HAL
open science

CAN OPINION BE STABLE IN AN OPEN NETWORK WITH HIERARCHY?AN AGENT-BASED MODEL OF THE COMMERCIAL COURT OF PARIS

Juliette Rouchier, Paola Tubaro

To cite this version:

Juliette Rouchier, Paola Tubaro. CAN OPINION BE STABLE IN AN OPEN NETWORK WITH HIERARCHY?AN AGENT-BASED MODEL OF THE COMMERCIAL COURT OF PARIS. 2009. halshs-00409373

HAL Id: halshs-00409373

https://shs.hal.science/halshs-00409373

Preprint submitted on 7 Aug 2009

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

GREQAM

Groupement de Recherche en Economie
Quantitative d'Aix-Marseille - UMR-CNRS 6579
Ecole des Hautes Etudes en Sciences Sociales
Universités d'Aix-Marseille II et III

Document de Travail
n°2009-22

CAN OPINION BE STABLE IN AN OPEN NETWORK WITH HIERARCHY? AN AGENT-BASED MODEL OF THE COMMERCIAL COURT OF PARIS

Juliette ROUCHIER
Paola TUBARO

July 2009

WORKING PAPER

Juliette Rouchier (CNRS-GREQAM, Marseille)

Paola Tubaro (CNRS-CMH, Paris)

CAN OPINION BE STABLE IN AN OPEN NETWORK WITH HIERARCHY?

AN AGENT-BASED MODEL OF THE COMMERCIAL COURT OF PARIS*.

This draft: 26 July 2009.

* Contact information: juliette.rouchier@univmed.fr, paola.tubaro@ens.fr. Earlier versions of this paper were presented at the seminar "Réseaux et régulation", University of Paris-Dauphine, 25 May 2009, and at the 5th UK Social Networks Conference, University of Greenwich, 3-5 July 2009. We thank Emmanuel Lazega and Lise Mounier for providing access to the data as well as valuable documentation and information on the case study considered. Tubaro gratefully acknowledges financial support from the European Science Foundation (ESF) under the EUROCORES-ECRP I program.

CAN OPINION BE STABLE IN AN OPEN NETWORK WITH HIERARCHY? AN AGENT-BASED MODEL OF THE COMMERCIAL COURT OF PARIS

The co-evolution of social networks and opinion formation has received increasing attention in recent years. As a contribution to the growing literature on this topic, we explore connections between empirical data representing the advice network of judges at the Commercial Court in Paris and an agent-based simulation protocol testing various hypotheses on the motives that drive agent behaviors. A previous work (Rouchier et al. 2007) had already modeled the dynamics of advice-seeking among judges and studied the implications of different rationality assumptions on the shape of the emerging network. Here, we add an influence model to the previously examined advice-seeking relationships in order to explore the possibility that there is a form of "culture" at the Court that harmonizes the opinions of members over time; we identify a set of relevant stylized facts, and we use new indicators to evaluate how agents choose with whom to interact within this framework. The basic assumptions we analyze are that they seek advice from senior judges who are higher up in the hierarchy, who enjoy high reputation, or who are similar to them. Our simulations test which criterion –or which combination of criteria– is most credible, by comparing both the properties of the emerging network and the dynamics of opinion at the Court to the stylized facts. Our results single out the combination of criteria that most likely guide individuals' selection of advisors and provide insight into their effects on opinion formation.

The paper is organized as follows. Section 1 briefly presents our case study, the Commercial Court of Paris, and derives relevant stylized facts. Section 2 illustrates the main features and overall structure of the model, while section 3 outlines our main results on indegree centrality and section 4 focuses on our findings on opinion. Section 5 concludes.

1. The case study: the Commercial Court of Paris (CCP).

1.1 The CCP as a judicial institution

The Commercial Court of Paris (CCP) is a five-century old judicial institution which handles about 12% of commercial litigation and bankruptcy cases in France, including complex and politically sensitive ones. Interestingly, CCP members are not career magistrates but experienced businesspeople or top-level company managers who are elected by their peers and exercise their functions as unpaid volunteers. In this sense the CCP is an example of "joint regulation" of markets (Falconi et al. 2005; Lazega and Mounier 2003) integrating representatives of the private sector with the public sector.

