Job Search
Section 2. Equilibrium Search Model

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Road-map

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Motivation

1. The weakness of the basic job-search model

A. The distribution of wages is left unexplained

Why would wages for **homogeneous** workers be distributed ("pure wage dispersion")?

◊ If the labor market is competitive, identical workers in identical jobs cannot durably get different wages.

◊ Under imperfect information: *Diamond (1971)'s critique* 
  Assumption: *firms post wages* (i.e. set take-it-or-leave-it wage offers that they commit to pay) and job-seekers search randomly

Equilibrium: A distribution \( H(w) \) such that every posted wage (with positive probability) earns the same profit and no other wage earns greater profit.
The weakness of the basic job-search model

Diamond’s critique or Diamond’s paradox

Start from the basic model in continuous time that leads to the reservation wage $x$ such that:

$$x = z + \frac{\lambda}{r + q} \int_x^{+\infty} (w - x) dH(w)$$  \hspace{1cm} (1)

- Any wage offer $w \geq x$ is accepted;
- \Rightarrow no incentive for firms to pay $w > x$;
- \Rightarrow From Eq. (1), $x = z$;
- \Rightarrow Diamond’s critique or Diamond’s paradox:
  - Degenerate equilibrium distribution $H(w)$ i.e. 1 wage ($z$);
  - Firms can take the entire surplus ($= \text{marg. product} - x$).
The weakness of the basic job-search model

B. Empirical issue

Hornstein, Krusell and Violante (2011): The basic job-search model, once properly calibrated, generates very low wage differentials among ex-ante similar workers:

- In the basic model of Section 1 (job-search1.pdf), the reservation wage equation (6) can be rewritten:

  \[ x = \rho \bar{w} + \frac{\phi}{r + q} (\bar{w} - x) \]

  where \( \bar{w} = E(w | w \geq x) \) and without loss of generality \( z = \rho \bar{w} \).

- From this, the “mean-min ratio” \( \bar{w}/x \) verifies

  \[ \frac{\bar{w}}{x} = \frac{1 + \frac{\phi}{r+q}}{\rho + \frac{\phi}{r+q}} \approx 1.05(US); 1.10(EU). \]

→ Negligible departure from ‘the law of one price’?
Motivation

2. Persistent wage dispersion

- **“Mincer log wage equations”** (inspired by human capital theory under perfect competition, and present in any labor textbook)

\[
\log(w_{it}) = \alpha_i + \beta_1 \cdot \text{Schooling}_{it} + \beta_2 \cdot \text{EXP}_{it} + \beta_3 \cdot \text{EXP}^2_{it} + \sum_{j=1}^{J} \gamma_j \cdot d_{ijt} + \varepsilon_{it}
\]

where

- $w$: the hourly wage;
- ‘EXP’: (actual or potential) experience on the labor market;
- $d_{ijt} = 1$ if worker $i$ is of type $j$ at time $t$ in which “type $j$” can be sector $j$, firm $j$, location $j$ or a combination of gender and ethnic/nationality dummies (0 otherwise);
- $\varepsilon_{it}$: unobserved heterogeneity ($E[\varepsilon_{it}] = 0$).
Inter-industry wage differentials: $J$ sectors
- Cross-section ($\Rightarrow \alpha_i = \alpha$): Strong evidence that the sectoral dummies have a significant effect assuming $d_{ijt} \perp \varepsilon_{it}$.
- Panel data (with fixed effect $\alpha_i$) distinguishing a sufficient number of sectors: Weak or insignificant effects $\gamma_j$ (France, US).
- So, (persistent) inter-industry wage differentials reflect mainly unobserved individual (fixed) effects rather than a sign of non perfectly competitive markets.

Inter-firm wage differentials: $J$ firms
- Firms fixed effects $\gamma_j$ identified thanks to
  - Large matched employer-employee data and wage-earners who change firm under the assumption that this mobility is $\perp \varepsilon_{it}$.
- Message: Individuals with identical individual observed characteristics are paid differently in different firms (Abowd-Kramarz).
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<td>EXP and EXP²</td>
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<tr>
<td>Residual</td>
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</table>

**Table:** Components of variations of (log of) real annual wages in France and in the US.

Source: Extracted from Cahuc, Carcillo and Zylberberg (2014), henceforth CCZ, p. 302; based on research made by Abowd, Kramarz, Lengermann and Roux (see e.g. Abowd and Kramarz, 1999).
As Samuelson (1958) writes below it makes however no sense to talk about a “firm’s pay policy” in a purely competitive labor market:

“In a perfectly competitive market, a firm need not make decisions on its pay schedules; instead it would turn to the morning newspaper to learn what its wage policy would have to be. Any firm, by raising wages ever so little, could get extra help it wanted. If, on the other hand, it cut the wage ever so little, it would find no labor to hire at all in a perfect competitive labor market.

