COSIN

IST–2001-33555

COevolution and Self-organization In dynamical Networks

Modelling interaction and dynamics within firms

Deliverable Number:	D15
Delivery Date:	March 2004
Classification:	Public
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Information Society

Project funded by the European Community under the "Information Society Technologies" Programme (1998-2002)

Abstract

In this deliverable CR5 (ENS, Paris) has focused on the decision making process within the board of directors of a firm. Starting from the existing literature we have developed a simple theoretical framework in which is possible to ask and answer quantitative questions about the impact of well-connected minorities within the board and about the impact of external forces, such as the information about decisions previously made in other boards. These studies have possible applications in corporate governance policy making.

INTRODUCTION

Several kinds of interactions occur among actors within a firm. Examples include redirecting a task to the person who has the information necessary to solve it, efficient information sharing, processes of decision making. Recently, these topics have begun to be addressed in the context of complex networks with methods and approaches inspired to Statistical Mechanics. For instance, most models about opinion and decision dynamics are based on binary choices that social actors update as a result of social influence. Often the update mechanism is some version of a majority rule. These kinds of models, first introduced in economics by Follmer (1974), are formally equivalent to an Ising model and have been studied from a statistical physics point of view since the '82 (Galam 1982). Economists are usually concerned about the efficiency/inefficiency of this kind of behavior in the market, known in economics as "herd behavior"(Orleans 1995). When this kind of dynamics take place on networks that deviate from random graphs and from regular lattices, then the topology of the network plays a crucial role, as shown recently by various authors. For instance, in the Ising model on Scale Free networks, the system is always in the ferromagnetic state (provided that the size of the network is large, Leone et al. 2002). This means that starting from a situation in which 50% of social agents have opinion +1 and 50% opinion -1, the system always converge to a consensus (either all have opinion +1 or all -1 depending on stochastic fluctuations). Such result is relevant to decision making processes when the individual knowledge is not sufficient to choose the best decision and agents rely on other agents opinions to form their own opinion. As a consequence, when social influence plays a significant role then the consensus is not necessarily on the best decision. A similar dynamics seems likely to occur in small networks as well if the connectivity is high enough. The board of directors of a firm, for instance, can be seen as a small fully connected network with heterogeneous coupling.

In this deliverable CR5 (ENS, Paris) has focused on the decision making process within the board of directors of a firm, addressing questions about the impact of well-connected minorities within the board and about the impact of decisions previously made in boards connected to the board under examination. Possible applications include methods for detecting situation of potential conflict of interest in corporate governance policy making.

DECISION MAKING IN CORPORATE BOARDS

In this context, unlike previous works, CR5 has worked on models in which the opinion dynamics takes place on an empirical heterogeneous network organized in interconnected groups. In [1,2] CR5 have studied a decision making dynamics taking place on the network of corporate directors, both at a single firm level and at a firm network level. Several social sciences approaches on decision making assume that decisions are binary and that agents influence each other to an extent proportional to the strength of their professional relationship. CR5 contribution to the field consists in pushing these assumptions to their full consequences and to choose the "right" quantities to study. We distinguish two cases whether boards make decisions independently or not from other boards and we assume an Ising-like dynamics on the variables representing directors' opinions.

We are then in a position to address two fundamental questions:

1. can a minority of well connected directors (a "lobby") drive the decision of the majority of a board and can we predict the impact of the minority based on its topological structure?
2. under which conditions a large majority of boards making the same decision can emerge in the network?

It turns out that the answer to the first question is positive. Moreover by means of a statistical analysis of real-world boards we are able to say that in a significant fraction of boards there is a powerful lobby. This result is published in (Battiston et al. 2003 [1]). The prominence of questions such the one we have addressed here is witnessed by the fact that the article has attracted the interest of the general public press [5].

The answer to the second question is discussed in Deliverable D16 (Firm networks dynamics). Such results show that most boards are connected in an intricate network of interlock and that the decision making process within a firm can be highly affected by the network to which it belongs. In this sense it is worth stressing the fact that the presence of a lobby within a board -a local phenomenon- is a consequence of the board network structure. Therefore the network topology [3] and the network decision making dynamics [2] presented in D16 are also relevant to D15.

- **NOVELTY OF THE RESULTS**

The idea that lobbies are present in board of directors is certainly common knowledge. The fact that these lobbies might influence the decision making process is also quite intuitive. The novelty of this work is in the following points.

