Search models.

Labour Economics - set 2

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Introduction

Why do we observe involuntary unemployment?
Several reasons

- searching costs (transaction costs)
- unions-industry bilateral monopoly
- wages used as an incentive tool

In this lecture we look at the searching costs along the lines of Pissarides (2000, cap. 1)

Motivation

- Look at the flows of workers and vacancies from activity to inactivity and viceversa. These flows determine the equilibrium unemployment rate and provide important insights about how unemployment emerges, and how policies/shock affect unemployment.
- In developed economies these flows are particularly intense.
- It could be misleading thinking at the unemployment stock as an "elementary variable"

Few Empirical Facts

1. flows in and out unemployment are countercyclical (both increase during recessions)
2. creation of new jobs (vacancies) is slightly procyclical
3. job destruction is highly countercyclical
4. $->$ job reallocation (i.e. job creation $+$ job destruction) is countercyclical

The model I

Because of informational problem about where job opportunities are open and imperfect matching between workers characteristics and what firms look for, searching is a long and costly process.

- A black box, the matching function: relates new jobs at a given instant t with the number of workers that look for work and the number of vacancies
$$M = f(U, V)$$
(Note: we are implicitly assuming that only the unemployed look for a new job)
- $f(.)$ is increasing and concave in both arguments and homogenous of degree 1

The model II

- homogeneity implies that

$$m = f(u, v)$$

where m, u, v are ratios taken over LF (labour force), i.e. u is the unemployment rate, v the vacancy rate and m is the job creation rate.

- Furthermore, by homogeneity, we can write

$$\frac{m}{v} = f\left(\frac{u}{v}, 1\right) \equiv q(\phi)$$

where $\phi = v/u$ is the (degree of) tightness on the labour market (it relates excess demand to excess supply of labour) and $q' < 0$

- Thus at each instant t, each vacancy has the same probability $q(\phi)$ of being filled.
- This implies that the average duration of a vacancy is $1/q(\phi)$

The model III

- Unemployed workers find a job with instantaneous probability equal to $\frac{f(u,v)}{u} = \frac{v}{u}\frac{f(u,v)}{v} = \phi q(\phi)$ increasing in ϕ
- Therefore, average duration of unemployment is $1/\phi q(\phi)$

Remark

each agent (worker or firm) causes two kinds of externalities on all other agents

- congestion externality (on agents of his/her type) (negative)
- thick market externality (on agents of the other type) (positive)

Therefore, the equilibrium needs to differ from the competitive equilibrium and, particularly, it should be inefficient (i.e. a benevolent social planner could do better, by direct allocation of workers to jobs)

Case 1 - exogenous job destruction

At each instant jobs are destroyed at rate λ, exogenously given.

Unemployment rate I

- At each instant t, some unemployed find a job while some employees loose their job.
- Therefore the instantaneous evolution of the unemployment rate is

$$\dot{u} = \lambda(1-u) - \phi q(\phi) u$$

where λ is the rate at which jobs are destroyed.
- At the equilibrium, unemployment must be constant. The stationary state of unemployment is such that $\dot{u} = 0$ i.e.

$$u = \frac{\lambda}{\lambda + \phi q(\phi)}$$

This is the so called **Beveridge Curve** that links unemployment with the vacancy rate. It is a decreasing and convex function.

Unemployment rate II

- Note: whatever the stationary equilibrium, there will always be vacancies and unemployment.
- Note: only exogenous shocks might alter the equilibrium unemployment rate and the position of the BC
  - For instance, the strongest the frictions on the labour market, that modify $q(.)$, the more distant from the origin will be the Beveridge curve and the more vacancies and unemployment the economy will experience.

