Signalling With “Extreme” Cost of Lying and Mixed Strategies

The Three

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Contents

1 Assumptions

Players have equiprobable types C, D with payoff structures

Own\ Opponent	H	L
H	a	10
L	24	20

Type C

Own\ Opponent	H	L
H	22	10
L	24	20

Type D

Table 1: Regime NC ($a \in \{30, 50\}$)

There are two types: agents who have no cost of lying (type o for "opportunists"?) and agents who keep their promise (type p for promise keeper) if they communicate.

Notation

- $x_k(i, j)$, $k \in \{o, p\}$ is the strategy of C_k in state (i, j). By assumption, $x_p(1, j) = 1$.
- α_k is the communication strategy of C_k and β_k is the communication strategy of D_k.
- The probabilities that types C and D send a message are, respectively,

$$\alpha^* = (1 - \pi)\alpha_o + \pi\alpha_p$$
$$\beta^* = (1 - \pi)\beta_o + \pi\beta_p$$

- Let $x^*(i, j)$ the probability that a player of type C plays H in state (i, j). Hence,

$$x^*(1, j) = \frac{(1 - \pi)\alpha_o x_o(1, j) + \pi\alpha_p}{\alpha^*}$$

and

$$x^*(0, j) = \frac{(1 - \pi)(1 - \alpha_o)x_o(0, j) + \pi(1 - \alpha_p)x_p(0, j)}{1 - \alpha^*}$$

SInce C_o, C_p have the same strategy space and same payoffs, we will assume without loss of generality that $x_o(0, j) = x_p(0, j)$.

2 Summary of Results

We summarize our findings (proven in the Appendix) of our findings.

	Theory	Exp
α^*	0.4	0.49
β^*	0	0.04
$x^*(1,1)$	1	0.99 - 1
$x^*(0,1)$	1	0.87 - 0.88
$x^*(1,0)$	1	0.74 - 0.75
$x^*(0,0)$	0.74	0.31 - 0.46

F50

	Theory	Exp
α^*	1	0.82
β^*	$1-\pi$	0.43
$x^*(1,1)$	1	0.96
$x^*(0,1)$	1	0.62 - 0.76
$x^*(1,0)$	π	0.34 - 0.45
$x^*(0,0)$	0	0.17 - 0.32

C50 ($\pi > \frac{10}{23}$)

state $(0,1)$ is an out-of-equilibrium state

	Theory	Exp
α^*	$\frac{8}{3}(1-\pi)$	0.3
β^*	0	0.03
$x^*(1,1)$	1	0.86 - 0.88
$x^*(0,1)$	$\frac{31-70\pi}{10(5-8\pi)}$	0.77 - 0.68
$x^*(1,0)$	$\frac{5}{8}$	0.66 - 0.61
$x^*(0,0)$	0	0.08 - 0.16

F30 ($\pi \leq \frac{31}{70}$)

	Theory	Exp
α^*	1	0.75
β^*	$1-\pi$	0.53
$x^*(1,1)$	1	0.68 - 0.48
$x^*(0,1)$	1	0.42 - 0.15
$x^*(1,0)$	π	0.26 - 0.13
$x^*(0,0)$	0	0.12 - 0.1

C30

state $(0,1)$ is an out-of-equilibrium state

Remark 1. For C30, if $\pi \in [2/5, 10/13]$, there is another equilibrium that is considered in the Appendix, but the equilibrium values do not fit as well.

The case F30 is the worst performing: impossible to have α^* and $x^*(0,1)$ to be both in the 'ballpark' experimental values. The problem is that in order to play H in state $(0,1)$, C must believe that the opponent cooperates sometimes. We can show that $x_o(1,0) = 0$; hence it must be that a communicating opponent is sometimes of type C_p. This implies however than $\alpha_o = 1$: indeed because $x_o(1,0) = 0$, C_p who is 'forced' to play H after communicating must have a strictly lower payoff from communication than C_o. However because both C_o, C_p have the same payoff if they do not communicate, it follows that $\alpha_p > 0 \Rightarrow \alpha_o = 1$, but then a lower bound on α^* is $(1-\pi)$, and in order to have $\alpha^* = 0.3$, π must be (unrealistically) large.

