Focused on friends

Dr Yann Bramoullé discusses how the recent explosion of interest in social networks is playing an increasingly central role in applied economic research. His work to better understand how individuals are influenced by social networks could have significant implications for policy and beyond

DR YANN BRAMOULLÉ

How would you define econometrics in the context of social networks? What is the aim of your work in this field?

The econometrics of social networks is a branch of the statistical study of social networks. Econometrics refers to methods and tools developed by applied economists. As economists, we bring the strengths, and weaknesses, of our discipline to the empirical study of networks. These include our expertise in handling large-scale representative data and paying careful attention to causality and to the microfoundations behind the statistical models. The objective of this study is to understand both the determinants and the impacts of social networks by analysing data collected in contexts where networks matter.

Could you discuss the main goals of your investigations into the econometrics of social networks?

In most empirical studies, we observe strong correlations in behaviours and outcomes among social neighbours. For instance, teenagers are much more likely to smoke, to have good grades or to engage in risky behaviour if their friends do

so. My primary objective is to understand where these correlations come from. More precisely, I am developing new statistical methods, based on social networks, to break down these correlations.

What data are you analysing and why? Does it have any limitations, and if so, how are you navigating these difficulties?

We have been working with data from a large-scale representative survey of teenagers' behaviour in the US, called the National Longitudinal Survey of Adolescent Health. It has become popular among researchers working on networks because it contains detailed information on social relationships.

The fact that friendships are self-reported raises a number of difficulties, such as subjective interpretations and measurement errors. For instance, a large proportion of friendship nominations are not reciprocated. So far, we have dealt with these difficulties using standard statistical methods such as robustness checks and Monte-Carlo simulations. For example, we look at whether statistical estimates change when varying the precise definition of a social relation or when adding and removing links at random. However, these issues warrant a more systematic methodological effort, which forms a clear part of the collective research programme on the statistical study of networks.

How does this research build on previous studies that have sought to understand the factors that determine how individuals are influenced via social networks?

Our research builds on a large empirical literature on peer effects. Applied economists and other social scientists have been investigating social effects for a long time. So far they have mainly focused on group interactions where agents are partitioned

into distinct groups, such as classrooms, and interact with every other member of their own group, but not with members of another group. However, social interactions in many contexts are embedded in social networks.

We have shown how the network structure helps to provide credible estimates of social effects and that the statistical study of social networks effectively complements earlier insights and techniques built on group setups. One exception here is spatial econometrics; there are many connections between the econometric study of spatial data and the econometrics of social networks.

What are the broader implications of your research to areas such as adolescent behaviour and government policy? How else might this work be of benefit?

Determining the precise reasons behind correlations in outcomes is important both to gain a better understanding of individual behaviour and in terms of policy implications. In the presence of true social effects (contextual effects and social influence), decision makers may wish to alter the socialisation patterns of individuals, for example by paying special attention to the composition of classes in high schools. In addition, social influence gives rise to a 'social multiplier' – any effect on individual behaviour tends to be amplified by peer effects, which may be harnessed by well-conceived social programmes.

Our analysis also has implications for the way researchers collect data on social networks. In particular, we have shown that obtaining reliable information on the absence of relations between people may be critical. When two people are not related, a statistical association between their behaviours must be mediated through the network. However, to be confident about this mediation, we need to be sure about the absence of links.

DR YANN BRAMOULLÉ

Understanding
peer pressure

With the importance of social networks increasingly being recognised by economists, research being carried out at **Aix-Marseille University** in France aims to overcome the challenges in developing accurate models of group behaviour

IT HAS LONG been suspected by economists that a greater understanding of group behaviour requires models that can accurately describe the complex interactions of peer effects. Recently this has led to a huge increase of activity exploring how specific groups influence the individual agents within them and how these agents in turn influence the group to which they belong. Using the tools and methodologies of econometrics to study social networks, researchers have been able to gain insights into a wide range of areas; educational choices, obesity, welfare participation, academic achievement and the employment of war veterans are just a few examples.

Although the body of work in this field is growing, empirical evidence remains scarce as attempts to determine what drives the correlation between the outcomes of individuals who interact together continue to present social scientists with serious challenges. In order to achieve reliable estimates of peer effects, one must be able to identify the relevant peer groups, distinguish between peer effects and confounding factors and, finally, disentangle the various peer effects to determine which is at work. Factors such as the reflection problem, identified by Professor Charles F Manski in 1993, can lead to cases of mistaken identity and fallible results.

NETWORK BEHAVIOUR

Using the structures and determinants of groups connecting individuals, the Econometrics of Social Networks project aims to provide innovative statistical methodologies for accurately distinguishing between peer effects. Formerly funded by the Social Sciences and Humanities Research Council of Canada (SSHRC), the project is spearheaded by Dr Yann Bramoullé, French National Center for Scientific Research (CNRS) Research Fellow at Aix-Marseille University. Working closely with Bramoullé

are two researchers from Laval university, Dr Vincent Boucher, an assistant professor and Dr Bernard Fortin, a professor of economics. A third researcher is Dr Habiba Djebbari, an associate professor of economics at Aix-Marseille University. With their help, Bramoullé's work has focused on the division of peer effects into four distinct types.

Bramoullé offers an analogy of people's smoking habits, a behaviour that is strongly mediated by social interactions, as a useful illustration of these concepts. It has been observed that smokers are often likely to gravitate toward other smokers (homophily). Moreover, a non-smoker may be influenced by their friend's habit and take up smoking (social influence) while their neighbourhood might be subject to heightened availability in the form of cheap contraband cigarettes (common shocks). The contextual effects in this instance could be that a social neighbour's parents are doctors whose knowledge of the dangers of smoking emanates outward into their child's friendship circle.