The structure of the institution needs to be briefly presented as our model reproduces its main features. First, the fact that mandates are for a fixed term of up to 14 years implies a regular turnover, with joiners and leavers every year. Second, the Court is composed of about 21 specialized and generalist Chambers in charge of different forms of commercial litigation and bankruptcy, with an average of 7 judges in each of them; to reduce the risk of corruption and conflict of interest, a formal rotation rule reassigns judges to a new Chamber every year. Finally, the CCP is a hierarchical institution which ascribes significant power to the President of the Court and Presidents of Chambers. Hierarchy is closely related to seniority as Presidents must have been at the Court for at least 8 years; an appointment as President confers a status that is conserved even after this role is passed to someone else.

Judges face multifaceted tasks requiring multiple competencies –legal, economic, managerial among others. Conflict resolution often calls for detailed knowledge of the norms, customs,

and expectations of the particular industry concerned. Unlike career magistrates, CCP members have hands-on experience in a variety of trade sectors. One argument to legitimize this lay institution is precisely that it pools and shares experience and expertise. Indeed, CCP judges intensely exchange advice and information with one another.

Together with specialized information, advice ties channel normative orientations on how to deal with situations in which judges have discretion. Different views may coexist and be discussed on, say, the merits of the free market, the respective roles of the public and private sectors, and the perimeter of regulation.

1.2 Stylized facts: network formation and opinion dynamics

To identify stylized facts, we rely on data on advice-seeking among CCP members which were collected by Emmanuel Lazega and Lise Mounier in 2000, 2002, and 2005. Judges were asked about their advice ties to one another, and a high response rate enabled to reconstitute the complete advice network among them at each wave.

First, the data reveals that the degree distribution is asymmetric, particularly regarding indegrees[1], as can be seen in Figure 1. *There is a correlation between degree and seniority*: junior judges, including newcomers, have low indegrees (i.e. are little sought out), while seniors and Presidents have high indegrees (i.e. are much sought out). The reverse is true for outdegrees[2], which are higher for junior than for senior judges, indicating that the former seek more advice than the latter.

In 2005, judges were also interviewed about their normative views, particularly the extent to which they believed they should be punitive in their decisions on matters of unfair competition between entrepreneurs. For the purposes of this paper, we interpret punitivity as severity in their interpretation of the law in cases in which they have discretion[3].

Our second empirical fact is that *opinion appears to be correlated with seniority* in that junior judges are on the whole more severe than senior judges; it is also related to degree, as severe judges have relatively low indegrees and high outdegrees. In fact the most central advisors are senior judges, often with a formal role as President of Chamber, and typically non-punitive.

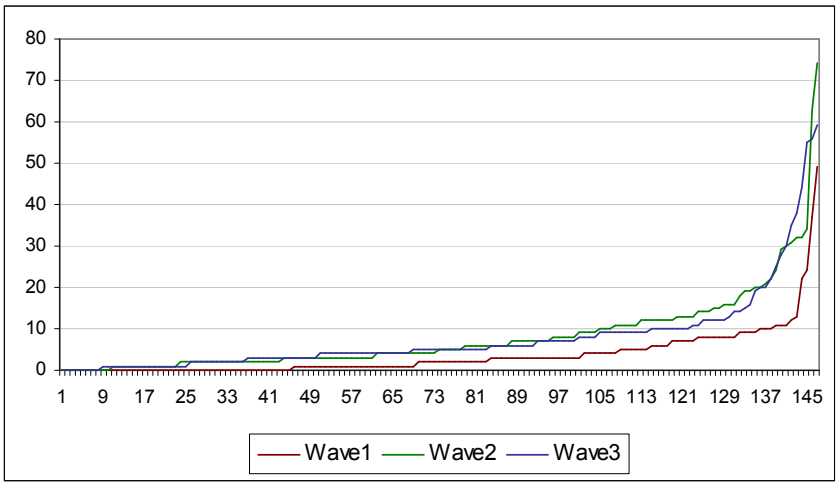
These observations suggest that some process may lead judges to become less severe over time, and that it may depend on judges' advice-seeking activity, at least to some extent.

