Why Should Theorists Care about Social Capital?

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These notes are intended to provide some background reading for Robert Putnam's talk on 7 March, 2001 at the theory workshop. The notes do not provide an extensive literature review - they simply identify a series of topics potentially interesting for theorists. Some of the readings can be downloaded from my website at http://post.economics.harvard.edu/faculty/mobius/links.html

1 Introduction

Social capital is embedded in social networks. For the purpose of these notes, I use the terms social capital and social networks interchangeably. At the most basic level it is useful to think of social capital in a supply-demand framework. Individual agents have some demand for social capital. More precisely, agents have demand for the *services* provided by social capital such as having access to the support of friends in times of need.[1] Agents 'purchase' access to the services provided by the community by producing links to other members of the community.[2] The joint investments of all agents in building links determine the level of supply of social capital.

[1] Although some of the literature does not strictly distinguish between social capital (the social network) and the services of social capital it is important to keep both concepts separate.

[2] One large cost in producing social capital is time spent in cultivating a tie with a stranger, and keeping up existing relationships. Other costs include expenses on entertaining guests, and paying for transportation to visit friends.

The demand for the services of social capital can decrease or increase over time due to changes in agents' characteristics (i.e. aging and changes in level and the dispersion of income). Similarly, the opportunity cost of time to invest in social capital can increase over time as new opportunities to consume free time evolve (such as television), and more people participate in the work force (in particular, women). Extending a simple investment model Glaeser, Laibson, and Sacerdote (2000) provide a theoretical analysis of how changes in individual characteristics and the opportunity cost of time influence the equilibrium level of social capital. Putnam (2000) and Costa and Kahn (2001) measure (and disagree about) the importance of demographic trends, shifts in income inequality and changes in the opportunity cost of time for the demand for and the provision of social capital.[3]

In these notes I focus on a simple sub-question of particular interest to theorists: how does social capital create services to agents? The question is important because most people believe that there is a large social multiplier due to strong interpersonal complementarities. This naturally gives rise to:

1. **Amplification.** Small changes in individual characteristics and the opportunity cost of time can have large effects on the equilibrium provision of social capital and the services of social capital.

2. **Multiple Equilibria.** If the complementarities are strong enough there can be distinct equilibria with low and high level of social capital. If the level of social capital is low, the returns are likely to be low, too, and agents will invest little time in making links. For example, a community where nobody helps a neighbor it does not make much sense to cultivate links to your own neighbors since you can't expect much from them anyway.

3. **Sub-Optimal Investment** Agents are likely to underinvest in social capital because they do not capture the full returns of social capital.

[3]Putnam (2000) extensively documents the decline in social interaction along various dimensions such as the membership in groups and concludes that television and the aging of the civic generations born between 1910 and 1940 are the primary culprits. Costa and Kahn (2001) find that birthplace heterogeneity and income inequality, as well as the greater participation of women in the labor force are powerful predictors for the number of social links measured in terms of group membership and the willingness to entertain guests

2 Social Capital and Its Services

Investment in social capital takes the form of investment in links to other agents. The joint investment of many agents in a community result in a social network represented mathematically by a graph with n nodes (each node representing an individual). To analyze how the investments of individual agents in social capital are related with the supply of services of social capital, we have to answer two questions:

1. What are the services of social capital, and how can we measure them? For the purpose of these notes I will concentrate on (A) the a ability to gain access to *information* (i.e. about job opportunities), (B) ability of agents to *cooperate* (i.e. mutual help), and (C) ability to *coordinate* actions (political action, revolution, momentum).

2. What are the salient features of social networks, and how do they relate to different measures of social capital?

One obvious feature of a social network is the number of links interconnecting a community of n agents. This is essentially the approach taken by Putnam (2000) in his book *Bowling Alone*.

There is a sense in which 'more links are better'. If I make more connections to other agents in the community I get more information and cooperation, and I can coordinate more easily. In the same way, I benefit from the social capital investments of others. A simple way to capture these effects in a model is given in Glaeser, Laibson, and Sacerdote (2000). They assume that agents invest in an individual stock of social capital S_i by making links with agents in the community (think of S_i as the share of agents you are connected with). The average level of social capital in the community is $\tilde{S}$. Agents derive utility $S_i R\left(\hat{S}\right)$ from consuming the services of social capital where R is an increasing function. This formulation generates a social multiplier and captures the idea that the services from social capital are monotonic in everyone's investment.

