

Program Proposal

UU High Potential Program 2004

Dynamics of Cooperation, Networks, and Institutions

Applicants

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Abstract

This program studies network formation and cooperation under different institutional arrangements. The aim of the program is to develop innovative theory on the emergence and stability of cooperative relations and to test this theory with complementary data from experiments and research on alliance formation among firms. The program integrates theoretical, experimental, and field research approaches from economics and sociology. Theoretically, we combine game-theoretic models and agent-based simulations with sociological theories on the advantages of certain social network positions. Experiments in which partner choice and cooperative behavior can be studied dynamically provide a rigorous test of our theories. Alliance formation among firms is chosen as an application on the interface of organizational sociology and industrial economics in order to test the theory in the field. Innovative statistical techniques tailor-made for the co-evolution of networks and behavior will be applied to provide sound tests of our hypotheses based on the experimental as well as the field data.

Introduction

Cooperative relations can nowadays be found on all levels of organization: colleagues collaborate, firms form joint ventures, governmental parties form coalitions, and countries form trading agreements or political pacts. Failure of such cooperative efforts can lead to societal problems, e.g., to bankruptcy of firms or discordant relations among countries. Although research on trust and cooperative relations provides insights into effects of networks on the success and stability of cooperative relations (Uzzi 1999; Buskens 2002), many mechanisms are hardly understood. Most existing research neglects that networks change over time. Moreover, research on the interdependence between network formation and the institutional context might provide new insights in such processes. This program aims at a unifying theory to explain the co-evolution of networks and cooperation, i.e., how actors choose partners for their cooperative relations as well as how successful these relations are.¹ In addition, it is likely that partner choices and success of these relations depend on the institutional context. As Nee (1998: 87) formulates it “[t]he close coupling of informal norms and formal rules is what promotes high efficiency in organizations.” If the institutional framework is flexible, it is likely that it can be adapted in order to improve the performance of some or maybe all actors. E.g., organizational structures within firms can be changed to arrange cooperation among employees such that the joint output is optimized.

Theoretical background

The research problem discussed above requires development and integration of two rather new and promising research lines in economics and sociology. In economics, the development of game-theoretic models on the evolution of networks and institutions started recently and seems to produce new insights quickly (Young 1998; Dutta and Jackson 2003). In sociology, research on advantages of certain network structures for all or specific actors in the network (Burt 2001) and research on dynamics of networks progress rather independently from the economic approaches (Snijders 2001). Bringing these two together provides theoretical and methodological progress in disentangling the causality between network evolution and behavior in cooperative relations, which is a major research problem in economics (Manski 2000) and sociology (Leenders and Gabbay 1999). Integrating aspects of the institutional context will broaden the implications of our program for both disciplines.

We define a network as a set of bilateral relations among actors in a group. Such relations might be actual cooperative relations, potential cooperative relations, or information exchange relations. Concerning institutions, we use the definition of North (1990: 3) that institutions represent “the rules of the game in a society or, more formally, the humanly devised constraint that shape human interaction.” Applied to our context, this implies that institutions might determine with whom actors may have cooperative relations, which costs and benefits are related to these relations, which sanctions are attached to potential non-cooperative behavior and how these sanctions are applied, which contracts can be made and how they will be enforced etc.

Research questions

Because we strive for an integrated program we present three main research questions for the program as a whole rather than specific questions for each project separately. Below, we will explain how research questions are assigned to different projects (see columns in Table 1).

1. The first main question is related to the problem of *network dynamics*: *Which kind of network structures will emerge if actors can choose their partners while they try to optimize individual network positions?* We consider situations in which actors’ benefits depend only on the structure of a network and thus only on partner choices. This research question implies a set of more specific research problems such as: which networks emerge if actors strive for optimal communication possibilities while maintaining ties is costly (cf. Bala and Goyal 2000)? Which structures emerge if they optimize their network position in terms of structural holes (Burt 1992)? Under which conditions will such networks be dense and under which sparse? Are networks expected to be integrated or segregated in smaller subgroups? Under which kind of dynamics do “small-world” networks arise (Watts and Strogatz 1998). Which cooperative relations are stable and which are unstable? Actors in

¹ Actors might be individuals but also corporate actors (Coleman 1990) such as firms or countries.

which network positions are performing better than others? Which networks are more efficient from a welfare or societal perspective?

