The Role of Social Network in the Job Search Mechanism

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Aim of the lecture:

The development of a probabilistic approach investigating job search mechanism at individual level (microstructure) coherently with the dynamics of macro-variables. We are going to use the model for investigating upon the role of social networks in the job search process.

Do we need it?

- Standard literature is mostly concentrated on a steady-state, aggregate analysis and does not allow investigation of the microstructure.
- Generally, it does not provide microfoundations to the matching function.
- It does not allow investigation on sociological spillovers (local effects).

Some attempts have been made by exploiting the Urn-Ball probabilistic model. Nevertheless they do not account for the previous three points in an overall framework

Some Stylized Facts acting as constraints in developing a job search theory:

1. The long run relationship between vacancies and unemployment rates (Beverdige Curve).

2. Microdata shows that job market is characterized by large gross flows of jobs creation and destruction (Davis, Haltiwanger and Schuh 1996) as well as workers' transition among unemployment, employment and out of the labor force status.

3. The Beveridge curve shows fuzzy movements, alternating relative stable regimes to large variations in position and slope, as well as non-monotone transitional paths (Blanchard and Diamond, 1989, Bleakley and Fuhrer, 1997, Nickell et al. 2002).

4. The matching function has CRS.

Relevant matches come from unemployment and out of the labor force

5. *Much of the movement into ad out of employment is from "out of the labor force"....."the relevant pool of workers appears to include some workers classified as being out of the labor force"* (Blanchard and Diamond 1989).

6. Workers out of labor force have a lower labour market attachment. (Castillo 1998 on CPS data).

7. Once they decide to become job-seekers, persons out of the labor force have more difficulty in finding a job (short vs long run unemployment);

Quit and Lay off

- Workers who leave voluntary the job are usually considered as retired from the labour force or not available for a "new hire“
- Akerlof, Rose and Yellen, 1986, calculate that 40 percent of workers quitting their job move directly to a new job without enter the unemployment status.

More controversial are layoffs:

- *A worker who is laid off may remain attached to the firm in two distinct senses. One is that the worker is less available for employment elsewhere than the typical unemployed worker. The second is that the worker is available for recall by the firm without the need to post a vacancy* (Blanchard and Diamond)

These points induce econometricians to exclude job losers on layoff from the stock of unemployment used to estimate the matching function but including persons out of the labor force that would accept a job if offered.

Some Data

	UU	UE	UR	EE	EU	ER	RR	RU	RE
2000	42.3	32.4	25.3	96.0	1.1	2.9	92.8	2.1	5.1
2001	46.2	29.9	23.9	95.6	1.3	3.1	92.6	2.3	5.1
2002	52.6	25.2	22.2	95.7	1.4	2.9	92.7	2.5	4.8
2003	53.3	23.9	22.8	95.8	1.3	2.9	92.7	2.5	4.8
2004 (Jan/Apr 04)	53.3	23.9	22.8	95.8	1.3	2.9	92.7	2.5	4.8

Monthly Average

Source: US Labor Bureau

What Data show:

1. Total labour supply is composed by unemployed job-seekers, U, employed, E, and out of the labour force or unattached, R.
2. The workers flow UR is not relevant for the search and match process, as they do not fill a vacancy
3. The flow EU is negligible and much lower than the ER one.
4. Workers leave R either to be employed or to get a job-seeker. This involves two matching functions in the model: one driving the RE flow and another the UE one.

To build a theoretical model we need to simplify

- We want to focus on the matching function as a device linking individual transitions to the aggregate rate of vacancy and unemployment
- The matching function driving the RE flow involves a second function of which we have no a clear idea.
- After a lay-off, workers are in the state R and have a chance to be matched again via the transition to the U status.
- Finally, we neglect the EU flow since it refers to a small share of fired individuals.
- We shall assume that individuals can be hired only by passing through the U status; we can think to U as a sort of job center.
- This allows us to focus on a single matching function driving the UE flow and we shall show that such function obeys to the standard requirments of the MP approach.

We conclude hence that the relevants states are $U \rightarrow E \rightarrow R \rightarrow U$ for workers and $V \rightarrow F \rightarrow V$ for firms.

Job Search and Social Networks

- It is commonly observed that job seekers use their friends and relatives to find a job. The empirical evidence suggests that about half of all jobs are filled through personal contacts (Granovetter, 1974, Holzer, 1988, Corcoran et al., 1980, Topa, 2001).
- The use of social networks is widespread both in employers' recruiting and workers' job-seeking. Social contacts help workers to find jobs, and employers to find employees, by conveying rich and reliable information, which they spread widely and fast throughout the labor market.

