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Extracting deep information from limited observations on an evolved social network ☆

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Abstract

We provide empirical evidence that in a social network which evolves over time, it is possible to extract deep information about the system from limited observations. In this paper, we consider a simple piece of readily available evidence on access to financial services by individuals in the UK. Detailed statistical analysis has shown that the decisions of agents on whether or not to have a basic financial account such as a bank account is heavily influenced by other individuals on their social network. We consider a small amount of straightforward and readily accessible information. We deduce from this, using an agent-based model, the type of social network across which information and influence on behaviour flows between agents in this context. Specifically, we show that information appears to flow across a small world network.

Keywords: Empirical social network; Agent-based model; Small world

1. Introduction

There is a growing literature of empirical evidence on the topologies of how agents in social and economic systems are connected in different circumstances. The world wide web has been studied intensively (for example [1]). Other examples include the sexual contacts of individuals [2], connections between movie actors [3], the dissemination of heresy in medieval Europe [4], the interlocking structure of membership of corporate boards [5], and collaborations between scientists (for example [6]).

An important property of networks which evolve over time is that they permit the extraction of deep information about the system from limited observations [7,8]. In this paper, we consider a simple piece of readily available evidence on access to financial services by individuals in the UK. The decisions of agents on whether or not to have a basic financial account such as a bank account is heavily influenced by other individuals on their social network [9]. We deduce from this basic evidence the type of social network across which information flows and agents influence each other's behaviour in this context.

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Section 2 sets out the background, and Section 3 describes how we extract information on the topology of the relevant social network across which information spreads in the context of deciding whether or not to have a bank (or other basic financial service) account.

2. The background

Almost one in 10 adults in Britain do not use mainstream financial services. Most of them are not in paid employment. However, most people without paid work have accounts. Two hypotheses have been put forward to account for the behaviour of the minority without accounts: (i) reluctance by financial institutions to serve low-income customers; and (ii) information failure on the part of non-consumers. Using logistic regression analysis of two different data sources, Meadows et al. [9] show that non-consumers of financial services are distinguishable from consumers only by belonging to social networks where financial services usage is relatively low. As social networks play a key role in transmitting information, this supports the information failure hypothesis.

Information on whether or not individuals in the UK have access to financial services is available in two official survey databases. The first is the Family Resources Survey. This is an annual survey undertaken on behalf of the Department of Social Security whose primary purpose is to inform government policy on benefits and pensions. The sample size is large (41,800 adults living in 23,500 households) and nationally representative in order to provide detailed information about the assets and incomes from different sources of recipients of state benefits. It also contains information about usage of financial services and extensive information about household circumstances. The data contain information on the use of financial services by other members of the household of individuals in this data set.

The second database enabled us to extend the concept of the social network beyond that of members of the immediate household to encompass both friends and relatives more generally. This was derived from the monthly Omnibus Survey carried out by the Office of National Statistics (ONS). Each month the survey interviews a nationally representative sample of around 1600 adults. In addition to standard questions, which are used for classificatory purposes, special questions are inserted mainly on behalf of government departments or research organisations. For the purposes of this research, we included four questions in the Survey in March and April 2000. The first asked all of the 3450 adults interviewed whether they had a bank, building society or Post Office account, and which sort of account they had. The other three asked the 1627 who were not in paid work:

- ''How many of the other people in your household do you think have bank, building society, post office, or similar accounts?''
- ''How many members of your family do you think have bank, building society, post office, or similar accounts?''
- ''How many of your friends do you think have bank, building society, post office, or similar accounts?''

The statistical analysis in Ref. [9] examines both databases in detail, but here we use two simple pieces of information from the smaller, less detailed Omnibus Survey to reveal the topology of the social network across which information spreads in this context.

3. Approximating the topology of the social network

In this section, we deduce an approximation to the type of social network which is relevant in this context. There is no direct evidence on this, for we simply have the information for each agent without an account on whether 'all or many', 'some' or 'few or none' of the agents on his/her social network have accounts. This is why we need to deduce indirectly the type of network which this is likely to be.

We set up a simple agent-based model, in which the decision of an agent to take up an account is determined probabilistically by the proportion of agents on his/her network who already have an account.

We have two empirical findings against which we can calibrate a theoretical model. The first is taken from the ONS Omnibus Survey and is set out in Table 1.