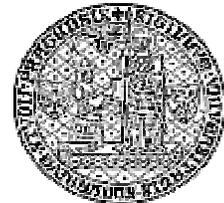


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Strategic Referring in Labor Market Social Networks

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Strategic Referring in Labor Market Social Networks

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Abstract:

We present a model of job search in which information about job opportunities is available either through direct search at the labor market or through network of socially tied individuals. We consider two cases - altruistic and self-interested agents that maximize their utility function. We show that optimal strategies range between full and no referring cases. Altruistic individuals tend to refer more than self-interested agents. Strategic referring allows agents alleviate employment variation and leads to higher average utility levels and lower unemployment rates

Keywords: agent-based modeling, networks, strategy, job referring

JEL: J62, J64, D82, D83.

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1. Introduction

Labor economists have long been interested in job search and the role of networks in it. Employee referrals are widely used and highly efficient in labor market search. In this paper I attempt to investigate decisions about job referrals in case of strong and weak ties between individuals within the network. Utility of agents connected with strong ties is mutually dependent whereas utility of agents connected through weak ties does not depend on the utility of other agents within the network.

The key insight of the model is that decision about sending a referral to other member of the network is made intentionally and influences agents' utility. The model shows that most successful family networks (networks of mutually altruistic agents) use referrals more often than networks of acquaintances (networks of agents connected by weak ties) but they do not use referring every time. On the other hand, even for networks of acquaintances it is advantageous to use referral hiring at some level.

2. Related literature

Empirical research has shown that approximately fifty percent of jobs are found through friends, relatives, and other social contacts. A great deal of empirical studies on the frequency of usage of social contacts analyzes US data sources. Rees and Shultz (1970) analyzed employment search in Chicago for 12 occupations, eight of which were blue-collar jobs. They found that the percentage share of blue-collar workers hired through referral hiring ranged between 53.6% (tool and die maker) and 73.8% (material handler) compared to 23.5% (accountant) and 37.9% (tab operator) for white-collar workers. Grantovetter (1974) studied

professional, technical and managerial workers (residents of Newton) and found that 43.5% to 65.5% of workers successfully used their network of friends and relatives to find employment. Holzer (1988) studied job search of unemployed young men (age 16 – 23). He found that 85 percent of participants used friends or relatives within one month of job search. Two most successful methods of job search proved to be friends and relatives and direct application. Together they constitute 67% of all reported offers. The offers received through friends and relatives were accepted much more often (in 81% of cases compared to 40% in case of newspaper search and 65% in case of direct application).

Bentolila et al. (2006) used US and European data from Multi-City Study of Urban Inequality that covered years 1992 to 1994 and European Community Household Panel that covered period 1995 to 1998. They found that the use of social contacts in job search leads to 1 to 1.5 months shorter period of job search. For US sample, the period of unemployment is on average 30% shorter for individuals who found their jobs through social contacts than for other workers. Using European data, the unemployment duration is about one month shorter for workers using referral hiring which is approximately 9% of the unemployment duration of the reference worker.

Addison and Portugal used quarterly Labour Force Surveys of the Portuguese National Institute of Statistics and found that 7.5% of those who used friends or relatives found job via that method in the following period compared to 1.9% of those who used advertisement, 1.5 of those who used public employment agency or 4.3% of those with direct approach. Addison and Portugal show that friends and relatives route fails to facilitate the reemployment of older workers compared to younger workers and white-collar workers compared to blue-collar workers. They conclude that mostly different observed characteristics define the success of the various job-finding methods.

There has been an important distinction in labor market networks made by Mark Granovetter (1983) who defined two types of social links – strong and weak ties. Strong ties are valuable in themselves, typical example of strong ties are ties to friends and relatives. Weak ties are rather instrumental; individuals are less emotionally involved. Granovetter argues that acquaintances are often more useful in providing an information about jobs than friends and relatives. Although friends and relatives are likely to be more interested in helping, acquaintances are more probable to deliver useful information. Acquaintances are less likely to be involved in the same environment as job seeker and hence more likely to provide useful

unexploited information about employment opportunities. Study of Eriksen and Yansey¹ showed that people with lower education tend to use strong ties more often. According to Granovetter (1983) poor and insecure people tend to rely more on strong ties.