The importance of social characteristics

- Topa (2001) and Conley and Topa (2002) examines the spatial patterns of unemployment in Chicago between 1980 and 1990. They study unemployment clustering with respect to different social and economic distance metrics (physical distance, travel time, and differences in ethnic and occupational distribution between locations) that reflect the structure of agents' social networks.
- Their results indicate that there is a strong positive and statistically significant degree of spatial dependence in the distribution of raw unemployment rates. Racial and ethnic composition variables are the single most important factor in explaining the observed correlation pattern
- Weinberg, Reagan, and Yankow (2004) show that one standard deviation reduction in neighborhood social characteristics and in job proximity raises individuals' hours worked by 6% and 4% in the average, respectively.

Some Stylized Facts

Several stylized facts about labor market networks have been established by empirical work on job information networks (Ioannides and Loury (2004).

1 There is widespread use of friends, relatives, and other acquaintances to search for jobs and it has increased over time.

2 The use of friends and relatives to search for jobs often varies by location and by demographic characteristics. In particular, US data suggest that almost one-fifth of the total difference in probability of gaining employment between black and white youth resulted from racial differences in the use of social contacts.

3 Both employed and unemployed workers who used friends to search for jobs received more offers per contact and accepted more offers per contact than did workers who used other sources of information about job openings.

The empirical findings

- Recent findings have improved our understanding of the supply side effects of social networks (Calvo-Armengol and Jackson (2004, 2005)). In their models, workers rely both on own search effort, and on information exchange with their social circles to find jobs

- Empirical research has shown persistent correlations in patterns of unemployment in US cities. Socioeconomic characteristics, and in particular ethnic and occupational distance, seem to explain a substantial component of the spatial dependence in unemployment.

The theoretical approach

- Calvo-Armengol (2003) and Calvo-Armengol and Zenou (2003) were the first to study the effect of the size of social network in a theoretical context.
- Workers are embedded within a network of social relationships and can communicate through word-of-mouth. They can find a job either directly or through personal contacts.
- From this micro scenario, they derive an aggregate matching function that has the standard properties but fails to be homogeneous of degree one
- They show that more social contacts increase the probability to find a job, a standard result in the social network literature, especially in sociology (see e.g. Wasserman and Faust, 1994).

Not only positive effects

- Wahba and Zenou, 2003, analyze the acquisition and transmission of job information by job seekers through their friends and relatives, and in particular the effect of the size and quality of social networks on the probability to find a job.
- However they do not model the matching process, but examine the transmission of job information by comparing the success of using “friends and relatives” versus other search methods.
- They show that, conditional on being employed, the probability to find a job through social networks, relative to other search methods, is increasing and concave for reasonable size of networks, but becomes decreasing when the network is too dense.
- They also show that the probability to find a job through friends and relatives decreases with local unemployment rate.

Social nets and Welfare

- Cahuc and Fontaine, 2002. provide a simple matching model in which unemployed workers and employers can be matched together through social networks and through more efficient, but also more costly, methods.
- In this framework, social networks can be over-utilized with respect to an efficient allocation in some circumstances, and under-utilized in others.
- Likewise, Fontaine, 2003. shows that an increase in the number of workers embedded in the social networks can increase the unemployment rate and decrease workers welfare.

The Model

- From now on, we shall be engaged in the development of a theoretical model embedding job search in a microfounded framework with social networks.
- We start from the basic model, i.e. in absence of net, and from the individual transition rates among the three previsously identified worker status: Employed, Unemployed, Retired.

Jump Processes

1. The single worker changes cyclically her status following the hierarchy U→E→R→U according to the transition rates α (U→E), β (E→R), and μ (R→U).

2. Kolmogorov forward equations are:

$$\begin{aligned}
\frac{dP^E(t)}{dt} &= -\beta P^E(t) + \alpha P^U(t) \\
\frac{dP^U(t)}{dt} &= -\alpha P^U(t) + \mu P^R(t) \\
\frac{dP^R(t)}{dt} &= -\mu P^R(t) + \beta P^E(t)
\end{aligned}$$

with initial condition and $P^U(0) = 1 - P^E(0) - P^R(0)$ given.

Jump Processes

1. The Steady State solution is:

$$P^E = \frac{\mu\alpha}{\beta\alpha + \beta\mu + \alpha\mu}$$

$$P^U = \frac{\beta\mu}{\beta\alpha + \beta\mu + \alpha\mu}$$

$$P^R = \frac{\beta\alpha}{\beta\alpha + \beta\mu + \alpha\mu}$$

- Lemma: *Over a sufficient time, the proportion of time spent in any state i={U,E,R} converges in probability to* P^i

Microfoundations of Transition Rates - Workers

- The transition probability from job seeker to employed is positively affected by the search intensity α.

- When unemployed, each worker chooses her optimal search intensity conditional on the expected return of joining the market.

