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Frames and social games

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ABSTRACT

In this paper, we model socially-embedded games. We use non-cooperative game forms with pure strategy Nash equilibria and embed them through framing structures. These frames alter how players perceive the game, or rule out the choice of some elements of players' option sets. In this way, we explicitly link the notion of social game to concepts taken from Erving Goffman's theory of interaction. According to Goffman, game theory is flawed because it applies a single-level model to two-leveled situations, ignoring the fact that people form impressions and expectations during or before any strategic game. In this essay, we provide a set-up endowed with these two levels. Firstly, players *endogenize* a given setting and frame the interaction. This determines what kind of game they will play. Secondly, they select Nash equilibrium strategies. As we shall discuss, it is possible in this way to consider how frames operate and what role they have in determining Nash solutions of non-cooperative games.

1. Introduction

During the last twenty years several books have provided alternative syntheses of what economists consider useful of contemporary game theory.[1] A common feature of these contributions is that they contain few references to the "*social* dimension" of strategic interaction. For instance, according to the well-established Arrowian tradition, in the impressive 639-page volume "*Playing for real*" by Ken Binmore, a master in game theory, the adjective "social" almost always is matched with "welfare functions" or "decision rules". Indeed, this restrictive interpretation of the social nature of strategic interaction makes game theory *sociologically-reductionist* and endorses an excessively individualistic notion of interaction order. For instance, take the concept of Nash equilibrium (Nash, 1951). As is well known, Nash suggests that the interaction order results from the correspondence of *individual* best responses, but he ignores the fact that, in many cases, this order is impossible without *non-individualistic* categories, mechanisms or constructions. Moreover, as the work of Thomas Shelling has clearly anticipated (see Shelling, 1960), even the kind of order an interaction achieves could be dictated by social factors, normative principles or interpersonal conventions. Neoclassic economists, however, prefer to suppose that social influences simply shape players' preference ordering over game outcomes. Impressions, relational status, social pressures and social stigma do not play any role in their theories.

Methodologically, there are good reasons explaining why social structures, social roles and socially-determined norms of behavior have been widely neglected by economic science. To inject social structures in games would have driven early game theory too far from the realm of intentional action, and strategic interactions in which actions and outcomes are only loosely determined by individual decisions and dispositions fit badly with Von Neumann and Morgenstern's definition of game. Only very recently, some contributions have tried to enlarge the game theorists' toolbox in order to reduce its social ingenuity.

Refinements have been proposed from different perspectives.[2] Some papers deal with non-cooperative games considering an endogenous interaction structure and players who simultaneously choose actions and players. In Hojman and Szeidl (2006) individual behavior is embedded in a *social network*, deliberately created by the players, and a social game is conceived as a triplet of elements: a finite number of agents, an underlying game structure (i.e. a traditional non-cooperative game), and a function which determines the cost of links with other players. Similarly, Jackson and Watts (2005) define a social game as a triple: a finite number of players,

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[1] Among others: Fudenberg and Tirole (1991), Binmore (1992), Obsourne and Rubinstein (1994) and, more recently, Binmore (2007).

[2] In fact, the first attempt to consider the sociality of games can be found in Aumann (1974). His notion of *correlated Nash equilibrium* is based on the idea that players might build "*signalling devices*" to coordinate towards payoff-improving equilibria. Roughly, Aumann conceives sociality as interpersonal co-ordination.

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an underlying game structure and a set of roles which determine role-oriented partitions of the reference population of agents (for instance, males and females). Both contributions determine refined Nash equilibria in which, respectively, players have to build an equilibrium network structure (*Nash network*) or have to efficiently match one with the other.

Bervoets (2007) follows a different research direction. He shows a way of embedding games in social contexts using *game forms*.[3] Given a finite population of agents (namely, a *society*), a finite set of strategies for each agent and an outcome function, Bervoets approaches the issue: "*In which society does an individual enjoy more options?*" even if, in this way, he ends up viewing the social embeddedness of games as formal interdependency in the definition of socially-accepted players' rights. These rights determine what kind of behavior will be socially permitted, and which behavioral options will be granted by the social context.

Finally, Herings et al. (2007) generalize the idea of cooperative, non-transferable utility games and define a *socially-structured game*. The latter is a cooperative interaction with a given set of agents, a finite set of admissible internal organizations between members of coalitions of players, and a power function determining the distribution of power between members of the admissible organizations (more powerful players are able to remove payoff units from less powerful ones). Herings et al. state that a payoff vector is *socially stable* if and only if a collection of coalitions and internal organizations which balance players' power exist. Not surprisingly, these authors provide conditions for socially-stable, core allocations of resources.[4]

In this paper, we explore a new route for modeling socially structured games. Firstly, like Bervoets (2007), we use game forms. Secondly, we explicitly model, as in Herings et al. (2007), *social structures* (even if we interpret them from a different sociological viewpoint (*see below*)). Thirdly, following Jackson and Watts (2005) and Hojman and Szeidl (2006), we confine our reasoning to non-cooperative, normal form games with perfect information and pure strategy Nash equilibria.