Remark 2.

- In the final paper, may want to introduce the idea of "monotonic" strategies, in the sense that independently of her communication strategy, a player is more likely to cooperate (play H) if the other player communicated, that is $x_o(1,1) \geq x_o(1,0)$ and $x(0,1) > x(0,0)$. Note that this allows situations like $x_o(1,0) < x(0,1)$.

  A consequence of having monotonic strategies is that in C50 and C30, types C_o, C_p, D_o communicate with probability one. Turns out that in the experiments, strategies seem to be monotonic.

- We ignore equilibrium with $x_o(1,1) = 0$: they do not seem consistent with experimental data. Also, we always have equilibria that replicate the no-communication equilibria, that we also ignore.

Appendix

A High Value of Cooperation $a = 50$

A.1 F50

In the case of F30 and F50, $\beta_o = \beta_p = 0$: indeeed, by communicating, a D_o player can get at most a benefit of 2 while the cost of communication is 3.[1]

Incentives to play H

State $(1,1)$**,** the incentive condition for C_o to play $x(1,1) > 0$ is:

$$\begin{aligned}(1-\pi)(10+40x_o(1,1)) + \pi 50 \\ \geq (1-\pi)(20+4x_o(1,1)) + \pi 24\end{aligned}$$

or

$$x_o(1,1) \geq \frac{5-18\pi}{18(1-\pi)}$$

which can be satisfied for any value of π. In particular, for any value of π, it is possible to have $x_o(1,1) = 1$. For $\pi \leq \frac{5}{18}$ there is also the mixed strategy $x_o(1,1) = \frac{5-18\pi}{18(1-\pi)}$.

[1] The strategy of player D_k depends on whether she communicates but not on the communication of her opponent, hence $y_k(i,1) = y_k(i,0)$ for all $k = 1, \infty$ and $i = 0, 1$. Hence, communicating or not yields the same payoff for a type D when facing another type D. The most D can get against a type C playing H is equal to 4, hence 2 in expectation.

State $(1,0)$**,** because the probablity than an opponent does not communicate is equal to $\frac{2-\alpha}{2}$, $x_o(1,0) \in (0,1]$ is a best response when

$$(1-\pi)\frac{1-\alpha}{2-\alpha}(10+40x_o(0,1)) + \pi\frac{1-\alpha}{2-\alpha}(10+40x_p(0,1)) + \frac{1}{2-\alpha}10$$
$$\geq (1-\pi)\frac{1-\alpha}{2-\alpha}(20+4x_o(0,1)) + \pi\frac{1-\alpha}{2-\alpha}(20+4x_p(0,1)) + \frac{1}{2-\alpha}20$$

Note that this is the same condition for type C_p and that the condition depends on the average value $(1-\pi)x_o(0,1) + \pi x_p(0,1)$. Hence, there is no loss of generality in assuming that $x_o(0,1) = x_p(0,1)$.[2] Hence, for the common value $x(0,1)$, we need

$$x(0,1) \geq \frac{5(2-\alpha)}{18(1-\alpha)}$$

which is possible if $\alpha \leq \frac{8}{13}$.

State $(0,1)$**,** playing $x(0,1) > 0$ is a best response when

$$(1-\pi)(10+40x_o(1,0)) + \pi 50$$
$$\geq (1-\pi)(20+4x_o(1,0)) + \pi 24$$

or

$$x_o(1,0) \geq \frac{5-18\pi}{18(1-\pi)}.$$

The right hand side is clearly less than one, is decreasing in π and positive for $\pi \leq \frac{5}{18}$. If $\pi > \frac{5}{18}$, then necessarily $x(0,1) = 1$.

[2]This does not affect the incentives of types D to communicate either.