Microfoundations of Transition Rates - Workers

- When employed the worker earns w per unit of time, while as job-seeker she incurs in a instantaneous search-cost C(α) proportional to the search intensity with C(0)=0 ,C′(α)>0 and C″(α)>0.
- Finally we assume that when the worker is out of the work-force she earns neither w nor pays for the search cost C(α); in particular we simplify assuming zero value for this state.
- The optimal search intensity α is chosen in order to maximize the discounted expected income stream over the working life:

$$V^U(\alpha, t) = -C(\alpha) + \int_t^{\infty} e^{-\rho\tau} \left[(P^E(\tau)w - P^U(\tau)C(\alpha) \right] d\tau$$

Microfoundations of Transition Rates - Workers

- By assuming $C(\alpha)=\alpha^2$ leads to:

$$\alpha_e^* = \frac{\sqrt{\mu\left(\beta^2\mu(1+\rho)^2 + 4w\rho(\beta+\mu)\right)} - \beta\mu(1+\rho)}{2\rho(\beta+\mu)}$$

- Optimal search intensity is increasing in *w*. The supply curve in the economy is upward sloping: the average number of matches is $\alpha_e^* U$ and is increasing in *w*.

Microfoundations of Transition Rates - Firms

- As far as firms is concerned, they have to choose the optimal search intensity α_f. The Bellman equations for, respectively, the filled V^F and vacant V^V status are:

$$\begin{aligned} rV^F &= y - w + \beta(V^V - V^F) + \dot{V}^F \\ rV^V &= -c(\alpha^f) - \alpha^f(V^V - V^F) + \dot{V}^V \end{aligned}$$

Microfoundations of Transition Rates - Firms

- Perfect Competition requires $\dot{V}^V = V^V = 0$
- Rational Expectation requires $\dot{V}^F = 0$
- Assuming a quadratic search cost, we obtain:

$$\alpha_f = \frac{y - w}{r + \beta}$$

- The higher the wage the lower the search intensity. In this case the demand curve is downward sloping

Market Equilibrium

- Instantaneous market equilibrium requires that same number of matches comes form both sides of the market, i.e. $\alpha_f v = \alpha_e u$ at the same wage w.

$$\alpha_e^* = \frac{\sqrt{\phi_1 u^2 + \phi_2 uv + \phi_3 v^2} - \mu\left(2\beta v + u(r+\beta)\right)}{2v(\mu+\beta)}$$

where $\phi_1 = \mu^2(r^2 + 2r + \beta^2)$, $\phi_2 = 4\mu^2\beta(r+\beta)$, $\phi_3 = 4\mu(\beta^2\mu + \mu + \beta)$.

Market Equilibrium

- The average instantaneous matching function for the entire economy is hence $m=\alpha^*_e u$:

$$m \equiv \alpha_e^* u \equiv \alpha^* v = \frac{\sqrt{\phi_1 u^2 + \phi_2 uv + \phi_3 v^2} - \mu\left(2\beta v + u(r+\beta)\right)}{2(\mu+\beta)} \frac{u}{v} = m(u, v$$

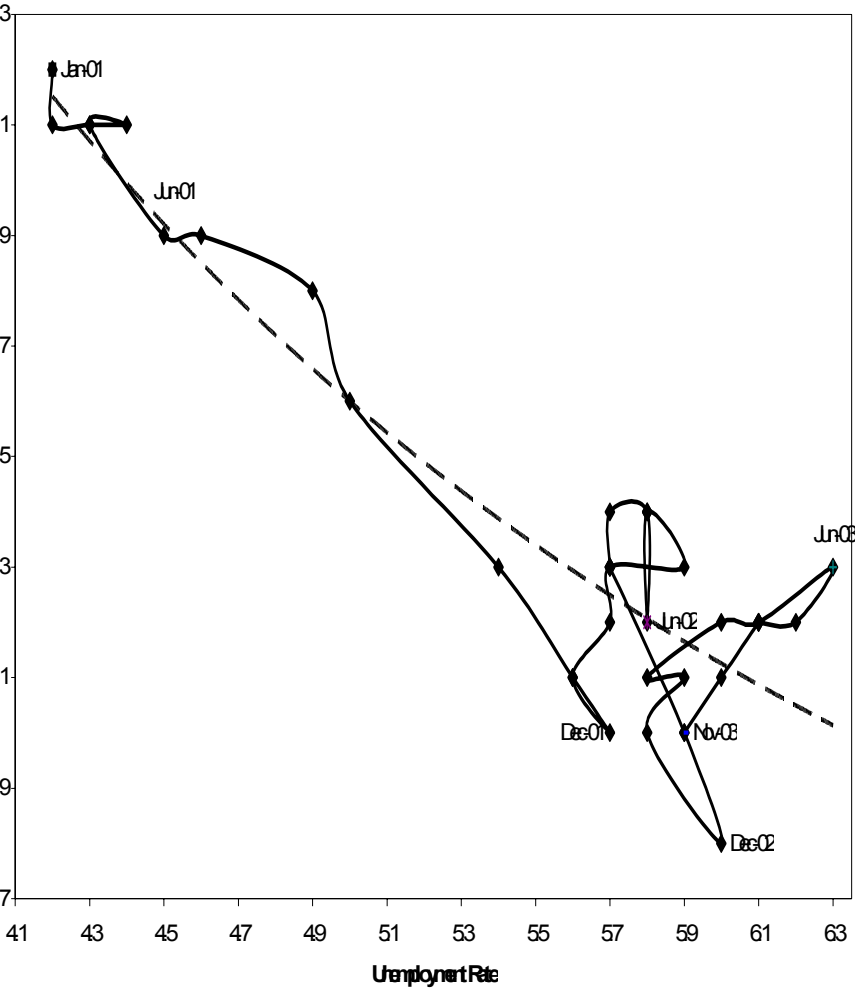
- The matching function is increasing, concave and linearly homogenous of degree one in u and v, as in the spirit of the MP approach.