Firms I

- Firms sell their homogenous good on a *competitive market*
- Firms post job offers, receive applications and start select candidates.
- Suppose all firms are alike and each firm can post at most one job. When the job is filled, production is Y_L each instant.
- Otherwise, when firms search a candidate they pay the cost cY_L (it is more difficult finding the right candidate for more productive jobs)
- Jobs, either filled or vacant, can be interpreted as financial assets.
  - Let J^1 be the net present value of a filled job to the firm and J^0 the NPV of a vacant job
  - The net present value of a vacant job is

$$J^0 = \frac{-cY_L + q(\phi)(J^1 - J^0)}{R}$$

(perpetual rent) and $-cY_L + q(\phi)(J^1 - J^0)$ is the expected instantaneous return.

Firms II

- New vacancies are opened (new firms enter into the market) until when $J^0 = 0$ (i.e. until when opening a new job is profitable; this is a sort of zero profit condition in a competitive market)
- Given the previous equilibrium condition we have

$$J^1 = \frac{cY_L}{q(\phi)}$$

  i.e. the NPV of a filled job is equal to the cost of search times the expected duration of a vacancy (this is also the total cost that the firm needs to pay for opening a vacancy)

- **Remark:** This is a rent (extra-profit) due to the fact that filled jobs are immediately productive and does not need to wait for applicants. Firms cannot enter into the market with a filled job, but only with a vacant job.

Firms III

- The NPV of a filled job must also satisfy the following equation

$$J^1 = \frac{Y_L - w - \lambda(J^1 - J^0)}{R}$$

i.e. it needs to be compatible with the instantaneous productivity (net of wage costs w) minus the risk of job destruction.

- Therefore we have

$$w = Y_L - \frac{(R+\lambda)cY_L}{q(\phi)}$$

This is the **job-creation equation** which links wages to market tightness. It is a sort of labour demand function. The tighter is the market, the more difficult is to hire a worker, the higher the costs of search and the lower the wage that can be paid (counterintuitive result: the tighter the market, the more scarcer are the workers looking for a job: one should pay more, not less. But competitions among firms and zero profit conditions explains this result).

Firms IV

- Note: wages are lower than (marginal) productivity because firms need to be compensate for their search costs. The term $\frac{(R+\lambda)cY_L}{q(\phi)}$ represents the instantaneous contribution of a filled job to the repayment of search costs.
- Note: if $c = 0$ (no search costs), wage = marginal productivity.

Workers I

- Workers and firms negotiate in order to share the rent represented by a filled job.
- To the worker, the NPV of unemployment is

$$W^0 = \frac{z + \phi q(\phi)(W^1 - W^0)}{R}$$

where $z < Y_L$ are (exogenous) unemployment benefits.

- The NPV of employment is

$$W^1 = \frac{w - \lambda(W^1 - W^0)}{R}$$

- From a joint standpoint, the instantaneous surplus of a filled job to the worker and the firm is given by

$$S = (RJ^1 - RJ^0) + (RW^1 - RW^0)$$

Workers II

- Worker and firm negotiate to share this joint surplus. Practically they negotiate over w. In case of negotiation failure, outside options are RJ^0 and RW^0.
  - Note: this is conceptually justified because firms enjoy a rent caused by the presence of frictions!
- Negotiation is model as a Nash Bargaining

$$w = \arg\max(RW^1 - RW^0)^\gamma (RJ^1 - RJ^0)^{1-\gamma}$$

where γ is worker's bargaining power.

- The FOC is

$$RW^1 - RW^0 = \gamma[(RJ^1 - RJ^0) + (RW^1 - RW^0)]$$

i.e. worker's surplus is a share of joint surplus equal to γ (his bargaining power).

Workers III

- Substitution yields

$$w = (1-\gamma)z + \gamma Y_L(1+c\phi) = z + \gamma(Y_L - z) + \gamma c Y_L \phi$$

  the **wage setting equation**.
- Note: wages are equal to worker outside option, plus a share of the additional productivity, plus a share of the total costs of hiring per unemployed worker $cY_L\phi$ $(=cY_L\frac{v}{u})$. The latter represents a compensation for the fact that agreement prevents further searching costs.