State $(0,0)$**,** playing H is a best response when[3]

$$(1-\pi)\frac{1-\alpha}{2-\alpha}(10+40x_o(0,0))+\pi\frac{1-\alpha}{2-\alpha}(10+40x_p(0,0))+\frac{1}{2-\alpha}10$$
$$\geq(1-\pi)\frac{1-\alpha}{2-\alpha}(20+4x_o(0,0))+\pi\frac{1-\alpha}{2-\alpha}(20+4x_p(0,0))+\frac{1}{2-\alpha}20$$

The condition depends on the average probability $x(0,0) := (1-\pi)x_o(0,0)+\pi x_p(0,0)$, and requires that

$$x(0,0) \geq \frac{5(2-\alpha)}{18(1-\alpha)}.$$

which is possible if $\alpha \leq \frac{8}{13}$

To summarize the best responses and – if relevant – the conditions on π, α are the following for having $x_k(i,j)$ positive:

- $x_o(1,1)\begin{cases} = 1 & \text{if } \pi > \frac{5}{18} \\ \in \left\{1, \frac{5-18\pi}{18(1-\pi)}\right\} & \text{if } \pi \leq \frac{5}{18} \end{cases}$
- Can always have $x_o(1,0) = x(0,1) = 0$
- For $\pi \leq \frac{5}{18}$, and $\alpha \leq \frac{8}{13}$, we can also have the mixed strategies $x_o(1,0) = \frac{5-18\pi}{18(1-\pi)}$ and $x(0,1) = \frac{5(2-\alpha)}{18(1-\alpha)}$.
- $x(0,0)\begin{cases} = 0 & \text{if } \alpha > \frac{8}{13} \\ \in \left\{1, \frac{5(2-\alpha)}{18(1-\alpha)}\right\} & \text{if } \alpha \leq \frac{8}{13}. \end{cases}$

Incentives to communicate

We assume that $x(i,j) > 0$ for all states (i,j).

We are left verifying the indifference condition for types C in communication ($\alpha \in (0,1)$).

[3]The condition is similar to the condiiton on $x(0,1)$ in the state $(1,0)$, this would not be the case if type C_o has a small cost of lying for then playing L in state $(1,0$ generates an expected payoff that is lower – for a given probability of playing H by types C who do not communicate.

$$\alpha\left[\frac{1-\pi}{2}(10+40x_o(1,1))+\frac{\pi}{2}50\right]+(1-\alpha)\frac{1}{2}(10+40x(0,1))+\frac{1}{2}10-3$$
$$=\alpha\left[\frac{1-\pi}{2}(10+40x_o(1,0))+\frac{\pi}{2}50\right]+(1-\alpha)\frac{1}{2}(10+40x(0,0))+\frac{1}{2}10.$$

The condition reduces to

$$\alpha(1-\pi)(x_o(1,1)-x_o(1,0))+(1-\alpha)(x(0,1)-x(0,0))=\frac{3}{20}. \quad (1)$$

If we assume $\alpha \leq \frac{8}{13}$, we can have $x_o(1,1)=x_o(1,0)=x(0,1)=1$ and the incentive condition is

$$(1-\alpha)(1-x(0,0))=\frac{3}{20}.$$

Clearly, one must have $x(0,0)=\frac{5(2-\alpha)}{18(1-\alpha)}$. Plugging this value in the previous expression, we obtain

$$\alpha=\frac{53}{130}\approx 0.4.$$

which is consistent with our assumption that $\alpha \leq \frac{8}{13}$. Then,

$$x(0,0)=\frac{115}{154}\approx 0.74.$$

The continuation strategies are consistent 'qualitatively' with the experimental values: players play H less often in state $(0,0)$ than in the other states, and the probabilities of communication per type are also consistent with the experimental value (0.4 instead of 0.49 for C and 0 instead of 0.04 for D).

Note that these results are independent of the value of π. This will not be the case for the regime without an exogenous cost of communication.