We design a model where the impact of the lobby on the decision making process can actually be measured. This is done defining an Ising-like dynamics on the nodes, where the coupling is proportional to the number of professional relationships. This is a well-defined notion of social tie, as opposed to friendship for instance. A concept we introduced is the one of ***interlock graph of a board***: in figure 1 we represent those directors of the board of Bank of America who also sit together in some other board.

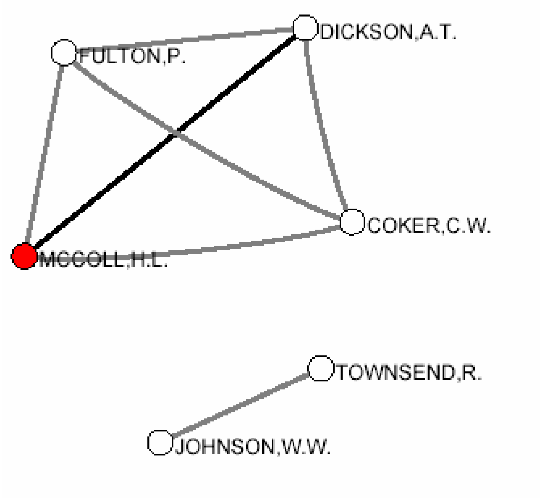

Fig. 1. Example of an interlock graph: The board of directors of the Bank of America Corporation. White nodes represent directors that are not in the management, black nodes represent directors that are also executive of the company. Two directors are connected by a gray edge when they serve on one same outside board. The edge is black when they serve together on more than one outside board.

The idea is that two directors who also serve together on some other board are likely to take into account each other's opinion more seriously than two any directors. Now, the interlock graph of a board can have very different structures: chain, triangles etc. While it can be intuitive that a chain of four nodes will have a bigger impact than a chain of three nodes, a priori one cannot compare a chain with a triangle. We have done numerical simulation of our decision making dynamics model in presence of all possible interlock graph structures or 'lobbies' from now on (figure 2).

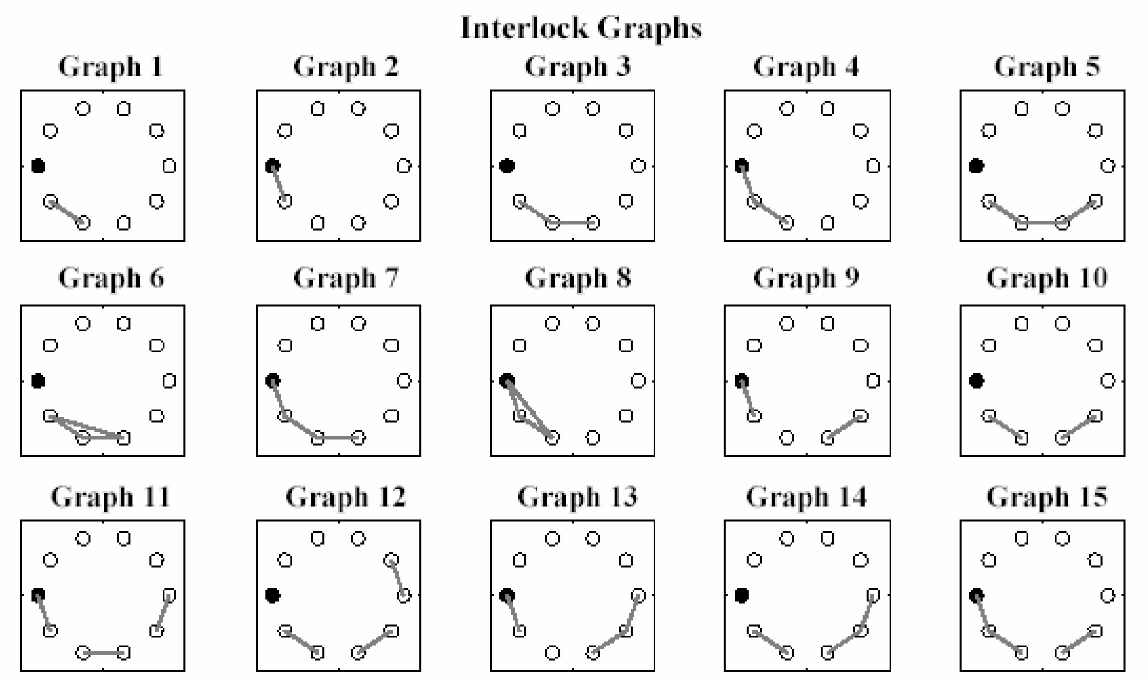

Figure 2. The simplest interlock graphs for boards with 10 directors. There are 15 different graphs that can be drawn with a maximum of 3 links and with up to 2 links per node. The black node is the CEO.