[1] Indegrees measure the number of incoming ties, and indegree centrality captures the extent to which an actor is identified by others as one of their contacts (Kilduff and Krackhardt 1994); it can be interpreted as a form of popularity or prestige (Wassermann and Faust 1994, pp. 174-75, 202-203).

[2] Outdegrees measure the number of outgoing ties.

[3] More precisely, being punitive means awarding the injured party not only "material" damages but also "moral" damages: the former are amounts of money that make up for the losses incurred because of the unfair behavior of the offender, while the latter are solely meant to discourage relapse into such practices. There is no consensus on whether the very concept of moral damages applies to business.

Figure 1: Observed indegree centrality at waves 1, 2, 3. Indegrees are on the *y*-axis and judges' position in the ranking of indegrees (in ascending order) on the *x*-axis; it emerges that the majority of judges receive very few requests for advice, if any, while a core of highly central advisors are much sought out by others. It can be noted that the three waves are slightly different in values but share the same qualitative shape.



The model we are now going to outline aims at reproducing these stylized facts so as to provide insight into the processes that lead to them.

2. The model

Our model represents an evolving social network with an exogenously given hierarchy which defines progress up the ladder, a regular flow of newcomers and leavers, and an internal rotation rule. The model addresses the question of who interacts with whom, and is evaluated with two indicators: evolution of opinion over time and a measure of convergence of opinion towards shared values. It simulates the advice-seeking interactions of a population of artificial Agents[4], and the ensuing changes in individual opinion. Agents are defined by attributes that represent their position in the hierarchy (current Chamber, role as current or former President, seniority), others that define their opinion, and their indegree centrality which is computed at each step.

We draw on a widely applied (abstract) influence model (Deffuant et al. 2002). While the original version assumes random pair matching during which Agents may influence each other, the choice of communication partners may not be random in our case but rather follow a systematic pattern. Thus, in what follows we first outline our hypotheses for the choice of communication partners and their empirical and theoretical bases, then we describe the model itself: the influence mechanism and our implementation of the choice of partners. We conclude with an overview of the simulation dynamics and its main parameters.

2.1 Hypotheses about the choice mechanism

Our assumption is that Agents have three basic ways to choose whom to communicate with:

- *Authority*: seek advice from judges higher up in the hierarchy (Presidents).
- *Reputation*: seek advice from those who are most sought out by others.

[4] We follow the agent-based literature in noting Agent when referring to artificial entities, and agent in the case of real-world ones.

- *Homophily*: seek advice from similar judges (i.e. who share the same opinions).

These representations of choice mechanisms are grounded in the sociological and organizational literature. Support for the authority argument stems primarily from Blau's (1955, 1964) social exchange theory, according to which status recognition tends to be given in exchange for advice in organizations. Thus, members high up in the formal hierarchy are most likely to be consulted. Blau's prediction is confirmed by the empirical observation that advice networks often exhibit a pecking order that closely follows hierarchy; evidence of such a mechanism was found for the Court advice network database by Lazega et al. (2006).

The case for reputation draws from the fact that with imperfect information, reputation can be taken as an indicator of the competency of an advisor and approximated by indegree centrality in the advice network. Indeed the latter measures the extent to which an individual is consulted, presumably for work-related input (Klein et al. 2004); thus, it helps to infer his/her degree of expertise. Indegree-dependent effects are often self-reinforcing, with the most popular advice-givers being increasingly sought out over time (Lazega et al. 2006).

The tendency towards homophilous choices, i.e. to form ties to similar others, is well documented (McPherson et al. 2001). Various dimensions of homophily have been investigated in the literature, for instance based on gender, education, or nationality; similarity of opinions may also generate homophilous choices of advisors (this is the dimension we focus on). Homophily may attenuate or reinforce the effects of hierarchy and reputation, sometimes in complex ways as shown by Lazega et al. (2008).

