium, incomplete information about the types of other responders and multiple equilibria can prevent joint resistance from occurring. We refer the interested reader to pp. 8-25 of the Technical Appendix of Cason and Mui (2013) that is available at http://users.monash.edu.au/~vlmui/CR_app.pdf for detailed analysis of the one-shot CR game with incomplete information about social preferences that contains the proof of Result 1 and the discussion of other results.

Now consider the effect of non-binding restrictive communication between the responders in the one-shot CR game. In the one-shot CR game with social preferences and with communication, the timing of events is as follows:

1. Nature chooses the type of each player.
2. The leader, L, chooses his action $a_L \in A_L = \{TAB, TA, TB, NT\}$.
3. At the *responder communication stage*, responders A and B observe the leader's action, and then simultaneously choose a message $m_i \in M_i = \{AC, CH\}, i = A, B$.
4. Observing the message sent by the other responder, a responder updates her belief about the type of the other responder.

5. At the *responder action stage*, each responder chooses her action $a_i \in A_i = \{AC, CH\}, i = A, B$, as a function of the observed message profile $(m_A, m_B) \in M_A \times M_B$ sent by the responders.

6. Payoffs are realized for the leader and the two responders.

In this game, the players' strategies constitute a Perfect Bayesian equilibrium if:

(E1) Given the responders' strategies, L's chosen action maximizes his expected utility.

(E2) At the responder communication stage, for any responder, given the leader's chosen action and the other responder's strategy, each type of this responder's chosen message maximizes her expected utility.

(E3) Having observed the message sent by the other responder, a responder updates her belief about the type of the other responder based on the other responder's strategy according to Bayes' rule.

(E4) At the responder action stage, for any responder and for any observed message profile, each type of this responder's action maximizes her expected utility given the leader's chosen action and the other responder's strategy.

Note that (E1) reflects the assumption that an *S*-type leader and an *SP*-type leader will behave the same in this model.

Result 2: If $-\theta > \frac{9^\alpha - 7^\alpha}{8^\alpha}$ and $p < \left(\frac{3}{4}\right)^\alpha$, then the following strategy profiles constitute a Perfect Bayesian equilibrium in the CR game with social preferences:

(i) The leader chooses NT. (ii) If the leader chooses TA, then both the *SP*-type and the *S*-type of responder A (who is the victim) will choose the message CH, while the *SP*-type of responder B (who is the beneficiary) will choose the message CH, and the *S*-type of responder B will choose the message AC. Both types of A will choose the action CH iff the observed message profile is $(m_A, m_B) = (CH, CH)$. The *SP*-type of B will choose the action CH iff the message profile is $(m_A, m_B) = (CH, CH)$, and the *S*-type of B will choose the action AC for any message profile (m_A, m_B). (iii) if the leader chooses TB, then A (who is now the beneficiary) and B (who is now the victim) will adopt strategies that are mirror images of the strategies just described when the leader chooses TA. (iv) if the leader chooses TAB, then regardless of their type, both responders will choose the message CH, and will choose the action CH iff the observed message profile is $(m_A, m_B) = (CH, CH)$. (v) if the leader chooses NT, then regardless of their type, both responders will choose the message AC, and will choose the action AC for any observed message profile (m_A, m_B).

As common in cheap talk games, a babbling equilibrium always exists, but Result 2 shows that an informative equilibrium also exists. In this equilibrium, both types of victim will indicate Challenge and will challenge if and only if both the victim and the beneficiary have indicated Challenge in the communication stage. An *SP*-type beneficiary will indicate Challenge, and will challenge if and only if both the victim and the beneficiary have indicated Challenge in their messages. An *S*-type beneficiary will indicate Acquiesce, and will acquiesce regardless of the messages sent by the victim and beneficiary. These strategies constitute an equilibrium because an *SP*-type beneficiary prefers that a DAC transgression be defeated and has the incentive to send a message of CH to indicate that she is an *SP*-type so as to induce coordinated resistance with the victim. On the other hand, an *S*-type beneficiary prefers that a DAC transgression succeeds, and has no incentive to deviate to send a message of Challenge. Communication can help coordinate resistance against DAC in this environment. We refer the interested reader to pp. 64-77 of the Technical Appendix of Cason and Mui (2013) that is available at http://users.monash.edu.au/~vlmui/CR_app.pdf for detailed analysis of the one-shot CR game with incomplete information about social preferences and restrictive communication that contains the proof of Result 2 and the discussion of other results.

References

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