An alternative measure of social capital is the precise structure of the network through which agents are connected. To see why structure matters consider a Prisoner's Dilemma played on a graph of size 1000 where every agent has exactly 10 connections. Compare the circle where everyone is connected to the five nearest neighbors to the right and left with a random graph where agents are simply connected to 10 randomly drawn neighbors.[4]

Cooperation is clearly easier to sustain on the circle because defection will be punished by a large number of neighbors. In contrast, in the random network defection is a much more attractive option: a neighbor will not necessarily punish my defection because it would cause the defection of all his neighbors who have not observed my defection yet. Therefore, cooperation will not be sustainable in the random network unless all agents can observe each others' actions and communication is cheap (or, there exists some central agency that collects everyone's action history).

In this example the quantity of links is the same in both networks. However, the circle structure implies a greater propensity to cooperate, hence creates more services to agents.

2.1 Classification of Network Structures

The seminal paper by Granovetter (1973) made the distinction between *weak* and *strong* links. Two agents are connected through a weak link if they have few common neighbors and they are connected through a strong link if their neighbors overlap to a large extent. Strong links imply the presence of 'cliques' of agents, and the average share of strong links in a network can be captured by a clustering coefficient (see Watts and Strogatz (1998)).[5] Weak links, on the other hand, increase the connectivity of a network and decrease the *degrees of separation* or the characteristic pathlength between agents (the average shortest path connecting any two agents in the network).

Granovetter (1973) argued that weak links are better for collecting information while strong links are important to foster cooperation. Granovetter (1974) applied his model to job search where he found that weak links are most useful. Referrals are important in job search, and weak links provide new information to the agent whereas strong links mainly provide information that the agent already possesses. Granovetter's research is important for two reasons.

[4]There is a small probability that a random graph is not connected. However, as long as the number of links k for each agent greater than $\ln(k)$ almost everyone is part of a giant connected cluster.

[5]The clustering coefficient is defined as follows. Suppose that a vertex v has k_v neighbors (including itself). Then at most $k_v(k_v-1)/2$ edges can exist between them (maximal connection). Let C_v denote the fraction of these allowable edges that actually exist. Define C as the average over all edges.

1. Weak and strong ties are a convenient way to classify important properties of networks that directly relate to economic phenomena such as the degree of cooperation and the ease of information exchange. To continue the above example, agents on the circle have all strong links, while agents in the random network have only weak links.

2. Different network structures can help provide different types of services. If our main variable of interest is the quantity of links in the social network it does not matter so much what measure for the services of social capital we use because 'more is better' for any type of service. However, the network structure complicates matters: weak links are good for fast information exchange (because they increase connectivity) whereas strong links are better for cooperation (prisoner-dilemma type games) and coordination.

The last point highlights the need to carefully distinguish between social capital and the services derived from social capital.

Example 1 *Assume that in a more advanced society the demand for cooperation decreases because agents do not need insurance through their social network any longer. However, jobs are of a more temporary nature in this advanced economy and agents have to change their work frequently. Therefore, their demand for referrals increases. It is likely that agents will substitute strong links for weak links. The effect on the total number of links is ambiguous, and quantity measures of social capital do not help us to decide whether the value of the social network has decreased or increased.*

2.1.1 Small-World Networks

Research by sociologists has shown that real-world social networks typically have both a high clustering coefficient (lots of strong links) and a high connectivity. Watts and Strogatz (1998) have demonstrated a convenient way to model generic 'small-world networks'. They start from a lattice (only strong links) and replace a small share ϵ of each agent's links with random links. This rewiring does not decrease the number of strong links a lot but by adding weak links the connectivity increases dramatically.

3 Exogenous Networks

A couple of recent papers[6] measure the social value of exogenously determined networks. Agents cannot choose their neighbors. This assumption is not necessarily a bad assumption - urban planners, for example, can design neighborhoods such that residents interact more (cul-de-sac) or less (streets). This setting is useful to examine which network designs are efficient in providing social value.