2.2 Agents: attributes and processes

Influence

Our representation of opinion change follows the "relative agreement" model of Deffuant et al. (2002), to which the reader should refer since we have little space to describe it thoroughly. Agent j is characterized by two continuous variables on [0, 1], namely its opinion x_j and its uncertainty u_j; its "opinion segment" is defined as the segment of length $2.u_j$ around x_j. Continuous values allow opinion to vary smoothly between the two extremes of the acceptable range; uncertainty is a measure of lack of individual self-confidence. At initialization, Presidents and senior Agents have "low" opinion (0.1 to 0.3, i.e. not too severe, consistently with empirical data) and low uncertainty (0.1, to suggest that experience and position in the hierarchy may increase self-confidence). For other Agents and newcomers, uncertainty is higher (0.7) and opinion is uniformly picked between 0 (non severe) and 1 (severe). These values are tested in the simulations presented below.

When an Agent meets another, it can be influenced only if the opinion of the other is included in its opinion segment. If there is influence, it is both in opinion and uncertainty, and it is proportional to the overlap between the two Agents' opinion segments (the agreement), divided by the uncertainty of the influencing Agent (expressing relativity in the sense that a more confident advisor has stronger influence). Notice that relativity makes the mechanism non-symmetric: only in some cases do the opinion and uncertainty of both Agents vary.

Choice mechanism

Agents' attributes determine their actions according to the following three-step process.

First, an Agent chooses whether to seek advice or not. To do so, it picks a number randomly from a uniform distribution and compares it to its uncertainty (between 0 and 1): if it is lower, this Agent will seek advice. The higher the uncertainty, the more advice is sought; hence with

the aforementioned differentiation between juniors and seniors, the former are more likely to seek advice than the latter, consistently with the empirical fact that those with lower seniority at the CCP have higher outdegrees.

Second, if an Agent seeks advice, it must select an advisor, with criteria that depend on the type of simulation we run: a "pure" or "mixed" choice, both based on the hypotheses exposed earlier, or random choice. More precisely, we consider six options:

- *Authority*: 60%[5] chance of selecting the President of its own Chamber; then 24% probability of selecting another President and a 16% probability of simply drawing a non-president more senior Agent[6].
- *Reputation*: 60% probability of picking up from the subset of the 10 advisors who have the highest indegree centrality levels, and a 40% probability of picking up a more senior advisor.
- *Homophily*: more senior advisors whose opinion is close enough for influence to take place (according to the Deffuant model).
- *Mixed strategies* are Authority-Reputation and Authority-Homophily with 50% probability of choosing one of these two choice procedures.
- *Random*: Any Agent with higher seniority.

Third, once an Agent has sought advice according to one of these criteria, it may be influenced by its advisor; in this case, it updates its opinion and uncertainty as explained above.

2.3 Simulation dynamics

A simulation is organized around two different time units. A step represents a year in the real Court, and a sub-step represents a month, with 10 months per year. 147 Agents belong to 21 Chambers of 7. Each year, all Agents who have been there for 14 years leave the Court and an equal number of newcomers replace them, while all remaining Agents are re-allocated randomly to a new Chamber. Agents that have been at the Court for more than 8 years can be President of a Chamber, with only one President per Court at each step. Newcomers are given uncertainty and opinion as described earlier, and an "age" (seniority) of 0 at entry.

At initialization, Agents' age is randomly picked between 0 and 14; those with age of at least 8 are given low uncertainty and low opinion, whereas those with age of 7 or less are given high uncertainty.

Each month, Agents decide whether to seek advice; if they do, they also choose an advisor. Then, centrality and opinion are observed for all. We run the simulation for multiples of 14 steps, so that we have several "generations" in a row (agents that are there at start will all be gone after 14 years).