	Theory	Exp
α^*	0.4	0.49
β^*	0	0.04
$x^*(1,1)$	1	0.99 - 1
$x^*(0,1)$	1	0.87 - 0.88
$x^*(1,0)$	1	0.74 - 0.75
$x^*(0,0)$	0.74	0.31 - 0.46

Table 4: F50

A.2 C50

There is no exogenous cost. Guided by our previous argument, we assume without loss of generality that $x_o(0,1) = x_p(0,1)$ and that types C_o, C_p communicate with the same probability α.

Remark 3. Compared to the previous version of the model, C_o does not bear a cost-of-lying of 1. This makes it *less* likely that C_o will play H in states $(1, j)$. On the other side, type D_o (previous type D_1) does not have a cost of lying either and therefore has *more incentives to communicate.*

If D_o communicates, he will play L and weakly prefers this to not communicate if H is more likely to be played by a player who communicates. By contrast, because D_p is constrained to play H after communication, she will strictly prefer to not communicate.[4] The probability that type D_o communicates is β_o. Hence, in the experimental data,

$$\beta^* = (1-\pi)\beta_o$$

Rather than going through all the possible cases, we will consider the experimental results to guide our search for an equilibrium.

[4]The same logic does not apply to types C because if $x_o(1,0)$ is positive, type C_p also *wants* to play H. If however types D_o plays L after communication, type D_p *cannot commit to* play L because of the cost of lying

In the mode $C50$, the experimental results are (the second number corresponds to the last five periods of the experiment)

- $\alpha^* = 82\%$, $\beta^* = 43\%$: this suggests that both types C_o, C_p communicate, but not with probability one, and that (type D_o communicates with probability close to $\frac{0.4}{1-\pi}$.
- $x(1,1) = 97\% - 96\%$.[5]
- $x(1,0) = 45\% - 34\%$.
- $x(0,1) = 76\% - 61\%$.
- $x(0,0) = 32\% - 17\%$.

Hence, the equilibrium mode most likely to fit the data is when only D_p does not communicate. We need to verify the incentive compatibility conditions for $x(i,j)$. We will restrict attention to equilibria with $\alpha^* > \beta^*$, consistent with the experimental findinds.

Continuation Strategies for C

State $(1,1)$**.** Playing H is optimal for C_o if

$$(1-\pi)\alpha_o(10+40x_o(1,1)) + \pi\alpha_p 50 + (1-\pi)\beta_o(10) \\ \geq (1-\pi)\alpha_o(20+4x_o(1,1)) + \pi\alpha_p(24) + (1-\pi)\beta_o(20)$$

or, using $\pi\alpha_p = \alpha^* - (1-\pi)\alpha_o$, when

$$x_o(1,1) \geq 1 - \frac{13\alpha^* - 5\beta^*}{18(1-\pi)\alpha_o}. \tag{2}$$

[5]Because $x(1,1) = Pr(C_o|1,C)x_o(1,1) + Pr(C_p|1,C) = 1 - Pr(C_o|1)(1 - x_o(1,1))$, $Pr(C_o|1,C)(1 - x_o(1,1))$ is small (smaller than 4%). Same logic for the other cases

State $(1,0)$. Playing H is a best response for C_o if

$$\begin{aligned}(1-\alpha)(10{+}40x(0,1)) &+ ((1-\pi)(1-\beta_o)+\pi)10 \\ &\geq (1-\alpha)(20+4x(0,1)) + ((1-\pi)(1-\beta_o)+\pi)20\end{aligned}$$

or,

$$x(0,1) \geq \frac{5}{18}\frac{2-\alpha^*-\beta^*}{1-\alpha^*}.$$

The bound is clearly positive and is not greater than one when

$$13\alpha^* \leq 5\beta^* + 8.$$

which is impossible if $\alpha^* > \beta^*$. Hence, $x_o(1,0) = 0$, implying that $x^*(1,0) = \frac{\pi\alpha_p}{\alpha^*}$, that is the conditional probability that C is of type C_p conditional on communicating.