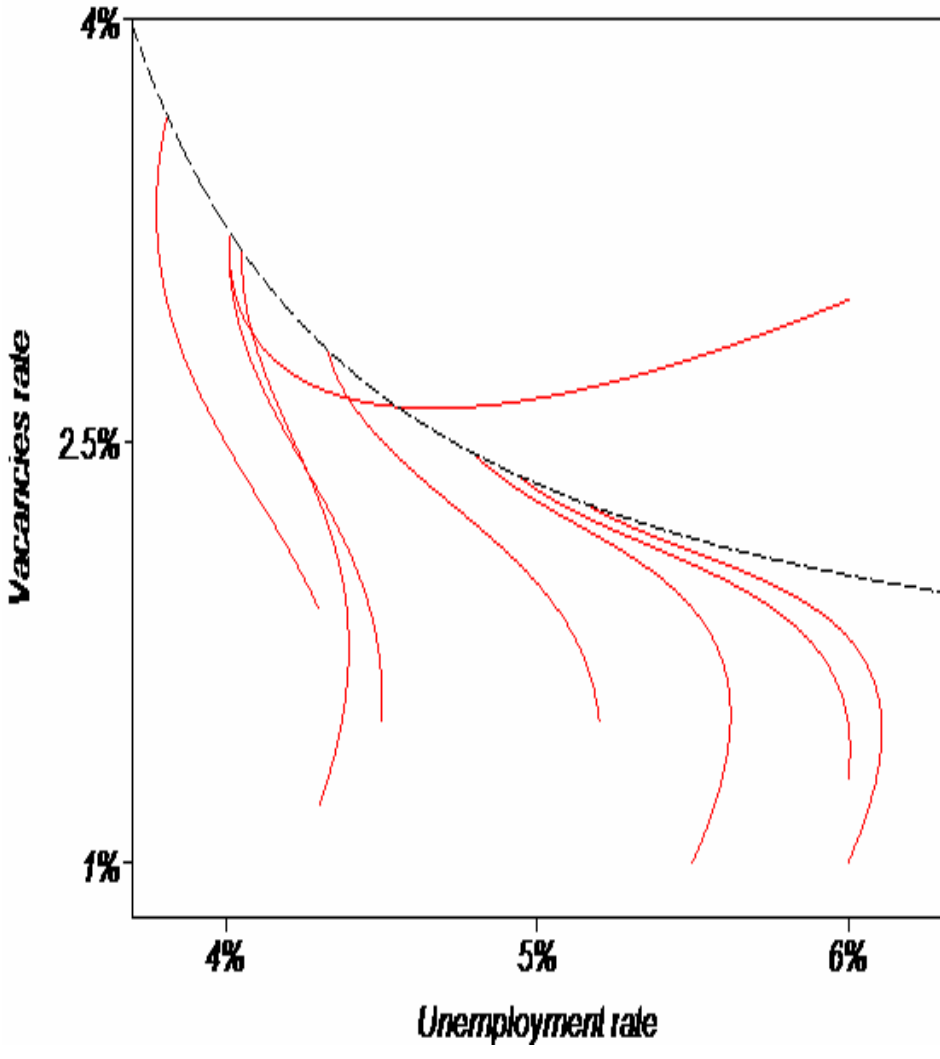
Macro-Dynamics

- Once known the matching function we derive the macro-dynamics

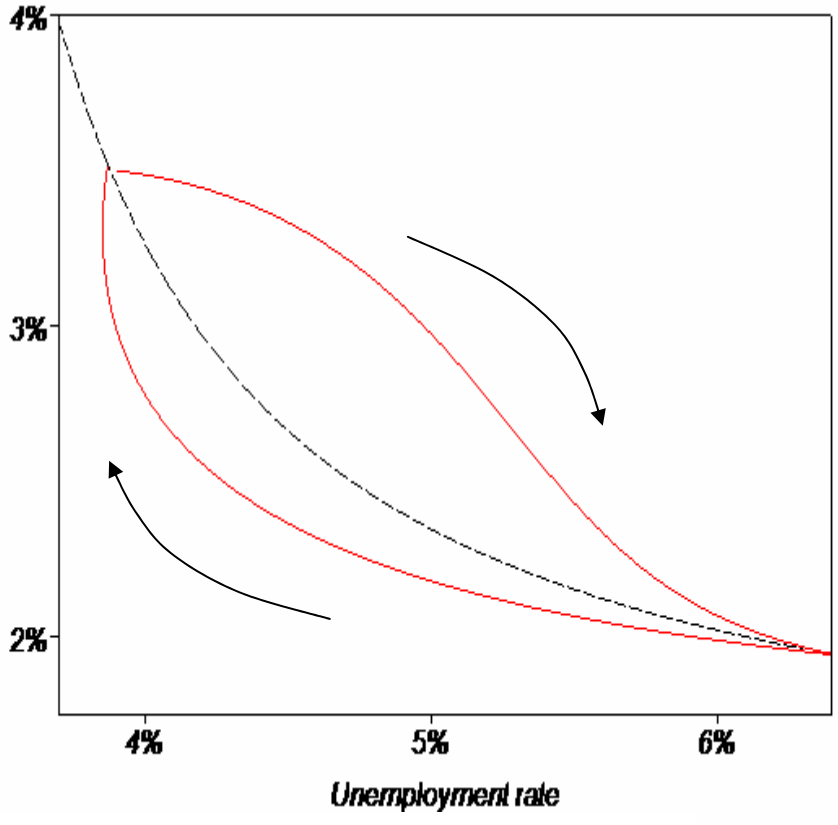
$$
\begin{aligned}
\frac{du}{dt} &= -m(u,v) + \mu r \\
\frac{dv}{dt} &= -m(u,v) + \beta(1-u-r) \\
\frac{dr}{dt} &= \frac{dv}{dt} - \frac{du}{dt} = \beta(1-u-r) - \mu r \\
u(t) + e(t) + r(t) &= 1 \\
e(t) + v(t) &= k
\end{aligned}
$$