We introduce a quantity called "*force*" which measures the field perceived by the directors within the lobby due only to the directors of the lobby itself. It turns out that the probability that the board makes a decision in accord with the opinion of the lobby is linearly increasing with the force of the lobby. A strong point is that we can look at real data and we can count how many boards have a lobby of a given force. It turns out that 20% of the boards of largest US companies in 1999 have a non-negligible lobby [1]. Similar figures are found in the boards of the Italian Stock Market [3].

- **APPLICATIONS**

Having a lobby is not necessarily bad, but it is an indicator of a potential conflict of interest. In fact, having a powerful lobby inside the board simply means that the opinion of some directors has counted more than the opinion of others, which is not necessarily wrong if, for example, the directors in the lobby were the most competent about the matters in discussion. But suppose now the lobby rather represents the interest of some minority. This minority could consist of officers of the company itself, reluctant to a change of management or officers of another company that owns a minority of stocks and want to attack the company. This could be seen as a dangerous situation for the company and the majority of investors. In this perspective, norms could be introduced to limit the force of the lobby e.g. when a new director is proposed for an appointment in the board.

Therefore this model offers a quantitative framework for policy making in corporate governance. This work obviously contributes to D15 because it investigates an intra-firm dynamics, but it also contribute to some extent to D7 because it introduces a new notion of centrality of actors related to role of the lobby.

THE OWNERSHIP CONCENTRATION

Ownership concentration is a topic related to minorities and lobbies in the board of directors because the board is supposed to represent shareholders interests.

We have analyzed ownership concentration of the companies quoted in two US stock markets and in the Italian stock market, introducing an index of concentration that weigh shares quadratically [4]. This kind of analysis looks at single firms and gives indirect information about the typical interaction among shareholders within a company. Interestingly, from our results we can infer that in the Italian stock market typically one shareholder dominates the others, whereas in the US market there are typically 6 equally important shareholders (figure 3). In the future one could try to model the interaction among shareholders with some kind of dynamics of competition for shares. Our empirical results set some important constraint on the model.

By means of this participation index and other methods we are able to go from a local description to a network description [4] [6], which is part of deliverable D16. For this reason there is an overlap between the scientific production of D15 and D16.

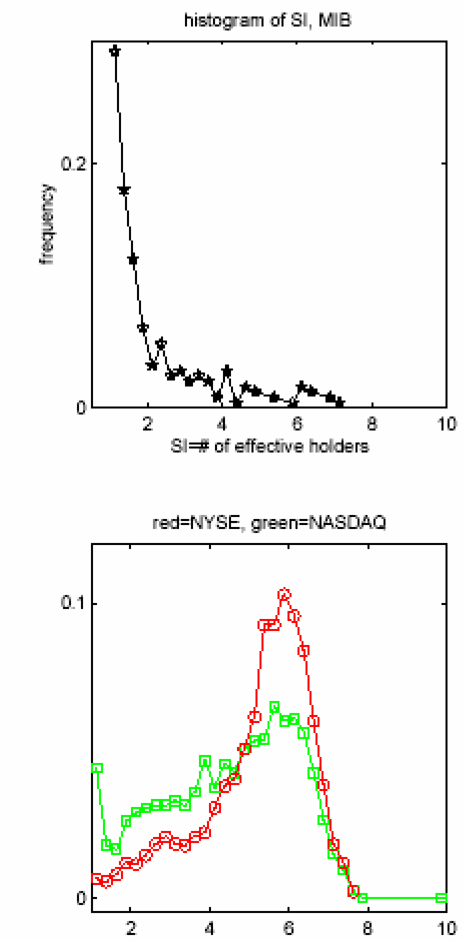

FIG. 3: Distributions of the effective number SI of holders for a stock.
Top: the Italian Stock Market. Bottom: the US stock markets.

- **SCIENTIFIC PRODUCTION**

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