State $(0,1)$. Playing H is a best response for C if

$$\begin{aligned}(1-\pi)\alpha_o(10{+}40x_o(1,0)) &+ \pi\alpha_p 50 + (1-\pi)\beta_o(10) \\ &\geq (1-\pi)\alpha_o(20+4x_o(1,0)) + \pi\alpha_p(24) + (1-\pi)\beta_o(20)\end{aligned}$$

hence, using $x_o(1,0) = 0$;

$$0 \geq 1 - \frac{13\alpha^* - 5\beta^*}{18(1-\pi)\alpha_o}.$$

which is possible only if

$$\pi\alpha_p \geq \frac{5}{18}(\alpha^* + \beta^*). \tag{3}$$

State $(0,0)$**.** Playing H is optimal under a similar condition as in state $(1,0)$, that is $x(0,0)>0$ when

$$x(0,0)\geq \frac{5}{18}\frac{2-\alpha^*-\beta^*}{1-\alpha^*}.$$

the right hand side is greater than one when $\alpha^*>\beta^*$, and therefore $x^*(0,0)=0$.

Incentives to Communicate

D weakly prefers to communicate than not communicating ($\beta_o>0$) when

$$\begin{aligned}(1-\pi)[\alpha_o(20+4x_o(1,1))+(1-\alpha_o)(20+4x(0,1)))]&\\ +\pi[\alpha_p 24+(1-\alpha_p)(20+4x(0,1)]+20&\\ \geq(1-\pi)[\alpha_o(20+4x_o(1,0))+(1-\alpha_o)(20+4x(0,0))]&\\ +\pi[\alpha_p 24+(1-\alpha_p)(20+4x(0,0)]+20&\end{aligned}$$

or,

$$\alpha_o(1-\pi)(x_o(1,1)-x_o(1,0))+(1-\alpha^*)(x(0,1)-x(0,0))\geq 0 \qquad (4)$$

This is the same condition as for C_p, hence if $\beta_o>0$, we also have $\alpha_p>0$. Type C_o is not constrained in her actions after communicating and because $x_o(1,0)=0$, it must be the case that $\alpha_o=1$ if α_p is positive.

In keeping with the values in the experiment, H is played more often in state $(1,1)$ than in state $(1,0)$ and also more often in state $(0,1)$ than in state $(0,0)$. Hence the incentive condition (**??**) is not binding, imply that $\alpha^*=\beta_o=1$.

While type D_o strictly prefers to communicate, it is clear that type D_∞ prefers not to communicate in order to avoid having to commit his (in the static game) dominated strategy. Therefore, $\beta^*=1-\pi$ and $\alpha^*=1$. It follows that equilibria are in pure strategies.

If $\alpha_p = \alpha^* = 1$ and $\beta^* = 1-\pi$, (??) is $x_o(1,1) \geq \frac{10-23\pi}{18(1-\pi)}$ while (??) is $0 \geq \frac{10-23\pi}{18(1-\pi)}$. Hence a necessary condition to have $x(0,1)$ positive is that $\pi \geq \frac{10}{23}$, in which case we have generically $x(0,1) = x_(1,1) = 1$

The table below compares the theoretical values to the experiment values when using the "closest" theoretical values. (Note that as $\alpha^* = 1$, state $(0,1)$ is an out-of-equilibrium state for type C agents.)

	Theory	Exp
α^*	1	0.82
β^*	$1-\pi$	0.43
$x^*(1,1)$	1	0.96
$x^*(0,1)$	1	0.62 - 0.76
$x^*(1,0)$	π	0.34 - 0.45
$x^*(0,0)$	0	0.17 - 0.32

Table 5: C50 ($\pi > \frac{10}{23}$)