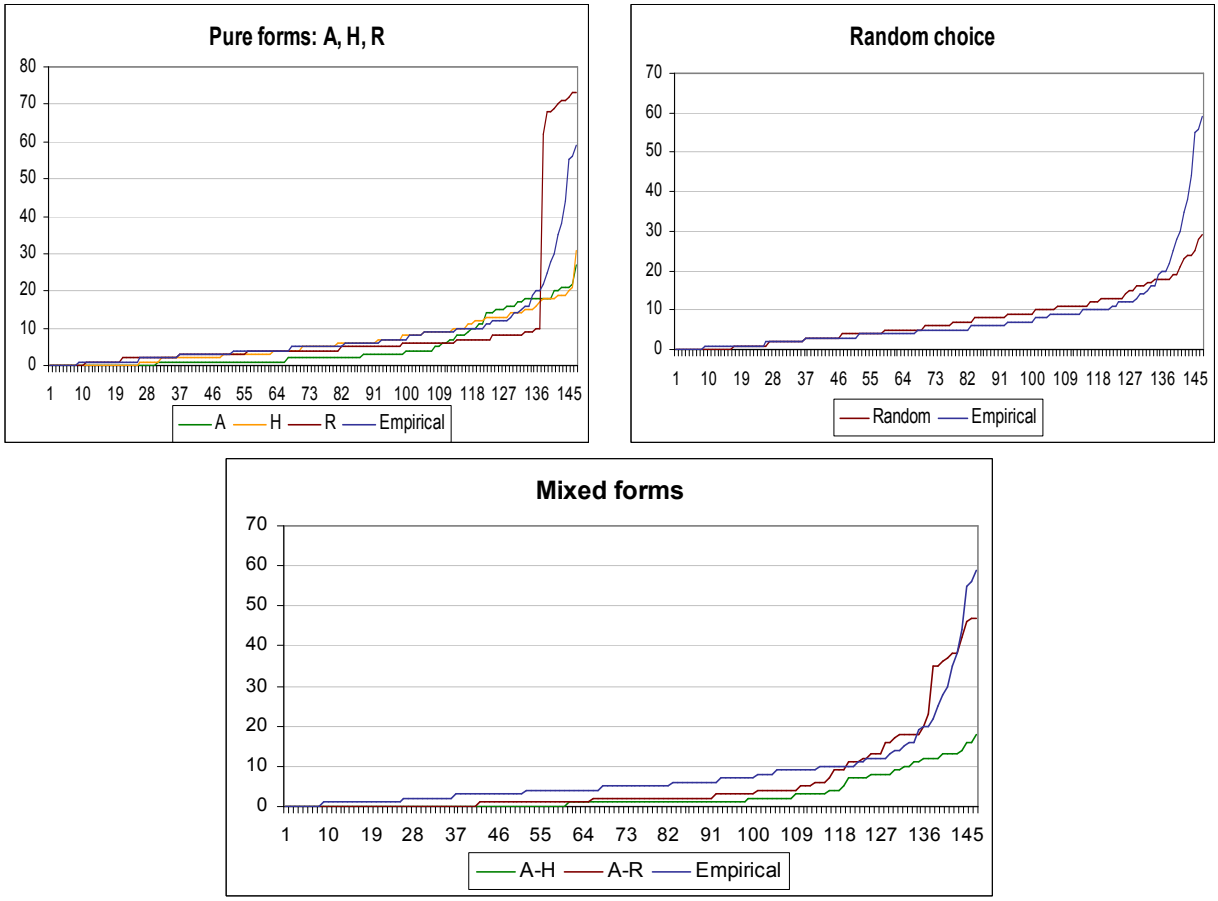
Parameters for a simulation are: the type of choice for interaction (1), the initial opinion (2) and uncertainty (3) of initial senior agents (more than 8 years), the opinion (4) and uncertainty (5) of initial junior agents and of subsequent newcomers. In this paper we develop precise results that correspond to 18 simulation protocols with all six values for parameter 1 and three values for parameter 2.

