RESEARCH STATEMENT

Daniel Opolot

1. Research interests

My primary research interests are in the theory and applications of game theory. I am particularly interested in evolutionary game theory, a subfield of game theory that models how people change their behaviour over time in competitive settings (i.e. where the rewards from individual actions depend on the actions adopted by the opponents). Evolutionary game theory finds many applications in economics and other social sciences, some of which include product diffusion through social networks; information sharing and diffusion; and institutional change. Institutions, especially informal institutions (e.g. social and corporate norms), can generally be viewed as conventions that govern how individuals in a group behave. A change from one convention to another usually starts with deviations by a few group members, and over time, the number of deviants reaches a tipping point from which the entire group eventually switches to the new convention. Evolutionary game theory is a suitable framework for modelling such dynamic processes.

2. Past and current research

To date, I have written eight papers on the theory and applications of evolutionary game theory – six papers involve theoretical modeling and two involve empirical analysis. Two of the theory papers are currently under 'revise and resubmit' in the International Journal of Game Theory and the Journal of Evolutionary Economics.

Theoretical work: Two of the six theory papers contribute to the theoretical concepts of evolutionary game theory, focusing on how the interaction structure influences evolutionary dynamics. Most of evolutionary game theory literature focuses on examining equilibrium behaviour in settings where interactions are global – each group member observes actions of all group members. In reality, however, interactions are localized in that people observe actions of only those with whom they share close ties (e.g. relatives, friends and colleagues) or geographical location. Moreover, the patterns of interactions tend to vary across groups, and these variations in turn affect equilibrium outcomes of evolutionary processes.

The mechanisms through which interaction patterns influence evolutionary dynamics are not yet well-understood. Part of my research aims to fill this gap. Specifically, I derive relationships between equilibrium outcomes of evolutionary game models and structural measures that capture interaction patterns: that is, the level of connectivity among group members; centralization (the extent to which connections between group members are organized around particular focal points); and group cohesion (the extent to which connections are uniformly distributed as opposed to a scenario where players are organized into cliques). These measures of interaction structure are easily computable from real-world networks, such as online social networks, and hence, have strong empirical relevance.

One of my theory papers (in collaboration with Professor Theophile Azomahou – University Clermont Auvergne) applies evolutionary game theory to product/behaviour diffusion, focusing on how a firm/planner can diffuse a product/behaviour through social networks by targeting some members of the group. The challenge for firms in such situations is the trade-off between the cost of targeting agents versus the cost of making the product more desirable to consumers than the available alternatives. If a product is much more desirable compared to the available alternatives, it can diffuse to the entire network through contagion, starting from a very small group of initial adopters. However, if the product is just as beneficial as or slightly more desirable than the available alternatives, then to diffuse it to the entire network, the firm has to target many initial adopters located at different regions of the network. In the former scenario, the cost of targeting initial adopters is very small because a firm invested more in making the product more desirable; in the latter, the cost of targeting is high because a firm invested less on making the product more desirable. Our paper derives conditions under which contagion is feasible, and hence, when targeting is less costly.

My other three theory papers apply evolutionary game theory to information sharing and diffusion, focusing on opinion formation through social learning. Understanding how processes of opinion formation lead to public disagreement and consensus is very important because the success of any public program or policy depends on achieving the latter. In one paper, I show that public disagreement persists in societies where people tend to interact only with those with whom they share attributes.

Empirical work: I have written two collaborative empirical papers (with Michael Rose, Max Planck Institute for Innovation and Competition, and Co-Pierre Georg, UCT's School of Economics) that examine how information sharing and diffusion through teamwork impacts individual productivity and the quality of research output. In the first project, we examine externalities that arise from teamwork – the notion that groups are more effective than individuals. These type of externalities are a form of synergies that arise when individuals with different but overlapping skills and knowledge work together. We find that externalities indeed exist in academic teams.

The second project extends this idea to informal collaboration (e.g. giving feedback to peers' work at seminars, conferences, etc.). Informal collaboration is increasingly becoming a norm in academia, especially in economics science. Our results indicate that informal collaboration contributes to both the quality and popularity (e.g. measured through citations received) of academic papers. Overall, our results have strong implications for science policy. They suggest that: (1) it may be optimal to allocate research funding in groups, at least for some type of projects where synergies in skills and knowledge can be exploited; and (2) the design of research grant schemes should take account of informal collaboration among scientists.

3. Future research

I plan to continue research in evolutionary game theory, contributing both to its theoretical advancement and application to economics. I also look forward to developing collaborative projects with faculty members of the department, particularly on empirical and experimental aspects learning and evolutionary game theory.

Theory and applications of game theory: There are still many theoretical aspects of evolutionary game theory that are under-developed. For example, whereas most models of evolutionary game theory assume that social learning occurs through observation of others' actions, there are many scenarios where people learn through word-of-mouth communication. The theoretical implications of this form of learning are not yet well understood. This is one of the theoretical aspects I intend to explore further.

I have recently started two new research projects on the applications of evolutionary game theory. The first project (in collaboration with Osei Davina, the Oxford Department of International Development, University of Oxford) applies evolutionary game theory to model the dynamics of corruption across countries. Our preliminary empirical analysis – using data collected from the International Country Risk Guide (ICRG) dataset, the World Values Survey and the Cross-country Analyses of National Systems, Growth and Development (CANA) dataset – indicates that in the long-run, countries tend to make transitions between the "good" and "bad" states of corruption. The rates at which these transitions occur vary across countries and we aim to develop a calibrated model of transitional dynamics that explains how decentralized versus centralized institutional structures affect transitional rates. With this approach, we depart from the traditional agency models of corruption and instead treat the states of corruption as conventions which can be exited and re-entered over time.

The second project (in collaboration with Michael Rose, the Max Planck Institute for Innovation and Competition) applies evolutionary game theory to model the process of innovation through research and development. It is well-known that the distributions of innovations (e.g. distribution of patent sizes) follow patterns that are stable over time. Using a new measure of innovativeness for academic papers, our preliminary empirical analysis (using data from SCOPUS) indicates that, just like the distribution of patent sizes, innovations in academic research follow a power-law pattern which is stable over time. Understanding the process that generates such distributions will help to guide competition and science policies (e.g. reward systems and grant allocations). We aim to develop a theoretical model, which is guided by empirical analysis, that explains how distributions of innovations naturally arise from optimally allocating time between learning and producing research output.

Experimental work: Many aspects of evolutionary game theory and game-theoretic models of social learning in general are yet to be tested. This can only be done through a combination of econometrics analysis and lab and field experiments. There is a growing literature in these areas of research, which includes field experiments on how farmers learn new technologies and crop varieties from their peers; how doctors learn new practices from their peers; and the diffusion of programs such as microfinance through word-of-mouth learning. However, there are still many aspects of these models that are yet to be tested, ranging from the

behavioral assumptions to the impact of exogenous factors such as the interaction structure. Many staff members at the Department of Economics have expertise in empirical analysis and experimental economics, and I hope to engage in collaborative work in this area of research.