Equilibrium

- Three equations and three unknowns: w, u, v or, equivalently, w, u, ϕ.
- System between
  - the Beveridge curve

$$u = \frac{\lambda}{\lambda + \phi q(\phi)}$$

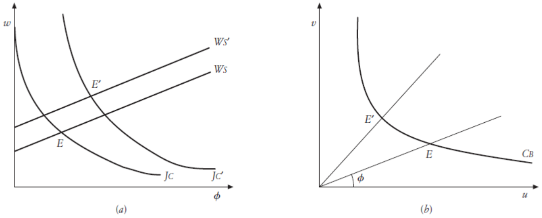
  - the job creation equation

$$w = Y_L - \frac{(R + \lambda) c Y_L}{q(\phi)}$$

  - the wage setting equation

$$w = (1 - \gamma) z + \gamma Y_L (1 + c\phi)$$

Equilibrium



Comparative statics I

- An increase of Y_L
  - moves up both JC and WS $->$ wages increase.
  - conditions for the existence of an equilibrium imply that also that $\frac{\partial w}{\partial Y_L}|^{JC} = 1 - \frac{(R+\lambda)c}{q(\phi)} > \frac{\partial w}{\partial Y_L}|^{WS} = \gamma(1 + c\phi)$ so that ϕ will increase.
  - an increase in ϕ implies that u decreases and v increases.
- If $z = \rho w$ (unemployment benefit is a proportion of the wage), variations in Y_L would not impact on ϕ but only on wages. This feature will account for the empirical observation that productivity follows a secular increasing trend but unemployment is not always decreasing.
- If z increases, JC does not move, WS shifts up $->$ higher wages and lower ϕ $->$ higher u and lower v (to firms, jobs are less profitable, since wages need to be higher)

Comparative statics II

- If λ increases, there is a negative effect on JC and also an effect on the Beveridge curve: ϕ decreases, u increases, ambiguous effect on v.
- If the matching function changes, the Beveridge curve moves: if for any V and U, less M result, $q(\phi)$ shifts down. This is the case of an increased mismatching between workers and vacancies for instance because of a technological innovation. BC moves outwards and JC downwards $-\!>$ u increases, effect on v ambiguous.
- **Remark:** according to the model predictions it is possible to tell apart whether an increase in unemployment results from a negative productivity shock or a negative shock on the matching technologies. Indeed the prediction change as regards the numbers of vacancies in the two cases.

Case 2 - Endogenous job destruction

- At the stationary state, job creation per employed worker = job destruction per employed worker

$$\lambda = \phi q(\phi)\frac{u}{1-u}$$

- Any shock that increases ϕ needs to be entirely compensate by a variation in u in order to meet equality if λ is exogenously given.
- However empirical evidence suggests that job destruction is not fixed and reacts to shocks as well (e.g. to productivity shocks during recessions).
- It is possible to accommodate this extension rather easily in a dynamic model where each period Y_L is subject to a shock which alters the convenience to keep the job filled and opens the possibility to the firm to decide whether to destroy the job or not, taking into account expected future productivity shocks.
- Shocks on productivity will be then associated to variations in unemployment more pronounced than in the basic model.

What is the role of job protection legislation? I

(from Pissarides, 2010, Nobel prize lecture)
Southern Europe has much more stricter rules for dismissal as compared to Northern Europe and especially the US and the UK (e.g. articolo 18 in Italy)
This can be explicitly intended as a tax on dismissals. What is the effect of this tax?

1. lower dismissal −> lower flow to unemployment
2. some low-productivity jobs that would have been destroyed before the imposition of the tax will now not be destroyed −> average labour productivity is lower
3. wages should also be lower to compensate the firm for the tax and the lower productivity

What is the role of job protection legislation? II

4. when the firm is creating a job it expects to have to pay the tax in some future date if it has to dismiss the worker. Job creation falls as a result –> just like the flow into unemployment, the flow out of unemployment also falls
5. the net impact on unemployment depends on which flow falls more [empirically, evidence that they fall roughly to the same extent], but if the size of the flows falls, there is less labour and job turnover, lower average labour productivity and longer durations of both unemployment and employment