2. The second main question is related to the topic of *co-evolution of networks and cooperation*: *Which kind of networks emerge depending on the type of interactions actors have in the network and how do actors behave in these networks?* Now, actors do not only choose their partners, but they also have to choose *how* to interact. Therefore, the decision for establishing ties is also based on the behavior of others and not only on the ties of others. Here, more specific research problems include: Which co-evolution paths of network formation and behavior lead to cooperative outcomes and which paths lead to non-cooperative behavior of actors? Under which conditions will behavior become homogenous? Under which conditions do stable situations exist in which behavior is heterogeneous?
3. The third main question concerns the *effects of institutions on network dynamics*: *How do institutions affect the co-evolution of networks and behavior?* Again, we can formulate some more specific questions: do institutions affect who is performing better? Can institutions improve efficiency of the co-evolution of networks and behavior, i.e., can they accomplish Pareto improvements or encourage more equality among the actors? Might it even be possible to optimize institutional arrangements such that macro-outcomes of cooperative behavior in networks become socially efficient? A possible last step depending on earlier results is to see whether we can understand changes in institutions based on the possibilities of these changes to improve efficiency. Is it possible to develop institutions that are dynamic themselves and adjust to behavior of actors and their choices for partners?

The approach

We did not formulate the research questions in terms of any specific application as, e.g., horizontal cooperation among firms. Our aim is to develop a more general theory that can be applied in principle to any group of actors (individuals or corporate actors) involved in cooperation problems. Relevant areas of applying these theories can be found in sociology as well as in economics. The program combines three complementary research elements with clearly visible interdisciplinary aspects within each of them: Element A comprises the development of formal theory. Element B consists of experimental research. Element C involves field research (see rows in Table 1).

- A. The theoretical part focuses on formal models based on (evolutionary) game theory. We will assume incentive-guided behavior, probably in a boundedly rational way (Rubinstein 1998). Given the complexity of our settings, it is likely that we also consider learning models in which actors adapt their behavior in a myopic way (Weibull 1995; Fudenberg and Levine 1998). Related to the network dynamics (first main question), we develop models in which actors choose ties and the “utility” of these choices depends on their network position and the costs of maintaining the ties in that position.² Clearly, profitable aspects of a network position might be jeopardized by third persons creating ties among each other. Although existing models are often insightful in terms of network dynamics in an interdependent context, they hardly address those externalities by using insights from sociology about which network positions are profitable. One obvious example is Burt’s (1992) theory on structural holes in which the value of a network position is measured by the extent to which actors can control resources of other actors by being in crucial network positions (see Buskens et al. 2004). Related to co-evolution of networks and behavior (second main question), we investigate models in which the benefits of the network also depend on how neighbors behave.³ In these models, sociological knowledge on which network positions are advantageous can be used to extend and improve existing models. A long tradition in sociology has provided evidence that trust and cooperation is easier in networks in which actors know each other well.⁴ However, it is hardly explored under which conditions such a situation can be reached through self-organization of self-serving actors in settings in which maintaining social ties is costly. Concerning the institutions (third main question), we will study the effects of adapting the “rules of the game” in the models described above such as comparing different regimes for sanctioning non-cooperative behavior. In this way, we can study which institutional mechanisms motivate people to aim for more efficient outcomes at the societal levels and which institutions assist actors to escape Pareto deficient outcomes in social dilemma problems.⁵
- B. In sociology and economics, more and more experiments are done on how actors behave in networks (Willer 1999; Kosfeld 2003). Experimental tests of a theory provide evidence “closer” to the theory than a field test in the sense that there are fewer assumptions to be made to link the choice situation to the theoretical choices to be made. In this way, stronger statements about causality and the internal validity of findings become feasible. Of course, the disadvantage is that the external validity of experimental tests is often questioned (Loewenstein 1999). By combining experimental tests with the field application on alliances mentioned below, we will have complementary tests of our theory, combining the advantages of the rigorous and controlled testing in the

² See Jackson and Wolinsky (1996), Bala and Goyal (2000), or for a more stochastic model, Marsili et al. (2004).

³ See Jackson and Watts (2002) and Goyal and Vega Redondo (2004).

⁴ See Granovetter (1985), Coleman (1990), Raub and Weesie (1990), and Buskens (2002).