FRIEND OF A FRIEND

In determining how the social network and its architecture can help to bring about a greater understanding of peer effects, Bramoullé's work seeks to elucidate the factors that influence the formation of networks and how they bear upon the quality of peer effect estimates. With extensive data on 90,000 students in US schools, the National Longitudinal Study of Adolescent Health (Add Health) has enabled Bramoullé to make significant progress in characterising the conditions under which these social effects can be identified. Having proved an invaluable

source of information to a wide range of disciplines, the details of social networks and outcomes of interest that Add Health contains makes it ideal for these purposes.

With each student asked to name up to five male and five female friends, the survey provides the requisite data for reconstructing a network of self-reported friendship relationships. Using this information, Bramoullé is able to separate the endogenous and contextual social effects within a network, a key finding that points to the influence of network characteristics: "We have shown how the 'intransitivity' of the network may help the identification and estimation of social effects," states Bramoullé. The concept of intransitivity provides convincing evidence of the effects of social influence on an agent because it describes the relationships between friends of friends. If A is friends with B, and B is friends with C, it does not necessarily follow that A is friends with C. If a shock affecting friend C is connected to a change in friend A's behaviour, it can only have been mediated by the social influence of their mutual friend, B.
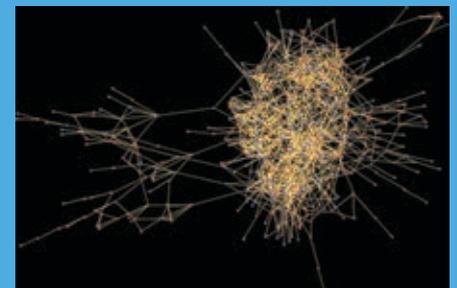
FRIENDSHIP NETWORK IN AN AMERICAN HIGH SCHOOL

THE ECONOMETRICS OF SOCIAL NETWORKS

OBJECTIVES

• To understand the determinants and the impacts of social networks

• To develop new statistical methods, exploiting structural features of the networks, to help break down social correlations into their four components: homophily, common shocks, contextual effects and social influence

KEY COLLABORATORS

Dr Vincent Boucher, Assistant Professor; **Dr Bernard Fortin**, Professor of Economics, Laval University.

Dr Habiba Djebbari, Associate Professor of Economics at Aix-Marseille University.

FUNDING

CONTACT

Dr Yann Bramoullé
CNRS Research Fellow

Aix-Marseille School of Economics
GREQAM, Centre de la Vieille Charité
2 rue de la Charité
13236 Marseille Cedex 02
France

T +336 73 13 82 30
E yann.bramoulle@univ-amu.fr

YANN BRAMOULLÉ graduated from École Polytechnique in France in 1995 and obtained his PhD from the University of Maryland, College Park in 2002. He was an economics professor at Laval University in Québec until 2012 and is now a French National Center for Scientific Research (CNRS) Research Fellow at Aix-Marseille University. He was nominated for the prize for the best French young economist in 2013.

STRONG TIES AMONG BOYS

Interestingly, Bramoullé's calculations for identifying peer effects in standard models suggest that this can be done without accounting for intransitivity. Although arrived at via a different route, these findings agree with the analysis proposed by Professor Lung-Fei Lee, of Ohio State University, which considers interactions within groups of different sizes. Within these groups, agents interact with every member of the group but no one else. The mechanical effects that occur as a result of different group sizes can then be exploited as a means of identifying peer effects. Having received attention already, researchers using these methods to grasp the impact of social networks will need to be careful in their data collection; in addition to seeking reliable information on the links between agents within a group, these methods highlight the importance in establishing the absence of relations as well.

CONTROLLING THE EQUATION

Accurately quantifying social influence, common shocks, contextual effects and homophily using current strategies rests on the assumption that homophily has been properly controlled within a model. Refining this control, however, remains a key objective for Bramoullé due to its strong bearing on the reliability of estimations, an issue that could benefit from greater understanding of the mechanisms of network formation. Homophily may be better controlled by accounting for, and contrasting, the relationships that are formed through a network, as these tend to be less homophilous. For example, social relationships are diversified when people meet friends through common friends. Bramoullé hopes to control homophily by exploiting the negative impact of decreased homophily that diversity creates. Another avenue lies in the fact that friendship nominations are often one way affairs. "Contrasting correlations for reciprocated and non-reciprocated friendships should also help to control for homophily," explains Bramoullé.

With better controls leading to more accurate estimates, the impact will no doubt be keenly felt by statisticians and economists, but already Bramoullé's work with Djebbari and Fortin has hinted at the practical implications of this research. In a study using classical administrative data from the Ministry of Education in Québec, the methodologies developed by Bramoullé have pointed to evidence of social influence in academic success. Looking at individual scores in tests in maths, history, science and French, endogenous peer effects were only found in the maths results. Using these findings, a strong argument could be made for improving the quality of mathematics lessons as any performance increase is likely to be shared among class networks. Currently halfway toward achieving its primary objectives, implications such as these will only become stronger as the project continues to advance the econometrics of social networks.

The four causes behind social correlations

Homophily – the formation of social relationships as a result of similarities between individuals

Social influence (or endogenous social effect) – the impact of a social neighbour's behaviour

Common shocks – the unobserved driving forces of behaviours that are shared by individuals within a social network

Contextual effects – the impact of a social neighbour's characteristics