Social networks are used both by employers looking for employees and job seekers looking for employment. Social network is a source of information about job opportunities as well as candidates. First, workers disseminate information about job opportunity through word-of-mouth communication to other members of their social network. The stronger the tie the more likely is that the information will be transferred. At the same time, the information received through social network is much profound and comprehensive than information received through other channels. In comparison with simple announcement about the skills required and position being filled, the word-to-mouth transmission comprises many other details and also “the inside story” such as precise description of working conditions, duties, corporate culture and other non-pecuniary characteristics attached to the job. This much more profound knowledge of particular job leads to much higher rate of job acceptance (Holzer (1988)), employees display lower turnover rate and stay longer in the firm.

The information asymmetry is serious drawback in recruitment of new employees. Companies use various screening procedures to separate the wheat from the chaff. They use signals such as years of schooling and experience, grades, letters of recommendation etc. The use of interviews and various tests (psychological, skill-testing, language tests, IQ tests etc.) is quite common. However, all kinds of these screening methods are limited and may lead to both types of mistakes – rejection of valuable potential employee, or acceptance of “shirker”. Therefore, the information provided by current employee about job applicant is extremely valuable. There are numerous studies analyzing the reliability of referrals by current employees. Calvo-Armengol (2006) writes: “Empirical accounts all show that referred applicants’ likely performance is, on average, higher than that of external applicants.” In a nutshell, there are three reasons for this outcome. First, employees tend to refer accurate information because their own reputation may be at stake. Saloner (1985) proved that if there exists a competition among employees than even if they use their private information about applicants strategically, the outcome will be the same as if employers had the private information themselves. Second, they are concerned with the quality of their future colleagues themselves. And third, people tend to refer people similar to themselves. Because the relationship between employer and incumbent employee is usually of a long-term nature,

¹ Eriksen, E., Yancey. W. (1980) Class, Sector and Income Determination in Granovetter (1983)

employer has sufficient information on incumbents' characteristics. Hence, the referral can be an efficient screening method.

Simon and Warner (1992) tested the hypothesis that referred workers should earn higher initial wages, experience lower subsequent wage growth and stay longer than workers hired from outside the network and found strong empirical support.

Hence, we see that referral hiring is very effective method of recruitment as well as a very effective method of job search. However, if we consider the success of the network as a whole, sometimes, available referral is not exploited because of diversification phenomenon. Networks that choose the best mix of referring and diversification of employment of their members among available firms survive and their strategies prevail. Stark and Bloom (1985) introduced theoretical analysis of decision making of socially tied individuals. People act collectively to minimize risks associated among others with labor market. Families or households are able to control risks by diversifying allocation of resources; one of the most important resources is family labor. While some family members can be employed in the local economy, others may be sent to work in foreign labor markets where wages and employment conditions are negatively or weakly correlated with those in the local market. In case of insufficient income due to downturn in local labor market, family can increase its income by migrant remittances. (Massey et al. (1993)) Hence, families use employment diversification to mitigate risk. Diversification of allocation of labor can mean being employed in agriculture in different regions with adverse agricultural conditions, or in different sectors of economy whose risks are not correlated or to be employed in companies whose performance are negatively or weakly correlated. For empirical research see e.g. Chen and Chiang (2001), Stark and Lavhari (1982).

3. The Model

We present a computational model of job search and investigate referring decisions of agents involved within social networks, connected by either strong or weak ties.

Agents and networks

At the beginning of each simulation N networks are created each of which consists of n agents.

Figure 3.1: Networks



Agents are characterized by type, strategy and network. Type is characteristic of agent that makes him compatible with the job of the same type. Type includes not only qualification or skills needed to exert the job but also other characteristics that are impossible to communicate through formal job advertising methods, hence to receive the information about the job type an agent need to be either given the referral through his network or apply for the job in given firm.

An agent receives wage 1 if employed and wage 0 if unemployed.

Each agent is member of one network. All agents within the network are of the same type, they are mutually connected and they are able to provide information about vacancies to each other.

The utility of agent is defined by following utility function:

$$u_i = w_i + \alpha \cdot W_j$$

where w_i is wage received by the agent i , W_j is sum of wages of other members of the network. α is set either to 0 or to 1. For $\alpha = 0$ agent is interested only in his own wage (we will call this utility function non-altruistic) and the relation between agents is characterized by weak ties defined by Granovetter. Social networks characterized by strong ties such as family networks are in our model expressed as the network of agents with $\alpha = 1$, who are effectively altruistic in a sense defined by Becker (1981):

“Altruistic” means that agent’s utility function depends positively on the well-being of other agents and effectively means that agent’s behavior is changed by his altruism.