Macro-Dynamics

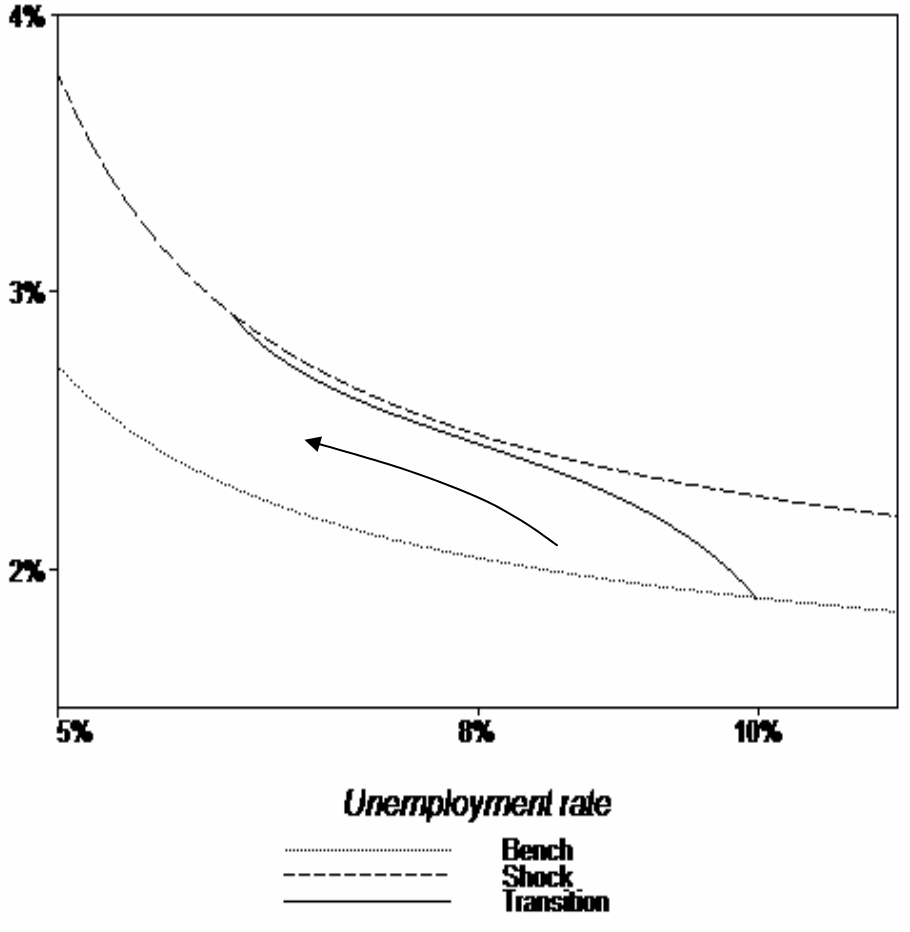




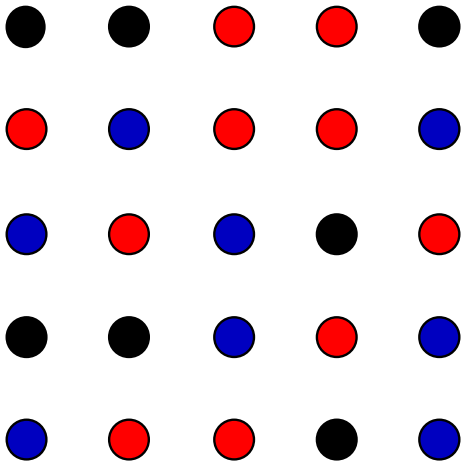
Spurious Cycle



Comparative Dynamics



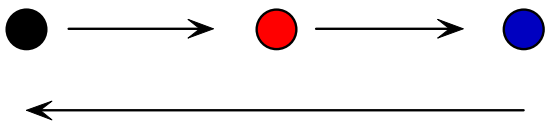
Micro-Dynamics



Seeker

Employed

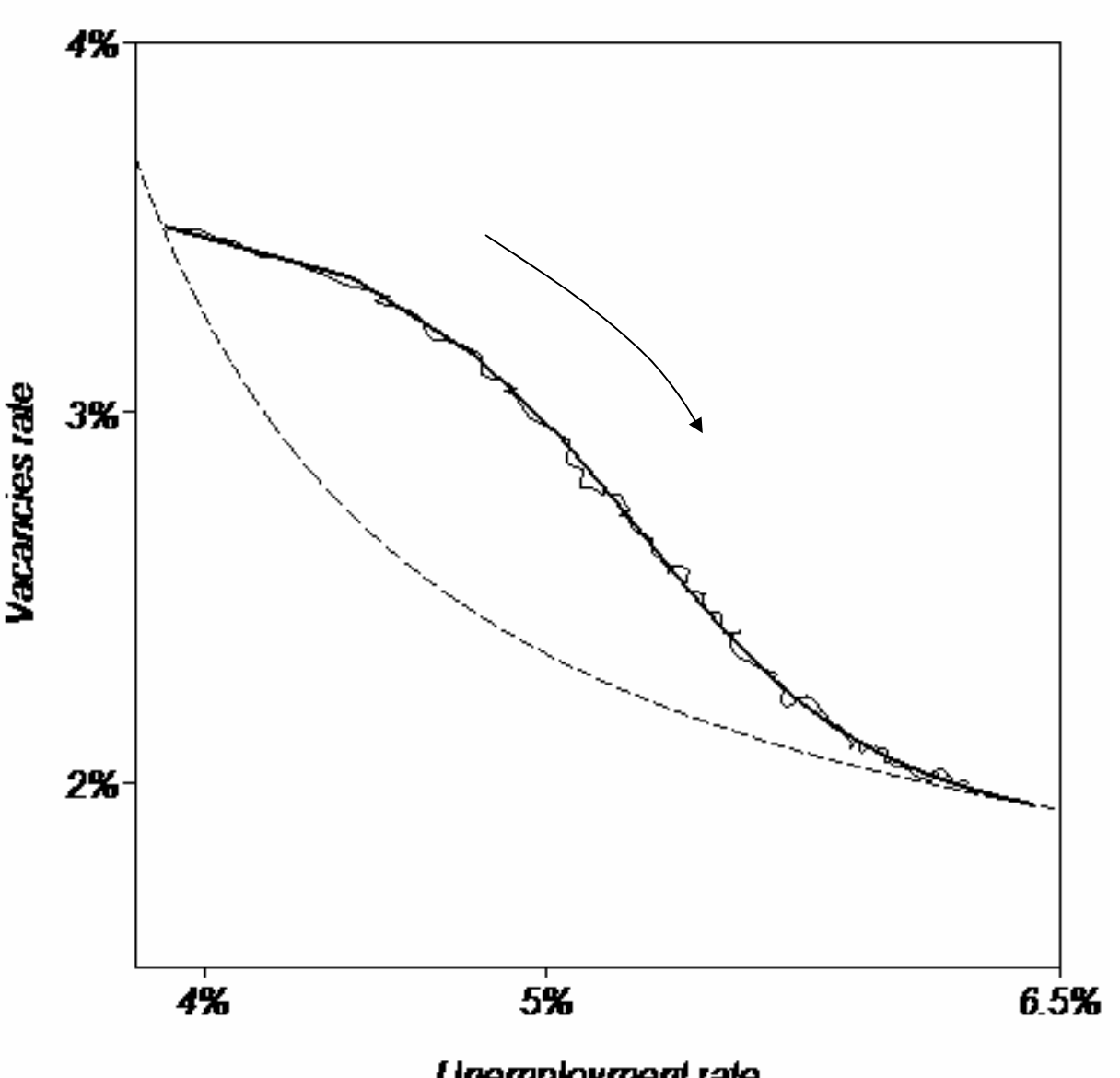
Non-Seeker



Algorithm

1. Random Draw
2. Identification
3. Computation of jump probability
4. Comparison with a threshold
5. If higher than the threshold the jump takes place.
6. States are updated
7. After a Poisson delay go to point 1

Simulation Result



Social Network

- Local interactions, or social networks, are often invoked in the human capital literature for explaining "club convergence" and inter-generational inequality persistence.
- In the search model, social networks are analyzed in Calvo-Armengol and Zenou 2001, Cahuc and Fontaine, 2002 where the social network is used to spread the job offer into the network, reducing the individual searching cost.
- Individual matching rates depend both on aggregate variables and on the number of workers in a neighboring of the unemployed individual. The higher the number of working agent in a surrounding of the unemployed worker, the higher the matching rate. We can think to a sort of positive spillover or complementarity effect.

$$\overbrace{\overbrace{(i-th)-6;(i-th)-5;.....(i-th)}^{Left}.\overbrace{.....(i-th)+5;(i-th)+6}^{Right}}^{Social\ Network}$$