B Low Value of Cooperation $a = 30$

B.1 F30

Following similar steps as for F50, we find the following possible continuation strategies. As in F50, only types C communicate and therefore upon communicating, a type C_o faces type C_o in state $(1,1)$ with probability $\frac{(1-\pi)\alpha_o}{\alpha^*}$ and type C_p with probability $\frac{\pi\alpha_p}{\alpha^*}$, where $\alpha^* := (1-\pi)\alpha_o + \pi\alpha_p$. Hence playing H is a best response when

$$(1-\pi)\alpha_o(10 + 20x_o(1,1)) + \pi\alpha_p 30 \geq (1-\pi)\alpha_o(20 + 4x_o(1,1)) + \pi\alpha_p 24,$$

that is when

$$x_o(1,1) \geq \frac{5}{8} - \frac{3\pi\alpha_p}{8(1-\pi)\alpha_o}$$

or using $\pi\alpha_p = \alpha^* - (1-\pi)\alpha_o$,

$$x_o(1,1) \geq 1 - \frac{3\alpha^*}{8(1-\pi)\alpha_o}. \tag{5}$$

Clearly, for any value of π, $x_o(1,1) = 1$ satisfies this condition, but if $8(1-\pi)\alpha_o > 3\alpha^*$, there is also a mixed strategy where $x_o(1,1) = 1 - \frac{3\alpha^*}{8(1-\pi)\alpha_o}$. For the pure strategy, $x^*(1,1) = 1$; for the mixed strategy, $x^*(1,1) = \frac{5}{8}$.

In state $(1,0)$, playing H is a best response for type C_o only if

$$\begin{aligned}((1-\pi)(1-\alpha_o) + \pi(1-\alpha_p))(10 + 20x(0,1)) + 10 \\ \geq ((1-\pi)(1-\alpha_o) + \pi(1-\alpha_p))(20 + 4x(0,1)) + 20\end{aligned}$$

that is when

$$x(0,1) \geq \frac{5(2-\alpha^*)}{8(1-\alpha^*)}$$

which is clearly impossible as the right hand side is greater than one. Hence $x_o(1,0) = 0$ and $x^*(1,0) = \pi\frac{\alpha_p}{\alpha^*}$.

Therefore, in state $(0,1)$, player C can get cooperation only from a C_p individual. Hence, playing $x(0,1) > 0$ is optimal when

$$(1-\pi)\alpha_o 10 + \pi\alpha_p 30 \geq (1-\pi)\alpha_o 20 + \pi\alpha_p 24$$

that is when

$$\alpha^* \geq \frac{8}{3}(1-\pi)\alpha_o. \tag{6}$$

If $\alpha^* = \frac{8}{3}(1-\pi)\alpha_o$, $x(0,1)$ can take any value in $[0,1]$, in particular can be chosen to be inferior to $x^*(1,1)$.

Finally, in state $(0,0)$, like in state $(1,0)$, we must have $x(0,0) = 0$.

Because $x_o(1,0) = 0$, type C_p has a lower expected payoff from communication than type C_o. Therefore, if C_p wants to commmunication, $\alpha_o = 1$. But then, in order to have $x(0,1) > 0$, we need to satisfy (**??**) for these values, that is to have

$$\alpha_p = \frac{5}{3}\frac{1-\pi}{\pi}. \tag{7}$$

Finally, given $x_o(1,1)=1$, $x_o(1,0)=0$, $x(0,1)>0$ and $x(0,0)=0$, type C_p is indifferent between communicating and not when

$$\begin{aligned}\frac{1}{2}&\left((1-\pi)30+\pi\alpha_p 30+\pi(1-\alpha_p)(10+20x(0,1))+10\right)-3\\ &=\frac{1}{2}\left((1-\pi)10+\pi\alpha_p 30+\pi(1-\alpha_p)20+20\right)\end{aligned}$$

Using (**??**), this yields to

$$x(0,1)=\frac{31-70\pi}{10(5-8\pi)}$$

which is possible when $\pi \leq \frac{31}{70}$. Then, $\alpha^* = (1-\pi)+\frac{5}{3}(1-\pi)=\frac{8}{3}(1-\pi)$ and $x^*(1,0)=\frac{\pi\alpha_p}{\alpha^*}=\frac{5}{8}$.