[5] A probability of 60% was suggested by Lazega and Mounier based on fieldwork. In Rouchier et al. (2007) it was shown to lead to plausible indegree centrality values.
[6] All random choices in the model are drawn from uniform distributions.

3. First set of results: Centrality

To evaluate our hypotheses on how judges select their advisors, let us first compare simulated and empirical indegrees (Figure 2). Our purpose is to identify which of the six options under scrutiny best approximates real-world data, in the hope to provide insight into the underlying social processes.

Figure 2: Simulated vs. empirical indegree centrality. Simulated values are obtained with pure forms of choice, randomness, and mixed forms, at the end of a simulation period of 70 time-steps (i.e. five "generations"), corresponding to the medium-long run. Empirical indegrees are taken at the last date of observation (wave 3). Agents' indegrees are on the ordinate and their position in the global ranking of indegrees is on the abscissa.



It appears that pure choices do not fit the data well. Both authority and homophily produce a relatively large group of middle-level advisors with indegrees between 10 and 20 and maxima of about 30, much lower than observed values. Reputation divides Agents into two groups, a large one with lower indegrees than in the data, and a tiny one with indegrees of more than 70, much higher than empirical levels. Random choice is also unsatisfactory: while it follows the empirical distribution rather closely for low-rank agents, it yields a relatively low maximum that hardly fits the data. Mixed strategies perform better, particularly Authority-Reputation which separates agents into three groups, one with bottom-level indegrees (0-10), one with intermediate-level values (10-20), and one with high values (about 35-50, very close to observed values). Instead, the Authority-Homophily mechanism produces a maximum lower than 20, inconsistent with the data.

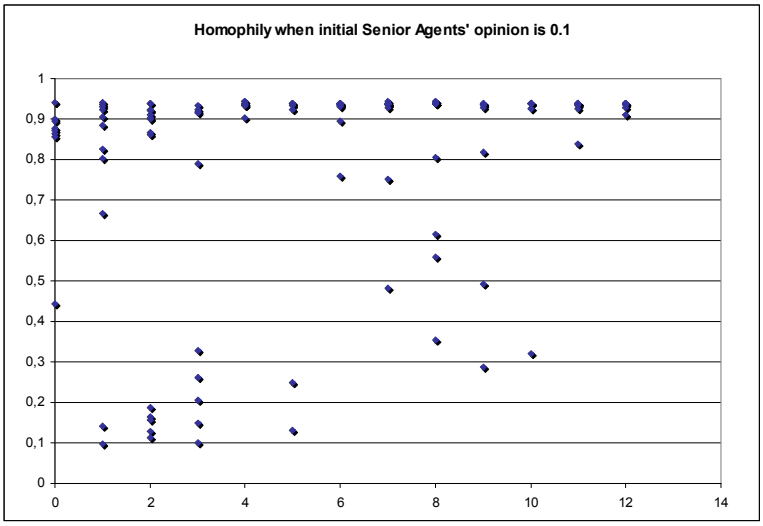
The Authority-Reputation mechanism enables both exogenous factors (seniority and formal roles) and endogenous mechanisms to affect the evolution of the advice network. Rouchier et al. (2007) note that, if we start from pure reputation and add formal hierarchy, we observe an increase in the number of central actors and a reduction of the gap between those with the highest indegrees and the others. In sociological perspective, this result sheds light on the importance of a formalized hierarchy for the distribution of knowledge and power. Conversely, if we take pure hierarchy as our starting point, adding reputation allows some non-senior, non-president agents to acquire centrality, which reflects the fact that informal networks may deviate from official organizational charts, with a potential impact on performance (see e.g. Krackhardt and Hanson 1993). The difference between results obtained with the mixed strategy and its two pure components suggests that although formal positions at the CCP are sometimes correlated with high centrality, it is not always the case, and informal mechanisms also operate.