... The world ... is a blend of (1) competition, and (2) some degree of monopoly power over the wage to be paid.” (p. 559)

So let’s see whether this “blend” and the notion of a firm’s pay policy emerge in a frictional economy...
2. An equilibrium Search model with wage posting

CCZ develop a rather general framework (p. 306-314).

- I develop a simpler setting inspired by Mortensen (2003) and Rogerson, Shimer and Wright (2005), henceforth RSW.
- (Without proof) I explain where and how the formulas are changed when the more general setting of CCZ is used.
- I do not expect that student understand the mathematical developments in this more general setting.

Seminal paper: Burdett and Mortensen (1998) = Job-search model where the focus is on the behavior of firms (wage formation).

Aim: To develop a theoretical setting where the equilibrium distribution of wages is not degenerate (a degenerate distribution is the distribution of a random variable which only takes a single value).
Assumptions

A1 Rational forward-looking and **homogeneous** risk-neutral agents who only care about their income (hand-to-mouth consumers). All unemployed are entitled to a flat UB, $b$, with no time limit. No taxes. $z \equiv b - c$.

A2 Job search intensity is fixed. In $[t, t + dt]$, each employer contacts a *finite* number of job-seekers at random.

A3 Job-seekers choose freely to reject or accept a job offer, if any. An accepted wage remains constant all along the employment spell. Rejected offers (i) cannot be recalled, (ii) lead to no sanction.

A4' On-the-job search. No threshold wage above which searching on the job no longer pays. $\lambda_u = \lambda_e = \lambda$ designate the equal **exogenous** arrival rates of job offers respectively for the unemployed and the employed. Ass.: $0 < \lambda < +\infty$. 

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Assumptions continued

A5’ An **endogenous** distribution of wage offers. Job-seekers know the distribution. “Wage posting”: Firms choose their wage offer and **commit** to pay that wage. To currently employed workers, firms send wage offers **ignoring their current wage**. The worker’s current employer does not make a counter-offer.

A6 Constant exogenous job destruction rate, $0 < q < +\infty$.

A7 A large **given** number of firms and workers. Formally, a continuum of worker and a continuum of firms, each of unitary mass.

$\Rightarrow$ Stationary environment.

We are looking for rational expectations equilibria, i.e., in which
- Firms know the search behavior of the labor force;
- The labor force knows the true distribution of wages.
Job-search behaviour of the unemployed:

\[ x = z + (\lambda_u - \lambda_e) \int_0^\infty \frac{\overline{H}(\xi)}{r + q + \lambda_e \overline{H}(\xi)} d\xi \]  

(2)

◊ No employer will offer a wage below \( x \).

◊ Why would an employer offer more than \( x \)? **Intuition:** Posting a higher wage affects the flow of employees (i) quitting the firm because they face a better offer and (ii) accepting offers by the firm. For a given firm, profit maximization might be attained indifferently through

- high wages and many employees or
- low wages and few employees.

◊ **The question:** In equilibrium, is \( H(w) \) degenerate?
The law of motion of the unemployment rate $u$:

$$\dot{u} \equiv \frac{du}{dt} = q(1 - u) - \lambda \cdot 1 \cdot u$$

since all offers will pay $w \geq x$.

In steady state $\dot{u} = 0$. Hence,

$$u = \frac{q}{q + \lambda}$$

So, the equilibrium unemployment rate is exogenous and hence not the focus of this model.
Equilibrium flows on the labor market

For any \( w \), the fraction of those employed at a wage \( w \) or less, i.e. the wage distribution function \( G(w) \), should not be confused with the distribution of job offers \( H(w) \).