There is a poor fit of the theory with the empirical values. In ordre for α^* to be of the order of 0.3, π must be of the order of 0.88, which is greater than $\frac{31}{70}$, the maximum value consistent with $x(0,1)$ positive. Similarly, to have $x(0,1)$ of the order of 0.7, π should be approximately equal to 0.28, but then the theoretical value of α^* would be greater than 1.

B.2 C30

As for the C50 case, type D_p equilibrium strategy must be $\beta_p=0$.

In state $(1,1)$, playing H is a best response for C_o only if

$$x_o(1,1) \geq 1-\frac{3\alpha^*-5\beta^*}{8(1-\pi)\alpha_o}. \tag{8}$$

Similar computations as in C50 show that

- $x_o(1,0)$ is positive if $x(0,1) \geq \frac{5}{8}\frac{2-\alpha^*-\beta^*}{1-\alpha^*}$, which is not possible if $\alpha^* > \beta^*$. Hence, $x_o(1,0)=0$ and $x^*(1,0)=\pi\frac{\alpha_p}{\alpha^*}$.

	Theory	Exp
α^*	$\frac{8}{3}(1-\pi)$	0.3
β^*	0	0.03
$x^*(1,1)$	1	0.86 - 0.88
$x^*(0,1)$	$\frac{31-70\pi}{10(5-8\pi)}$	0.77 - 0.68
$x^*(1,0)$	$\frac{5}{8}$	0.66 - 0.61
$x^*(0,0)$	0	0.08 - 0.16

Table 6: F30 ($\pi \leq \frac{31}{70}$)

- $x(0,1)$ can be positive only if $x_o(1,0) = 0 \geq 1 - \frac{3\alpha^* - 5\beta^*}{8(1-\pi)\alpha_o}$
- $x(0,0)$ is equal to zero.

Given this, the incentive constraint for D_o to be willing to communicate is the same as in C50, that is (**??**). Hence, $\alpha_o = \alpha_p = \beta_o = 1$, and $\alpha^* = 1; \beta^* = 1 - \pi$. (Note that the state $(0,1)$ is an out of equilibrium state for players of type C.)

It follows that $x_o(1,1)$ can be positive if $x_o(1,1) \geq \frac{1098-13\pi}{8(1-\pi)}$. A mixed strategy $x_o(1,1) = \frac{10-13\pi}{8(1-\pi)}$ exists if the right hand side belongs to the interval $[0,1)$, that is $\pi \in \left(\frac{2}{5}, \frac{10}{13}\right)$. In this case, $x^*(1,1) = (1-\pi)x_o(1,1) + \pi = \frac{10-5\pi}{8}$, which ranges in the interval $\left(\frac{10}{13}, 1\right)$ when $\pi \in \left(\frac{2}{5}, \frac{10}{13}\right)$.

If $\pi \leq \frac{10}{13}$, $1 - \frac{3\alpha^* - 5\beta^*}{8(1-\pi)\alpha_o}$ is positive, and therefore $x^*(0,1) = 0$. As $\alpha = \alpha^*$, $x^*(1,0) = \pi$. If $\pi > \frac{10}{13}$, we have $x_o(1,1) = x(0,1) = 1$.

	Theory	Exp
α^*	1	0.75
β^*	$1-\pi$	0.53
$x^*(1,1)$	$\frac{10-5\pi}{8}$	0.68 - 0.48
$x^*(0,1)$	0	0.42 - 0.15
$x^*(1,0)$	π	0.26 - 0.13
$x^*(0,0)$	0	0.12 - 0.1

(a) C30 ($\pi \in [2/5, 10/13]$)

state $(0,1)$ is an out-of-equilibrium state

	Theory	Exp
α^*	1	0.75
β^*	$1-\pi$	0.53
$x^*(1,1)$	1	0.68 - 0.48
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$x^*(0,0)$	0	0.12 - 0.1

(b) C30 ($\pi > 10/13$)

state $(0,1)$ is an out-of-equilibrium state

Table 7: C30