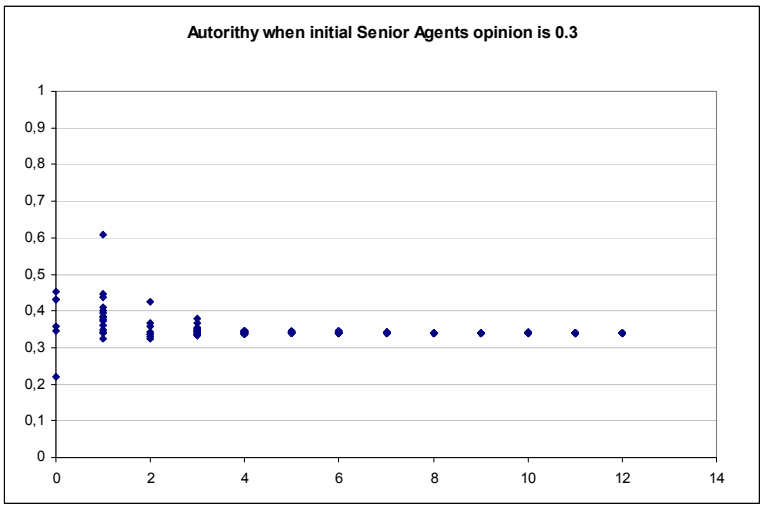
The fact that the authority-reputation mechanism prevails over authority-homophily confirms the finding of Lazega et al. (2008) that at the CCP, status is decisive but there is no pure effect of norm similarity on advisor selection.

4. Opinion dynamics

To assess agents' criteria for selection of advisors, we also need to account for the possibility of a kind of organizational "culture" that may transform the opinion of members over time. We use two main indicators to characterize the system: the evolution of average opinion and the opinion of agents at the last time step relative to their age. For the latter indicator, two typical situations can arise: 1/ either all Agents converge to the same opinion after they have been in the Court for some years or 2/ they display two diverging opinions and the distance between these opinions is larger than the uncertainty of newcomers. These two situations are similar to the possible equilibria described in Deffuant et al. (2002). As said before, for each choice procedure, we study three initial settings: when initial senior members are very tolerant (with a low opinion of 0.1) and increasingly less tolerant (opinions of 0.2 and 0.3).

Figure 3 : represents the opinion of Agents present at the Court after 70 time-steps. Age is on the abscissa and opinion on the ordinate, and we observe the number of clusters of opinion for Senior Agents, those who have been in the Court long enough to learn. Two cases can be identified: two opinions (for Homophily and initial Senior opinion of 0.1); one opinion (for Authority and initial Senior opinion of 0.3).





What we observe in this setting is that results depend both on the choice procedure and on the initial opinion of Senior Agents. In table 1, this result is made more precise. The data are given for 10 simulations per case, as an average which is statistically significant.

Table 1 : Opinion of Senior Agents at final time step, by initial Senior opinion and mode of advisor selection. The results are given for 10 simulations for each case –i.e. initial Senior opinion of 0.1, 0.2, and 0.3. With Homophily, two groups always emerge and the larger one in all cases is the one with high value opinion (as in figure 3 above). With Authority or Random, which give high importance to the structure of interaction, when the initial value is low a small group of high-opinion Seniors emerges as well.

Average opinion	**0.1**	**0.2**	**0.3**	**Percentage of Senior Agents with high opinion**	**0.1**	**0.2**	**0.3**
Authority	***0.3***	***0.3***	0.34	Authority	***18***	***8***	0
Reputation	0.44	0.44	0.47	Reputation	0	0	0
Homophily	***0.78***	***0.76***	***0.76***	Homophily	***95***	***90***	***92***
Random	***0.28***	0.29	0.35	Random	***15***	0	0
Authority-Reputation	0.38	0.39	0.41	Authority-Reputation	0	0	0
Authority-Homophily	***0.28***	***0.30***	0.33	Authority-Homophily	***15***	***8***	0

Two situations can be observed in the system, either there is just one opinion among Senior Agents at the end of the simulations or two opinions cohabit. Remarkably in most cases, the average opinion of seniors remains very close to the initial Senior opinion. In most cases as well, the number of Agents that deviate is very low. This means that even after 5 generations, Agents who stay for more than 8 years in the Court are led to think similarly to those who left the organization 70 years before. The initial opinion has an impact, as well as the way of choosing who to communicate with. The lower the initial opinion of Seniors, the more often one can witness the formation of two groups, because a higher number of newcomers cannot communicate with those who are attracted by, or are at, the lower opinion of the beginning.