Agents choose strategies $S \in R$ to maximize their utility. Each employed agent follows this rule: If sum of network members within his firm² exceeds S , he does not refer to unemployed members of his network about vacancies. Otherwise the agent sends referrals about vacancies in his firm to other members of his network.

² He does not count himself.

There are two possible modes in which networks operate. Either function LEADER is active in which case all agents within one network follow the same strategy and strategy evaluation takes place on the level of networks (utility levels achieved by whole network are evaluated) or function LEADER is not activated in which case each agent chooses his own strategy independently of others and strategies of individual agents are evaluated and compared with other agents' results.

Firms

At the beginning of each simulation $2*N$ firms are created, each firm consists of m vacancies. The probability that the firm bankrupts in given period is equal to b . Firms do not search for employees, they fill the vacancy with an applicant in case he is of the same type as the vacancy. All jobs within the firm are of the same type.

Job search and dynamics

In the first period all agents randomly choose one firm and apply for the job. In case that the job is of the same type as they are, agents are willing to take up the job. In case there are more or exactly the same number of vacancies in the firm as the number of applicants all applicants are accepted. Otherwise firm randomly chooses among applicants those who fill the vacancies, referred workers are preferred. Agents are employed within the firm until the firm bankrupts. At the end of each period employed workers can send referrals to unemployed members of their network. In case that the number of other members of agent's network in the firm is lower than S , agent sends a referral to one member of his network.

At the beginning of following period each firm bankrupts with the probability b . In case of bankruptcy all agents employed within the firm become unemployed. In place of each bankrupted firm new firm of the same type occurs.

Each unemployed agent (who did not receive a referral) randomly chooses one firm and applies for the job. The same process as in the first period occurs. In case that agent received a referral, she applies for the job in the referred firm if the firm did not bankrupt at the beginning of the period. She is accepted if number of applicants is lower than number of vacancies. Otherwise, firm randomly chooses from suitable candidates, referred agents are preferred.

Evolution of strategies

In the first period the strategy is set randomly between 0 and $(n - 1)$. Average strategy is therefore equal to $\frac{n-1}{2}$. Each network (LEADER) or agent (NON-LEADER) follow randomly chosen strategy for the next fifty periods. At the end of fiftieth period each network's or agent's average utility is calculated. Networks are ranked according to average utility and 30 percent of networks or agents with lowest utility abandon their current strategy and adopt new strategy.

Table 3.2: Events schedule

PERIOD		
1	Model	Create N networks, each of them consists of n agents
	Model	Create $N*2$ firms, each of consists of m vacancies
	Agents	All agents go to the labor market, randomly choose firm and apply for the job
	Agents	If type of job accords with agent's type, agent is willing to accept the job
	Firms	Firm accepts applicants, in case of abundance of applicants, it randomly chooses those who will be employed
	Agents	Employed agents send referrals according to their strategy
2	Model	Firm bankrupts with probability b
	Model	Instead of each bankrupted firm new firm of the same type is created
	Agents	Unemployed agents go on the labor market and search for job, those who received referrals go to referred firm, otherwise they choose randomly
	Agents	If type of job accords with agent's type, agent is willing to accept the job
	Firms	Firm accepts applicants, in case of abundance of applicants, it randomly chooses those who will be employed
	Model	Employed agents send referrals according to their strategy
:		
50	Model	Firm bankrupts with probability b
	Model	Instead of each bankrupted firm new firm of the same type is created
	Agents	Unemployed agents go on the labor market and search for job, those who received referrals go to referred firm, otherwise they choose randomly
	Agents	If type of job accords with agent's type, agent is willing to accept the job
	Firms	Firm accept applicants, in case of abundance of applicants, it randomly chooses those who will be employed
	Model	Employed agents send referrals according to their strategy
	Agents	Calculate average utility for previous 50 periods
	Model	Ranks networks according to average utilities
	Network	30% of networks or agents with lowest average utility change their strategies (randomly choose one of strategies used by 30% of most successful networks or agents)
	Model	With probability d the strategy of network is changed by + 1 or - 1

Thirty percent of networks with the highest utility are taken and each of the least successful networks randomly adopts one of their strategies. Then networks or agents follow their new strategy for the next fifty periods and then again utility is calculated.

