European Economic Review 108 (2018) 172–190

Contents lists available at ScienceDirect

European Economic Review

journal homepage: www.elsevier.com/locate/euroecorev

Payoff inequity reduces the effectiveness of correlated-equilibrium recommendations☆

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ARTICLE INFO

Article history:
Received 25 September 2017
Accepted 10 July 2018
Available online 17 July 2018

JEL classification:
C72
D81
D83
D03
C92

Keywords:
Correlated equilibrium
Recommendations
Inequity
Other-regarding behaviour
Level-k reasoning

ABSTRACT

We examine theoretically and experimentally how individuals' willingness to follow third-party recommendations in 2×2 games is affected by payoff asymmetry. We consider six versions of Battle-of-the-Sexes. Recommendations imply monetary payoffs that are equal ex ante, but unequal ex post. So, although following recommendations constitutes a Nash equilibrium under standard preferences, sufficiently inequity-averse players can rationally disobey a recommendation that would lead to a very unfavourable payoff distribution, as long as the cost of doing so is not too large. Our theoretical model incorporates inequity aversion, along with level-*k* reasoning. Our main experimental result is consistent with the model: as either payoff asymmetry increases or the cost of disobeying an unfavourable recommendation decreases, subjects are more likely to disobey recommendations.

1. Introduction

Coordination problems are ubiquitous in economics. Theoretical study of these settings dates back at least to the work of Schelling (1960), and experimental study dates back almost as far (see Ochs, 1995 and Camerer, 2003, pp. 336–407 for surveys of early experiments). From the beginning, experiments have confirmed that coordination failure is a very real possibility, and a large strand of this literature has investigated ways of overcoming coordination problems. Some well-known tools are shared history (Van Huyck et al., 1991), focal points (Mehta et al., 1994), communication (Farrell, 1987), financial incentives (Brandts and Cooper, 2006) and competition (Bornstein et al., 2002).

Another tool that has received some attention is the use of external signals. While theoretically signals serve mainly to expand the set of equilibria (which in principle ought to exacerbate the coordination problem), behaviourally they often improve coordination substantially. This is especially true when signals take the form of *recommendations* – that is, when

☆ Much of this work took place when Anbarcı was at Deakin University. Financial support from Boğaziçi University (BAP 7921) and Deakin University is gratefully acknowledged. We thank John Duffy, Philip J. Grossman, Doruk Iris, Vai-Lam Mui, Aaron Nicholas, two anonymous referees, and participants at several conferences and seminars for helpful comments.

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https://doi.org/10.1016/j.euroecorev.2018.07.003
0014-2921/

G(M,n)		Player 2	
		A	B
Player 1	A	$0,0$	M,n
	B	n,M	$0,0$

Fig. 1. General form of our BoS games (with $0<n<M$).

the mapping from signals to intended outcomes is so obvious that it arguably approaches common knowledge – as the literature on correlated equilibrium induced by computer-generated recommendations (Bone et al., 2013; Cason and Sharma, 2007; Duffy and Feltovich, 2010; Kurz et al., 2018) has shown.[1]

As a simple example of how these recommendations can work, consider two cars approaching a four-way intersection at night, one from the south (S) travelling north and the other from the west (W) travelling east. One needs to yield or stop so that the other can pass, but both drivers prefer that the other car does so. There are two pure-strategy Nash equilibria (driver S stops to let driver W pass, or W lets S pass), but neither is likely to be focal, since neither equilibrium exhibits *label salience*, while each is *payoff salient* for only one of the two drivers.[2] Moreover, solving the coordination problem by communication between the drivers is likely to be difficult. Suppose, however, the intersection contains a traffic light that – as the cars approach – is equally likely to show green to either car (and red to the other). As long as both drivers understand the signals' literal meanings, this source of third-party recommendations will solve the coordination problem. Indeed, the recommendations are self-enforcing: as long as the driver facing the red light understands that the other car (facing a green light) will continue without stopping, he prefers to stop, and similarly the driver facing the green light will prefer to go.

The experimental literature on third-party recommendations used for solving coordination problems, while fairly small, has already examined some of the factors that make such recommendations more or less effective. Cason and Sharma (2007) found that recommendations were more effective when the level of strategic uncertainty was reduced (by having subjects play against computers that always followed recommendations, rather than against other humans). Duffy and Feltovich (2010) found that recommendations were more effective when they induce a correlated equilibrium (i.e., when following them constitutes a Nash equilibrium) with expected payoffs higher for both players than in the symmetric Nash equilibrium. Bone et al. (2013) find that recommendations are less effective when there exists a cooperative outcome that maximises joint payoffs but which is not recommended by the third party. (See also Moreno and Wooders, 1998, which to our knowledge is the first experimental paper looking specifically at correlated equilibrium.)

In this paper, we examine another potentially relevant factor: the *fairness* of the recommendations. To illustrate its potential impact, return to our traffic-light example, but suppose the intersection is near a chemical plant producing a very unpleasant smell; the driver who stops is exposed to the foul smell for the duration of the red light, while the other driver mostly avoids it.[3] The worse the disutility from the odour, the greater is the difference between the payoff to the driver getting the green light and the driver getting the red light; this is true even though the drivers' expected payoffs are ex-ante equal.[4] If this difference becomes sufficiently large, the driver facing the red light may well be tempted to ignore it and take his chances with the cross-traffic.

Consider the class of Battle-of-the-Sexes (BoS) games shown in Fig. 1, with $0<n<M$. Each member of this class has two strict pure-strategy Nash equilibria: (A, B) and (B, A), in addition to a mixed-strategy equilibrium that is symmetric but Pareto dominated by either of the pure equilibria. Without any way of breaking the symmetry between the players (who face an identical decision), behaviour is likely to be characterised by the mixed equilibrium. However, both players stand to benefit if a non-strategic third party recommends either of the pure equilibria with equal probability (i.e., with probability one-half, it recommends Player 1 to choose A and Player 2 to choose B, and with probably one-half, it reverses the recommendations). Not only are expected payoffs higher than in the mixed equilibrium, but following the recommendations is itself an equilibrium.

The equilibrium induced by recommendations is *ex-ante payoff equitable*, since if both players follow recommendations, each gets the same ex-ante (i.e., before recommendations are received) expected payoff of $(M+n)/2$. But it is not *ex-post payoff equitable*: after the recommendation is made, one player is "favoured" (with a payoff of M if recommendations are followed) and the other is "unfavoured" (with a payoff of $n<M$). If both players are *self-regarding* (own expected payoff maximising), then this ex-post unfairness is irrelevant; they will follow the recommendations no matter how unequal the

[1] See also the closely related experimental literature on sunspots (Duffy and Fisher, 2005).

[2] The "label salience" of an action profile is the extent to which it is focal due to the names of its component actions, while its "payoff salience" arises from the corresponding payoffs. These concepts come from Schelling (1960), though to our knowledge he did not use the terms themselves.

[3] Alternatively, loud music might be coming from a nearby house, or the intersection might be in a high-crime area so that the driver who stops risks being car–jacked.

[4] Kurz et al. (2018) consider *ex-ante* payoff asymmetry (in their words, "procedural fairness") in their experiment (in our traffic-light example, how likely each player is to get the green light). They find that it has little effect on whether recommendations are followed.