By the law of large numbers, the flow into the set of workers earning \( w \) or less is

\[
\lambda \cdot H(w) \cdot u
\]

The flow out of the same set is

\[
G(w)(1 - u)[q + \lambda(1 - H(w))]
\]

Taking \( u = \frac{q}{q + \lambda} \) into account, the equality between these two flows allows to relate \( G(w) \) to \( H(w) \) in the following way:

\[
G(w) = \frac{q \cdot H(w)}{q + \lambda \cdot \overline{H}(w)} \quad \text{with} \quad \overline{H}(w) \equiv 1 - H(w)
\]
Expected discounted profit

The cdf $H(\cdot)$ being given

The expected discounted profit from posting wage $w \geq x$, $\Pi(w \mid H(\cdot))$, is the product of the job offer arrival rate, $\lambda$ and of two other terms:

- $p(w)$ the probability that the wage offer $w$ is accepted and
- $J(w)$ the expected value of hiring a worker whose real product is $y > z$ (y constant!) at wage $w$.

$$p(w) = u + (1 - u) \cdot G(w) = \frac{q}{q + \lambda} + \frac{\lambda}{q + \lambda} \cdot \frac{qH(w)}{q + \lambda H(w)}$$

The higher the wage, the bigger the acceptance rate of a wage offer $w$ (through $\lambda \cdot H(w)$).

$$rJ(w) = y - w + (q + \lambda \cdot H(w)) (-J(w))$$

where $r$ is the discount rate. The higher the wage paid, the bigger the retention rate $\lambda \cdot H(w)$ and the lower the instantaneous profit.
Expected discounted profit

The cdf $H(\cdot)$ being given

The \textit{expected profit from posting wage} $w$ is then the product of these three terms:

$$
\Pi(w \mid H(\cdot)) = \lambda \left[ \frac{q}{q + \lambda} + \frac{\lambda}{q + \lambda} \frac{qH(w)}{q + \lambda H(w)} \right] \frac{y - w}{r + q + \lambda H(w)}
$$

$$
= \frac{\lambda \cdot q}{q + \lambda \cdot H(w)} \frac{y - w}{r + q + \lambda \cdot H(w)}
$$

- a higher wage increases $\Pi$ through the acceptance and the retention rates (denominators)
- a higher wage lowers $\Pi$ via the instantaneous profit $y - w$

Notice that \textit{for any} $w$, the R.H.S. is strictly increasing in $H(w)$. 
Wage posting

How does a given firm choose its posted wage?

- Clearly no firm posts \( w > y \) nor \( w < x = z \).
- Each employer makes his decision in a noncooperative context in which the other employers’ wage policies are taken as given. So, for any given cdf \( H(\cdot) \) and hence \( G(\cdot) \):

\[
\begin{align*}
    w &= \arg\max_{s \geq x} \{ \Pi(s \mid H(\cdot)) \} \\
    &= \arg\max_{s \geq x} \left\{ \frac{\lambda \cdot q}{q + \lambda \cdot H(s)} \cdot \frac{y - s}{r + q + \lambda \cdot H(s)} \right\}
\end{align*}
\]

The expected profit function \( \Pi \) implies that firms set wages partly to limit the extent of quits and to attract (‘poach’) workers from other firms.
We are not searching for a wage \( w \) given a cdf \( H(\cdot) \). We are searching for a cdf \( H(\cdot) \) and its support.

Equilibrium requires that any posted wage yields the same profit, which is at least as large as profit from any other wage. More formally, any equilibrium wage offer \( w \geq x = z \) in the support of \( H \) must yield the same level of profit, say \( \pi \):

\[
\pi = \frac{\lambda q}{q + \lambda \cdot H(w)} \cdot \frac{y - w}{r + q + \lambda \cdot H(w)} \quad \forall w \text{ in the support} \quad (3)
\]

An equilibrium solution can be described by a triple \((x, H, \pi)\) such that \( x = z, \pi \) defined above, and \( H \) is such that

- \( \Pi(w | H) = \pi \) for all \( w \) on the support of \( H \)
- \( \Pi(w | H) \leq \pi \) out of the support of \( H \)
Equilibrium

Let \( w \geq z \) and \( \bar{w} \leq y \) denote the infimum and the supremum of the support of \( H \).

◊ What is the value of the infimum \( w \)?
As \( \bar{H}(w) = 1 \), from (3), the employer offering the lowest wage in the market maximizes \( \Pi(w \mid H(\cdot)) \) by setting \( w = x = z \).