⁵ Related theoretical approaches can be found in institutional economics (Williamson 1985) and the new institutionalism in sociology (Nee and Ingram 1998).

laboratory with advantages of observing “real-life” behavior and relations in the field.⁶ In the experiments, subjects will be able to choose partners before having to complete another task. This task might be an individual task that is not interdependent itself, but can be performed better if a certain network position is obtained (first main question). The task might also involve interactions with other actors (second main question), e.g., one has to play coordination or cooperation games with each of the partners (cf. Riedl and Ule 2003). This will provide evidence for the predictive power of the developed models and will probably reveal conditions for favorable effects of institutions (third main question). The data collected will not only be analyzed with standard methods but also with the innovative statistical methods of Snijders (2001). These methods are tailor-made to analyze longitudinal data on complete networks taking statistical interdependencies over time and within networks into account and, thus, allow to study co-evolution of networks and behavior. This is especially crucial when actors choose with whom they want to interact as well as their behavior in these interactions. In such settings, it is often difficult to disentangle whether connected actors who behave similarly did find each other because they behaved similarly in the first place, or that, after being connected to each other they convinced each other into a certain combination of actions (Manski 2000).

C. For an empirical test outside the laboratory, we study horizontal relations among firms. These relations are studied extensively in industrial organization.⁷ Organization sociology studies the emergence of network relations and their effects on performance.⁸ But empirical studies have a limited theoretical underpinning and neglect the bi-directional causality between partner choices and performance of the firms. Building upon our theoretical insights, we plan to empirically test how the stability of a cooperative relation between a set of firms depends on characteristics of the network in which the relation is embedded (first main question) and on how the network evolves over time given the success of its cooperative relations (second main question).⁹ Longitudinal data on, e.g., joint ownerships, joint ventures, collaborative research, cross-licensing agreements, interlocking directorates or informal personal ties can be used to study network relations. These data combined with data on the performance of individual firms will be used to test hypotheses derived from the theoretical analysis. Furthermore, we also plan to control for institutional factors (third main question). An initial step would be to test whether alliance formation, stability and network evolution differ across various institutional context, e.g., by comparing networks of alliances in countries.

Research questions	1. Dynamics of networks	2. Co-evolution of networks and cooperation	3. Institutions and network dynamics
A: Theory	post-doc 1 & 2, PhD 1	post-doc 1 & 2, PhD 2	post-doc 1 & 2, PhD 3
B: Experiments	post-doc 1, PhD 1	post-doc 1, PhD 2	post-doc 1, PhD 3
C: Application	post-doc 2, PhD 1	post-doc 2, PhD 2	post-doc 2, PhD 3

Table 1. Overview of the projects and their interdependence

The projects

Although we (the applicants) will closely supervise all projects ourselves, we envision also an important role for two post-docs. One should be a specialist in game-theoretic model building and testing these models in experimental settings. The other should be specialized in organizational relations and have some background in modeling and simulating the dynamics of these relations as well as in applied statistics. This implies that the specializations of the post-docs cover all three research elements (rows in Table 1). The scope of the post-doc projects includes all three types of research questions (columns in Table 1), but the emphasis will vary depending on their own interests and complementarities with the PhD students. As a consequence, both post-docs will play a role in the projects of all three PhDs. Of course, how important that role will be depends on the emphasis a PhD puts on the different parts of the dissertation. PhDs are assigned to the columns in the matrix. That is, each PhD has his or her own main research question. PhD 1 works primarily on dynamics of networks, PhD 2 on the co-evolution of networks and cooperation, and PhD 3 on the role of institutions in these dynamics. By assigning PhDs to columns we make sure that they obtain training in a wide range of research methods under supervision of not only ourselves but also in cooperation with the post-docs. Moreover, PhDs experience in this way the

⁶ See Buskens and Raub (2004). Sniderman and Grob (1996) make a similar claim for experimental designs in surveys.

⁷ For an overview see Rosenkranz (1996). See Rosenkranz (2003, 2004) for theoretical analysis of dynamic alliances and Contractor and Lorange (1988), Kogut (1989), Vonortas (2000), and Hagedoorn (2003) for empirical approaches.

⁸ Sorensen and Stuart (2001) find that venture capital relations depend on embedded relations among actors, which indicates that performance of a firm depends on its position in an information exchange network. Gulati and Wang (2003) illustrate that firms’ relative advantage in an alliance depends on the individual network position of these firms.