Two separated groups appear most often when Homophily is used for choosing other Agents, which means that there is a reinforcement among Agents who deviate from the low opinion. In all other cases, one can consider that extremely few Agents deviate, and that they have almost no impact on the average final opinion. Hence, almost all of our current choice procedures are in line with the data collected in the study. In particular, this is true of the Authority-Reputation procedure (which has been shown above to be particularly relevant for indegree centrality). It has to be noted that the reproduction of culture in a group of this kind has not been produced with such a simple algorithm until now.

5. Conclusions

For the moment, the mix of Authority and Reputation gives the best result in the simulation compared to field data. It corresponds to important observed features of our case study and gives rise to plausible results on opinion, showing the combined importance of both the formal structure of the Court and of endogenous reinforcement effects.

For future work, homophily has to be defined differently for two reasons. First, it gives outlying results in terms of evolution of opinion. Second, the algorithm itself may be little credible, since the information needed for Agents to choose whom to ask advice, requires information that is unlikely to be available before communication takes place (opinion). As a consequence, we plan to redefine homophily and make it more dependent on structure (age classes for example).

6. References

Blau, P.M. 1955. *The Dynamics of Bureaucracy*, Chicago, University of Chicago Press.

Blau, P.M. 1964. *Exchange and Power in Social Life*, New York, John Wiley.

Deffuant G., Amblard F., Weisbuch G., Faure T. 2002. How can extremism prevail? A study based on the relative agreement interaction model. *Journal of Artificial Societies and Social Simulation*. 5 (4). http://jasss.soc.surrey.ac.uk/5/4/1.html

Falconi, A.M., Guenfoud, K., Lazega, E., Lemercier, C., Mounier, L. 2005. Le contrôle social du monde des affaires : une étude institutionnelle. *L'Année sociologique*. 55 (2): 451-484.

Kilduff, M. and Krackhardt, D. 1994. Bringing the individual back in: A structural analysis of the internal market for reputation in organizations. *Academy of Management Journal*. 37: 87-108.

Klein, K.J., Lim, B., Saltz, J.L. and Mayer, D.M. 2004. How do they get there? An examination of the antecedents of centrality in team networks. *Academy of Management Journal*. 47: 952-963.

Krackhardt, D. and Hanson, J.R. 1993. Informal Networks: the Company behind the Chart. Harvard Business Review. July-August. 104-111.

Lazega, E., Lemercier, C. and Mounier L. 2006. A spinning top model of formal structure and informal behaviour: Dynamics of advice networks in a commercial court, *European Management Review*, 3: 113-122.

Lazega, E. and Mounier, L. 2003. Interlocking judges: On joint external and self-governance of markets. In V. Buskens, W. Raub and C. Snijders (eds), *Research in the Sociology of Organizations*. 20: 267–296.

Lazega, E., Mounier, L., Snijders, T.A.B. and Tubaro, P. 2008. Réseaux et controverses: de l'effet des normes sur la dynamique des structures et les processus sociaux. *Revue Française de Sociologie*. 48 (3): 467-498.

McPherson, J.M., Smith-Lovin, L. and Cook, J.M. 2001. Birds of a feather: homophily in social networks. *Annual Review of Sociology*, 27: 415–444.

Rouchier J, Lazega E., Mounier L. 2007. Articulation of hierarchy and networks as an evolving social structure. In: *Agent-Based Approaches in Economic and Social Complex Systems IV*. T. Terano, H. Kita, H. Deguchi, K. Kijima (eds.). Springer. 97-104.

Wasserman, S. and Faust, K. 1994. *Social Network Analysis. Methods and Applications*. Cambridge University Press.