To enable agents to search the strategy space properly, there exist a mutation in strategies that is applied at rate d . Each fiftieth period strategies are revised as described above. After the strategy correction there exists the probability d that the network or agent changes its strategy by 1 (either adds 1 or deducts 1 from current strategy).

At the beginning of each simulation we set:

- Number of networks
- Number of agents within the network
- Number of professions
- Probability of bankruptcy
- Mutation rate

4. Simulation results

If not mentioned otherwise the setup of the simulation is following³:

Number of networks	20
Number of agents within the network	5
Number of different types	4
Probability of bankruptcy	0.5
Mutation rate	0.005

Simulation runs lasted 2,000 or 20,000 periods (ticks). Hence, the strategies were evaluated and revised 40 or 400 times. All results quoted in this section were received as an average of 10 simulations for given setting for runs lasting 2,000 periods and 5 simulations for 20,000 periods lasting runs.

³ Number of networks and different types influence only computational manageability of simulations, number of agents within the network changes ability of agents to find optimal solutions (with rising number of agents within the network the link between agent's action and utility achieved is weaker).

4.1 Comparison of full referring, no referring and strategic referring

First of all we compare simulation results in three cases: full referring (employed agents refer about all vacancies), strategic referring (employed agents refer about vacancies according to their strategy, they refer only in case that number of other members of their network in the firm is lower or equal to S) and no referring (agents do not refer about vacancies at all).

For five agents within the network full referring means that the strategy is equal to 4. In case of no referring the strategy is equal to 0. We can see in Table 4.1 that if agents were given the choice they have chosen average strategy 2.6817 for ALTRUISTIC, LEADER setting and 1.9989 for NON-ALTRUISTIC, NON-LEADER setting and 20,000 periods. For both settings strategy chosen by agents is significantly lower than 4. NON-ALTRUISTIC, NON-LEADER setting shows lower strategies than ALTRUISTIC, LEADER maximization.

In case of strategic referring average utility achieved is highest and average number of unemployed agents is lowest of all three compared cases. At the same time variances are lowest in no referring case because agents are more evenly distributed across firms and hence they are more equally hit by unemployment and drops in wage (and utility) level.

Table 4.1: Comparison of full, strategic and no referring

ALTRUISTIC, LEADER

	full referring	strategic referring	no referring
strategy	4	2.6817	0
average utility	2.6138	2.7141	2.4508
variance utility	0.1401	0.1284	0.0040
average unemployment	71.6885	68.5779	75.4515
variance unemployment	126.0765	115.6283	90.8091

NON-ALTRUISTIC, NON-LEADER

	full referring	strategic referring	no referring
strategy	4	1.9989	0
average utility	0.5005	0.5634	0.4969
variance utility	0.0052	0.0048	0.0042
average unemployment	74.9147	70.0013	75.4515
variance unemployment	117.5712	108.5366	90.8091

Let us explain the mechanism causing that average unemployment is lower in case of strategic referring than in case that agents fully use their knowledge about vacancies and referring about all available vacancies. Imagine following example. There are 4 agents already employed in the firm and there is a vacancy to be filled. There are two possibilities. First, agents refer about the vacancy to the last unemployed member of their network and consequently all 5 agents are employed in company A. Second, agents do not refer about the

vacancy and fifth agent search independently at the labor market to find firm of the same type. Suppose that he finds appropriate job in firm B. Now the firm A bankrupts. In the first case all agents become unemployed, they do not receive any referrals until at least one of them finds firm of the same type. The chance that at least one of them finds a job within the first period of unemployment is approximately 0.76^4 . In the second case, one of them immediately receives referral from one agent employed in firm B. The agents assure through employment diversification that in case of bankruptcy of one firm, they receive referral immediately⁵. Figures 4.1 and 4.2 show development of strategies, utility and unemployment for one particular simulation run and altruistic (leader) and non-altruistic (non-leader) utility functions. We see that after few initial periods the level of utility and unemployment stabilized.