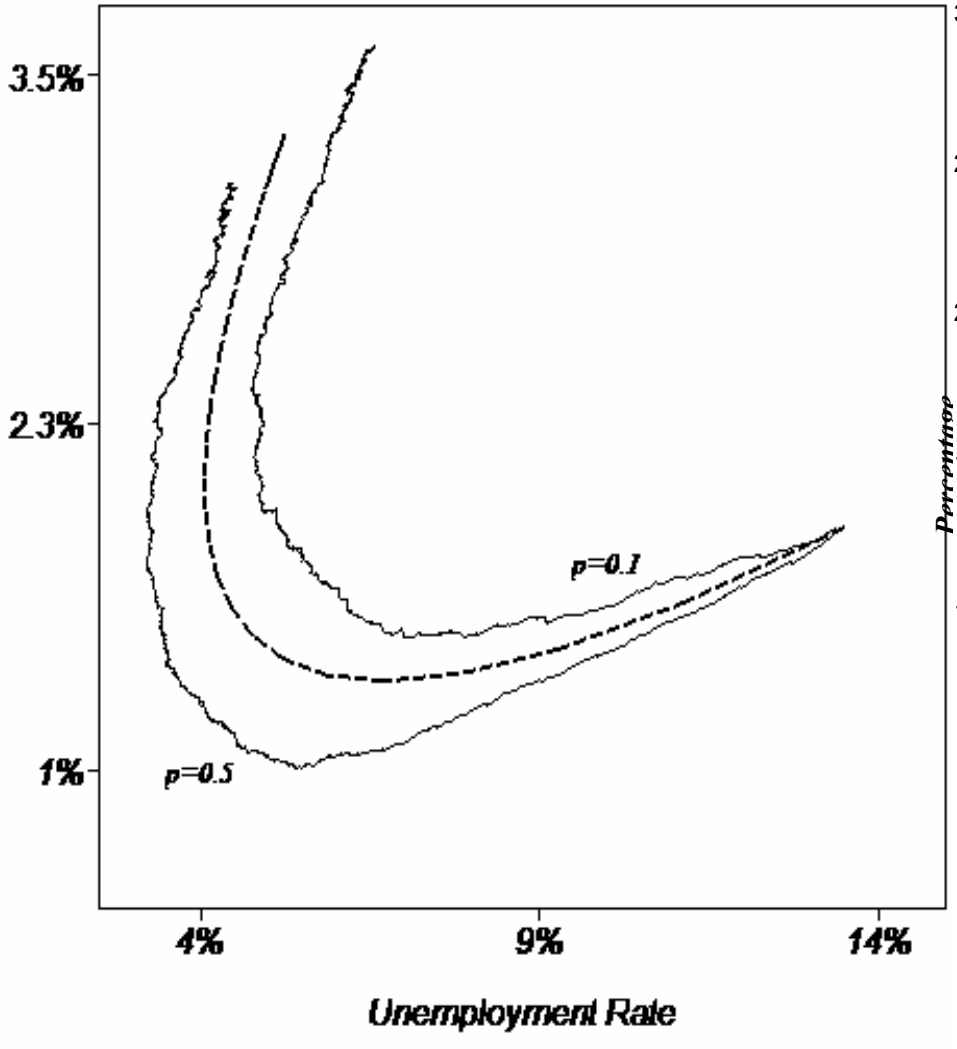
Social Network

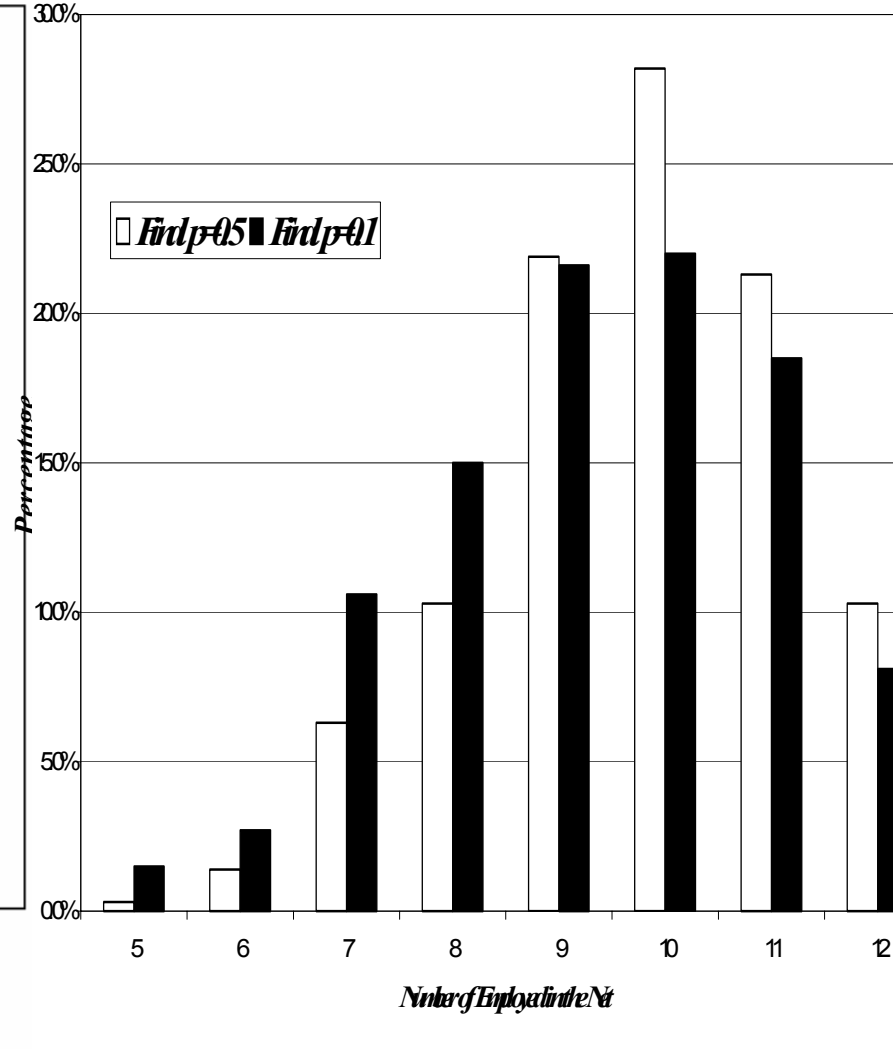
- Let us define p as the probability that an unemployed worker becomes working due to the presence of a worker in the neighbor. The individual transition rate is then:

$$U \rightarrow M \quad : W_U = \Gamma \alpha^*(u, v) + \Lambda(1 - (1 - p)^n)$$

- *(1-(1-p)^n)* is the probability, per unit of time, for an unemployed to be hired if she has *n* working neighbors.

Social Network





Unemployment Traps

	1	*2*	*3*
1	11.26	85.18	3.56
2	14.28	79.58	6.13
3	6.42	89.52	4.06

- The first row sums up the average time of occupancy for individuals starting from status U and having the lowest number of employed in the network in the initial condition (4 out of 12) in the benchmark simulation, while the second one shows the simulation with $p = 0.1$ of the same individuals and the third row with $p = 0.7$.
- It is rather evident that the network can generates unemployment traps hence social discrimination when p is low; the average occupancy time of individuals starting in the unemployed situation in the second row is remarkably increased w.r.t.the benchmark simulation. Nevertheless, when p is sufficiently high the network reduces social discrimination.

Conclusions

- This first attempt at modelling job search at individual level has interesting potentialities that the macro-dynamics can not capture. It allows us to investigate both micro and macro-dynamics in a coherent way.

- The approach we are developing fits particularly well at coping with spillover effects. Individual transition rates can depend on the social and economic cluster of the individual. This involves heterogeneity in such rates; this brings to dynamical path which are quite different by the ones we can describe by the aggregate equations.