⁹ Along those lines Knoke et al. (2002) provide one of the first studies to show how networks of alliances in the information technology sector can be analyzed using spatial techniques as well as dynamic network analyses.

complementarities associated with theory-guided research in combination with laboratory experiments as well as field research.¹⁰

Acquiring data

An experimental laboratory meanwhile belongs to the standard infrastructure at many social science (including economics) faculties; in Utrecht, however, adequate facilities are still lacking. Therefore, we propose to build a laboratory with about 20 subject PCs such that experiments in somewhat larger groups/networks can be accommodated. Of course, this facility will be made available for experiments of other groups (e.g., social psychology) to ensure efficient exploitation. An IT specialist will be hired for one day a week to set-up and maintain such a laboratory. If time permitted, he or she could also support programming for experimental work.

Concerning data on alliance formation, we will mainly rely on secondary data. As mentioned in the section below, we will be collaborating with other researchers who have data that suit our research questions (e.g., Duysters and Hagedoorn 2002; Gulati and Wang 2003). The way in which researchers in industrial organization and organization sociology collect data on horizontal relations among firms and firm performance is an approved concept also in the case of research questions about networks and cooperation (see Kogut 1989; Walker et al. 1997). Exploring possibilities of commercial data sets (e.g., Thomson Database ‘SDC Platinum’ for joint ventures and alliances), own data collection in public data bases (Cefis et al. 2004) or primary data collection on inter-firm relations (Buskens et al. 2003) can be part of the program.

Possibilities for cooperation

Utrecht: Within the KNAW-accredited research school ICS, our program is closely linked to the PIONIER-program “Management of Matches” (Raub, Weesie), which was financed by NWO from 1993-1999 and is supported since then by “Stimuleringsgelden” of the UU. Our program is also related to other research within ICS, e.g., on networks in contexts (Flap, Völker) and on emergence of norms (Baerveldt). The program can strengthen several research lines of the TKI, e.g., research on institutions, employment relations (Schippers, Siegers, Van den Berg), and organizational relations (Cefis, Heugens, Schenk, Weitzel). The program will also have positive spin-off for the “International Prestige Master Program” Sociology and Social Research and the planned research master of the Utrecht School of Economics.

The Netherlands: Our research is related to work done at other economics departments, e.g., game-theoretic work at the University of Tilburg and experimental economics at the University of Amsterdam (CREED). In sociology, research on evolution of networks and behavior is also done at the University of Groningen, while our research is linked as well to other research on organizations at the University of Maastricht (MERIT) and the Eindhoven University of Technology. With all these institutes we have well-established working relations.

International: Fehr and his colleagues, in particular Kosfeld (Institute for Empirical Research in Economics, University of Zürich) will be strong partners for collaboration given their experience in experimental economics related to network questions. Furthermore, the program will benefit from Schlag’s (European University Institute, Florence) and Shaked’s (University of Bonn) expertise on evolutionary game theory and the input of Gulati’s (Kellogg School of Management, Northwestern University) research on alliances among firms. Existing contacts with Cornell University, i.e., Macy (evolution of networks and norms) and Nee (relation between institutions and embeddedness) are also relevant for the program. Finally, our program is closely related to the EU-funded Specific Targeted Research Project (STREP) “Polarization and Conflict” (PAC) in which Buskens participates and which is lead by Esteban (Instituto de Análisis Económico, Barcelona).

Budget

<i>Manpower</i>	
Two post-docs (four years, starting in scale 11.0, 200k each)	400,000
Three PhDs (four years, starting 01-09-2005, 139.5k each)	418,500
Applicants’ research time (five years, 0.15 fte per person in scale 12.3)	99,500
Student assistants (third-year students, 0.2 fte over 5 years)	28,000
IT specialist (scale 9.0, 0.2 fte over 5 years)	36,500
<i>Data collection</i>	
Experimental laboratory (20 subject PCs, server, experimenter PC, furniture)	65,000
Experiments (2000 subjects, 20 euro per subject)	40,000
Acquiring/collecting data on relations among firms	50,000
<i>Internationalization</i>	
Travel (seven people, 2000 per person per year)	70,000
Interdisciplinary starting conference and closing conference with invited speakers	30,000
Running seminar (5 invited speakers per year, 500 euro per speaker)	12,500
<i>Total</i>	€1,250,000

¹⁰ Of course, the PhDs will follow PhD courses of the ICS and/or the TKI depending on the focus of their project.

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