Figure 4.1: Development of strategy, utility and unemployment: ALTRUISTIC, LEADER

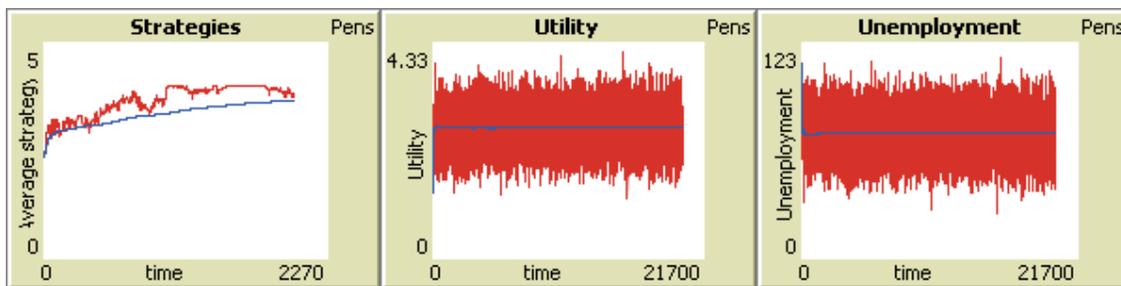
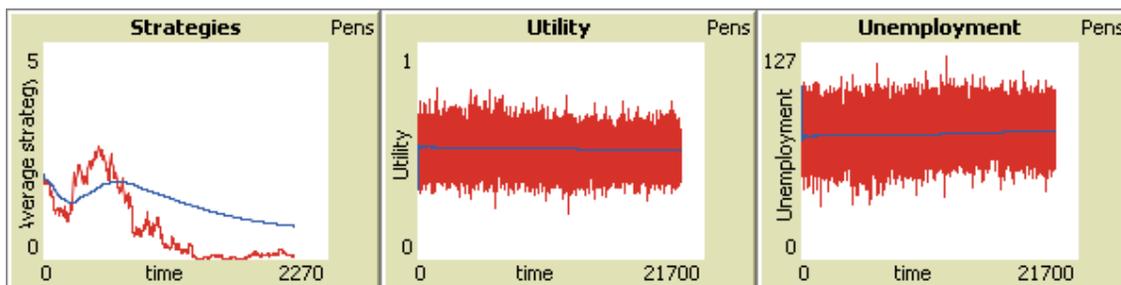


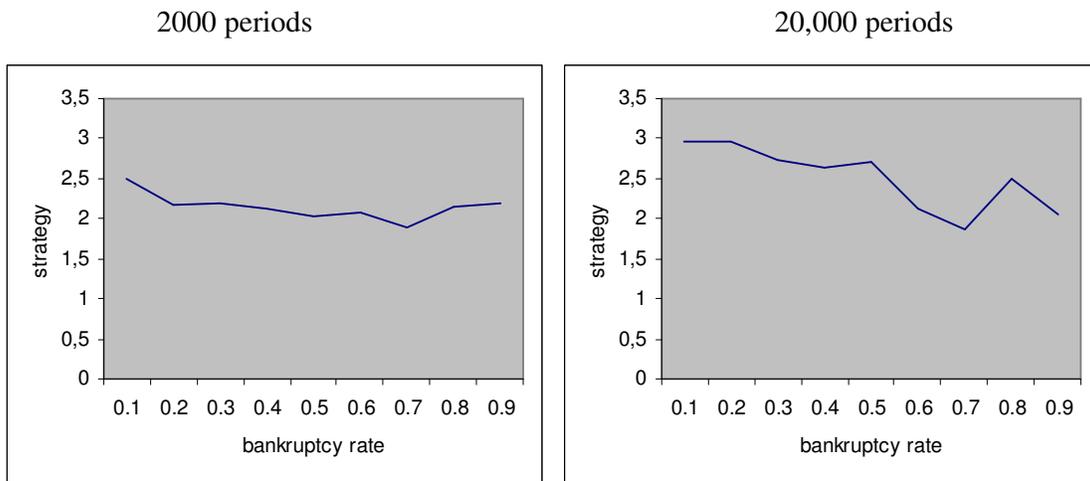
Figure 4.2: Development of strategy, utility and unemployment: NON-ALTRUISTIC, NON-LEADER



⁴ $P = 1 - (3/4)^5$

⁵ If in the surviving firm vacancies exist.