3.1 Social Learning

Bala and Goyal (1998) analyze how the structure of the social network affects social learning. They define a property of the network structure, local independence, which facilitates social learning greatly.

There is also a nice empirical paper on social learning by Kelly and Grada (2000). They look at the spread of two bank panics in 1854 and 1857 at a small New York bank, the Emigrant Industrial Savings Bank. This bank served mainly Irish immigrants.

They find that observable characteristics such as length of time an account was open do matter (people panic later). However, the most important determinant for an agent panicking is county of origin in Ireland. In fact, immigrants from the same county tended to live very close together in New York, and they also intermarried. There is therefore ample evidence that coming from the same county was a good predictor for the existence of a strong social link between two agents.

3.2 Cooperation

Haag and Lagunoff (2000) examine optimal social linkage when agents play a Prisoner's Dilemma game with each of their neighbors in a repeated games setting. Each individuals' discount factor is randomly determined. A planner chooses a local interaction network or neighborhood design before the discount factors are realized. Each individual then plays a repeated Prisoner's Dilemma game with his neighbors. Potentially suboptimal punishment arises in designs with local interactions since in this case monitoring is imperfect. Due to heterogeneity of discount factors, however, greater social

[6]For some papers, I have simply pasted parts of the abstract into this summary.

conflict may arise in more connected networks. When residents' discount factors are known to the planner, the optimal design exhibits a cooperative core and an uncooperative fringe. Uncooperative (impatient) types are connected to cooperative ones who tolerate their free riding so that social conflict is kept to a minimum. By contrast, when residents' discount factors are iid, the optimal design partitions individuals into maximally connected cliques (e.g., cul-de-sacs). Optimal clique size increases the more patient an individual is likely to be. Finally, if types are correlated, then incomplete graphs with small overlap (e.g., grids) are possible.

3.3 Coordination

Chwe (2000) looks at a coordination in which people use a communication network to tell each other their willingness to participate. The minimal sufficient networks for coordination can be interpreted as placing people into a hierarchy of social roles or "stages": "initial adopters", then "followers", and so on down to "late adopters". A communication network helps coordination in exactly two ways: by informing each stage about earlier stages, and by creating common knowledge within each stage. He then consider two examples: first he shows that "low dimensional" networks can be better for coordination even though they have far fewer links than "high dimensional" networks (because low-dimensional networks exhibit more clustering); second he shows that wide dispersion of "insurgents", people predisposed toward participation, can be good for coordination but too much dispersion can be bad.

4 Endogenous Network Formation

In these models agents can initiate new links and break old links. Therefore, these models both analyze the social value of network structures and the incentives of agents to invest in them. In many situations there is a tension between social efficiency and stability.

All these models are static. Jackson and Wolinsky (1996) consider a cooperative game theory model in which a link is stable if both agents are willing to invest in it. Bala and Goyal (2000) manage to analyze a non-cooperative model where the network structure pops out as a Nash equilibrium. However, they have to make the assumption that only one agent has to invest in a link to keep it open.

4.1 Cooperative Game Theory Models

Jackson and Wolinsky (1996) assume that agents can benefit both from their direct and their indirect neighbors. They then characterize the efficient networks and find that it usually takes simple forms such as the complete graph and the star. However, the star is not always stable.

4.2 Non-Cooperative Models

Bala and Goyal (1998) present an approach to network formation based on the notion that social networks are formed by individual decisions that trade off the costs of forming and maintaining links against the potential rewards from doing so. Like Jackson and Wolinsky (1996) they suppose that agents can derive value from their indirect links. Thus individual links generate externalities whose value depends on the level of decay/delay associated with indirect links. A distinctive aspect of their approach is that the costs of link formation are incurred only by the person who initiates the link. This allows them to formulate the network formation process as a noncooperative game. They first provide a characterization of the architecture of equilibrium networks. They then study the dynamics of network formation. They find that individual efforts to access benefits offered by others lead, rapidly, to the emergence of an equilibrium social network, under a variety of circumstances. As in Jackson and Wolinsky (1996) the limiting networks have simple architectures, e.g., the wheel, the star, or generalizations of these networks. In many cases, such networks are also socially efficient.

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