Two remarkable differences between the above papers and our model exist. On the one hand, following contemporary sociology, we view social structures as webs of social values, moral dictates and normative principles. These embeddedness structures alter how players perceive the game, and alter the possibility of choosing some elements from players' option sets.[5] Furthermore, these structures can be intentionally activated or unintentionally internalized. On the other hand, we explicitly link social games to concepts taken from Erving Goffman's theory of interaction.[6] As is well known, Goffman explains interaction order in terms of situational normality, inter-subjective consensus and reflexive expectations, and uses the concept of *frame* to explain the manner in which social interactions are defined and perceived by interactants. During 1970s his ideas about how a game operates were in open contrast with the orthodox view and Goffman was one of the most visible critics of early game theory. His approach was radical: game theory was flawed because it applied a single-level model to two-leveled situations, thus ignoring the fact that people manipulate impressions and expectations before, and during, strategic games. This is a venial sin, if we deal with *fun games*; it becomes an important lack when we analyze socially-embedded interactions.

Starting from Goffman's heritage, we shall provide a model endowed with these two levels. Firstly, players *endogenize* a given social structure and frame the interaction. This determines what kind of game they will play. Secondly, they select Nash equilibrium strategies. As we shall discuss, it is possible to consider, in this way, how framing structures operate and what role they have in determining Nash solutions. What we get at the end of our reasoning will be a Goffman-inspired theory of social games.

The essay is organized as follows. In the next section, we introduce our set-up and provide definitions and notation. Then, in Section 3, we show the use of our framework in a famous 2X2 normal form game. Some introductory results are presented in Section 4, while Section 5 discusses them and presents a simple application. The last section is reserved to a concluding comment.

2. Definitions and notation

Consider a finite population of players ($i = 1, \ldots, n$) and denote with $\mathbb{C}$ what we shall call a *game compact*. This compact is a set of possible, alternative, descriptions of a game-like situation which is going to interest the above agents. As we shall see, the final form of the game will depend on what framing structure embeds the interaction. More precisely, $\mathbb{C}$ specifies players' option sets (Θ_i with $i = 1, \ldots, n$) and, therefore, describes alternative socializations of a game. Option sets contain sets of permitted strategy sets (S_i), one for any feasible description of the strategic interaction.[7] Formally:

$$\Theta_i := \{\forall S_i | S_i \in \mathbb{C}\}\,\forall i \tag{1}$$

A strategic interaction is described as a game form (μ). The latter is given, as usual, by two elements: the Cartesian product of players' current strategy sets and an *outcome function*, $g : \prod_{i=1}^{n} S_i \to X$, i.e. a map which associates a game outcome ($x \in X$) to any n-tuple of individual strategies.[8]

In order to obtain individual payoffs, we consider a *value function*, $V : X \to R_+$. This determines a social surplus value for any possible game outcome. Finally, we shall denote with y_i individual payoffs with $\sum_{i=1}^{n} y_i = V(x), x \in X$ and $y_i \geq 0\,\forall i$. Consistently, a game outcome will be *collectively optimal* only if $V(x) \geq V(x')\,\forall x' \neq x$. Let us proceed to introduce some social features into this set-up.

Firstly, suppose that some values are seen as relevant for characterizing the game compact we are dealing with. For the sake of tractability, assume they are common to all players and denote them v_j with $j = 1, \ldots, J$. An *option map*, $\phi_i : \Theta_i \to R_+$, sets out how different feasible strategy sets perform in terms of value fulfillment. Straightforwardly, by using ϕ_i, the *bliss set* can be defined as:

$$S_i^* := \{S_i | S_i \in \mathbb{C} \wedge \nexists S_i' \in \mathbb{C}\, s.t.\, \phi_i(S_i') > \phi_i(S_i^*)\} \tag{2}$$

Moreover, in order to compare different game outcomes in terms of value fulfillment, players use a *evaluation map*, $m_i : X \to R_+$, that is an outcome-oriented version of ϕ_i. Namely, the couple of elements $\Xi_i := (\phi_i, m_i)$ is said to be the *values system* of each interactant in $\mathbb{C}$.[9]

After all this, we are equipped to provide some important definitions.

Definition 1. A *meta-game* Σ is a couple of elements $\langle \mu \langle \prod_{i=1}^{n} S_i, g \rangle, < \Theta_i >_{i=1,\ldots,n} \rangle$.

[3] The idea of game form was originally introduced by Sen (1970). For details on this notion, and its uses in social choice theory, see Gibbard (1973) and, more recently, Gaertner et al. (1992).
[4] Burns and Gomolinska (2000) suggest another interesting way of modelling socially-embedded games. They use the *theory of rule complexes*. Unfortunately, social games they use are not comparable with traditional definitions of a game. For this reason, their ground-breaking contribution has not received wide attention.
[5] We take the idea of embeddedness from the seminal works of Granovetter. See Granovetter (1985, 2005).
[6] See Goffman (1959, 1963, 1969, 1974, 1983). For comments and criticisms to Goffman's ideas see, *inter alia*, Garfinkel (1967), Jameson (1976), Maynard (1984, 1991), Cahill (1998) and Misztal (2001).
[7] By assumption, singletons are not allowed.
[8] Maps and functions we introduce hereafter are assumed to be twice-continuously differentiable.
[9] Hereafter, we suppose that m_i and ϕ_i are additively separable.