Figure 4.4: Average strategies for various bankruptcy rates: ALTRUISTIC, NON-LEADER



Figures 4.3 and 4.5 show very similar outcomes for different utility functions. The key to this result lies in the strategy selection mechanism. In case of LEADER setting, after each fifty periods the average utility of each *network* is calculated. Hence, the difference between simulations with NON-ALTRUISTIC and ALTRUISTIC utility function will be only that in case of ALTRUISTIC utility function the utility of each member of the network will be included 5 times compared to NON-ALTRUISTIC case. Therefore, the ranking of networks will be exactly the same and the same strategies will prove to be successful in NON-ALTRUISTIC & LEADER and ALTRUISTIC & LEADER settings.

For NON-ALTRUISTIC & LEADER setting the agents' utility function is non-altruistic but the fact that evaluation of strategies takes place on the network level causes that cooperative strategies prevail in the population.

Figure 4.5: Average strategies for various bankruptcy rates: NON-ALTRUISTIC, LEADER

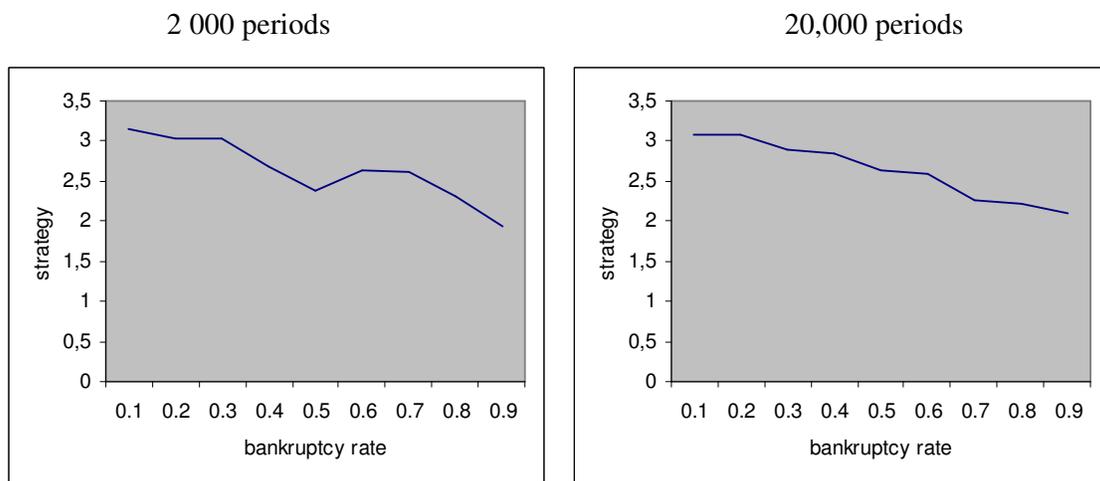
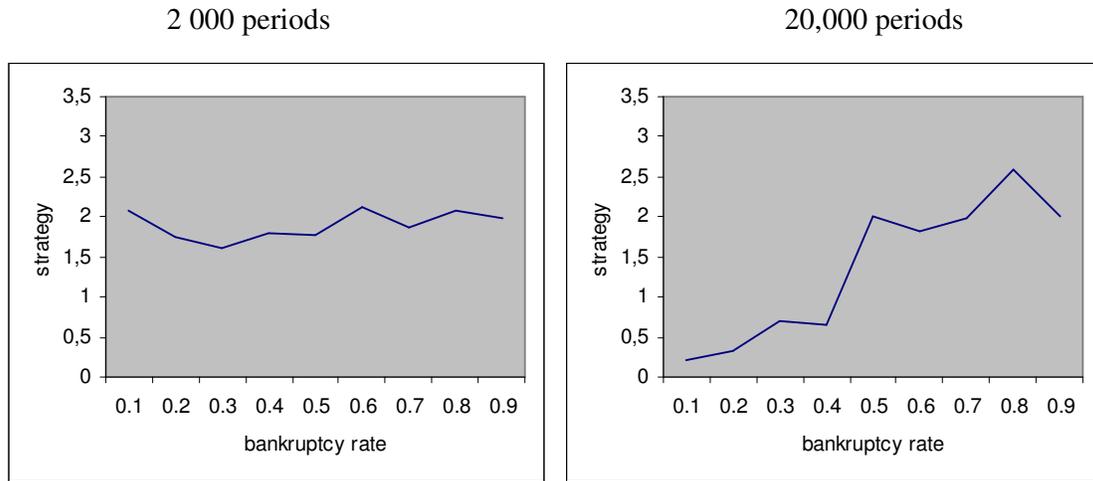


Figure 4.6: Average strategies for various bankruptcy rates: NON-ALTRUISTIC, NON-LEADER



NON-ALTRUISTIC & NON-LEADER setting (Figure 4.6) exhibits rather opposite pattern to previous three cases with referring rate starting at 0.2 for probability of bankruptcy 0.1 reaching 2.5 for probability of bankruptcy equal to 0.8. Figures 4.3 to 4.6 show that for NON-ALTRUISTIC & NON-LEADER setting the rate of referring is lower than for other three cases (except for bankruptcy rate 0.8), which is expected result.

NON-ALTRUISTIC & NON-LEADER setting is the only purely non-altruistic case in which agents decide independently and their strategies are independently evaluated. Figure 4.6 shows the greatest difference between 2,000 and 20,000 periods lasting simulations, which suggests that for agents it is fairly difficult to find optimal solution. Furthermore, the cooperative behavior in this setting is limited compared to other three cases. However, even in NON-ALTRUISTIC & NON-LEADER setting the cooperative behavior prevailed for higher probabilities of bankruptcy.

For low bankruptcy rates the fact that agent himself finds job is sufficient to assure that his strategy survives (because the utility gain from employment is relatively high thanks to long lasting employment contract). Furthermore, not to provide information about the vacancy to other agents within the network improves agent's chances to get good ranking when evaluation takes place.

With rising volatility of labor market (rising bankruptcy rate) only agents included in networks where high rate of referring prevails are able to attain sufficiently high utility levels that assure survival of their strategies. Hence, even for NON-ALTRUISTIC & NON-

LEADER setting the cooperative behavior with referring strategies around 2 prevails for high bankruptcy rates.

5. Conclusions

Previous empirical research has shown the importance of employee referrals in job search. In our model we investigate behavior of agents included in two types of networks – networks of mutually altruistic individuals (equivalent to strong ties) and networks of agents whose utility is not directly mutually connected but who are able to provide information to each other (equivalent to weak ties).

We used two settings: LEADER (all agents within the network follow the same strategy and the strategies of 30% of most successful networks replace strategies of 30% of least successful networks during evaluation process) and NON-LEADER (agents within one network individually choose their strategies and strategies of 30% of most successful agents replace strategies of 30% of least successful agents during evaluation process).

Our model suggests that agents use referrals strategically to assure more fluent employment history with shorter periods of unemployment. This new view enriches the debate about the role of social networks in job search and elucidates the mechanism of job search. We argue that even if the utility of individuals within the network is directly related (as e.g. in family networks) the rate of referring does not reach the maximum possible value. Put differently, not all available vacancies are filled with network members. On the other hand, even in case that the utilities of agents within the network are not mutually dependent the cooperative behavior emerges to some extent. Hence, through the process of natural selection of more successful strategies a cooperative behavior within the networks emerged for both kinds of networks - with strong and weak ties.

At the same time, agents linked with strong ties or using LEADER setting were more motivated to be of assistance in case of unemployment, because the survival of their strategy is directly dependent on the successfulness of whole network. This result is supported by empirical findings mentioned in the first section that friends and relatives are the most successful method of job search. The model predicts that the intensity of use of social network as a job search mechanism is greater if the expected length of employment within one firm is longer.

For NON-ALTRUISTIC agents with NON-LEADER setting cooperative behavior prevailed as well in case of highly volatile environment with high bankruptcy rates. Hence, the opposite

pattern emerged than for ALTRUISTIC & LEADER, NON-ALTRUISTIC & LEADER, and ALTRUISTIC & NON-LEADER setting. In this case it is the volatility of environment that drives people to cooperate in job search.

To conclude, our model predicts that for highly volatile labor markets all types of networks will follow approximately the same cooperative referring strategies. On contrary, stable labor markets with low bankruptcy rates should show significant difference between purely non-altruistic setting (NON-ALTRUISTIC & NON-LEADER) and three other settings (ALTRUISTIC & LEADER, NON-ALTRUISTIC & LEADER, ALTRUISTIC & NON-LEADER).

In the real world the rate of referring about job vacancies should be approximately the same in case of highly unstable markets with short employment duration (e.g. for low-skilled workers) but should differ for stable labor markets with long employment duration. Job search on these labor markets should be characterized by intensive use of referring in case of family networks but rather weak use of referrals in case of networks composed of acquaintances.

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