◊ What is the value of the supremum \( \bar{w} \)?
\( \bar{w} \) solves (3) in which \( \bar{H}(\bar{w}) = 0 \) and \( \pi = \Pi(z \mid H) \) (see (5)). So,

\[
\bar{w} = \left(1 - \frac{q(r + q)}{(q + \lambda)(r + q + \lambda)}\right)y + \frac{q(r + q)}{(q + \lambda)(r + q + \lambda)}z \tag{4}
\]
i.e. \( \bar{w} \) is a weighted average of \( z \) and \( y \).
As long as the weight of \( z \) is not equal to 1, the property \( \bar{w} > w \) is guaranteed since \( y > z \).
To characterize the distribution \( H(w) \) (and, hence, \( G(w) \)), one knows that in equilibrium

\[
\Pi(w \mid H) = \Pi(z \mid H) \quad \forall w \in [z, \bar{w}]
\]

i.e.

\[
\frac{\lambda q}{q + \lambda \cdot H(w)} \cdot \frac{y - w}{r + q + \lambda \cdot H(w)} = \frac{\lambda q}{q + \lambda} \cdot \frac{y - z}{r + q + \lambda}
\]  \hspace{1cm} (5)

\( \forall w \in [z, \bar{w}] \), this is an implicit equation with one unknown: \( H(w) \).

The LHS of (5) is continuous in \( H(w) \) and increasing in \( H(w) \) on \([0, 1]\).

The RHS is a constant.

For any wage in the support \([z, \bar{w}]\), one gets a unique \( H(w) \) with

- when \( w = z \), the solution to (5) is \( H(z) = 0 \);
- when \( w = \bar{w} \) given by (4), the solution to (5) is \( H(\bar{w}) = 1 \).
Equilibrium

Some technical issues:

◊ Suppose a mass point at some \( \hat{w} \), such that \( z \leq \hat{w} < \bar{w} \).
  
  - A firm posting \( \hat{w} + \varepsilon \) would increase its revenue discretely (hiring away any worker contacted paid \( \hat{w} \)) while paying an \( \varepsilon \) more.
  
  - So, a wage such as \( \hat{w} \) associated to a mass point cannot maximize profits.

◊ Can there be “gaps” in \( H(w) \)?

A gap between say \( \tilde{w} \) and \( \check{w} \) means \( H(\tilde{w}) = H(\check{w}) \). Then a firm posting \( \check{w} \) could reduce its offer and hence its cost without reducing its flow of entrants or increasing its flow of exits.

Hence, \( \check{w} \) cannot be optimal.

\[ ^1 \text{Hence, there is a finite number of workers paid exactly } \hat{w}. \]
Equilibrium

If $r \to 0$

In this limit case, explicit expressions can be found:

$$\bar{w} = \left[ 1 - \left( \frac{q}{q + \lambda} \right)^2 \right] y + \left( \frac{q}{q + \lambda} \right)^2 z$$  \hspace{1cm} (6)

From $\Pi(w | H) = \Pi(z | H)$ in the support,

$$H(w) = \frac{q + \lambda}{\lambda} \left[ 1 - \sqrt{\frac{y - w}{y - z}} \right]$$  \hspace{1cm} (7)

From (7) one easily derives:

$$G(w) = \frac{q}{\lambda} \left[ \sqrt{\frac{y - z}{y - w}} - 1 \right]$$

Note: in the general case $\lambda_e \neq \lambda_u$, these formulas are modified as follows: (i) $\lambda_e$ instead of $\lambda$ and (ii) $x$ instead of $z$ verifying (2) (see CCZ, p. 310).
Monopsony power
The case where $r \to 0$

In all the previous relationships, the *matching friction parameter* $q/\lambda$ plays a key role. See the empirical part for estimates of $\lambda/q$.

In particular, if frictions vanish i.e. if $\lambda \to +\infty$, $q/\lambda \to 0$, then:

- $\overline{w} \to y$
- $G(w) \to 0$ for all $w < \overline{w}$
- $u \to 0$

In the absence of frictions, the search equilibrium has all the properties of perfect competition. *However, perfect competition is a limit case.*

As long as $q/\lambda > 0$, one has $w = z < \overline{w} < y$. *All workers are paid less than their marginal product.*

In this sense, they are “exploited.”

---

\[ E(w) = \frac{q}{q + \lambda}z + \frac{\lambda}{q + \lambda}y \]  

\[ (8) \]
“It is frictions, broadly defined, that give employers monopsony power in the labor market. The most important sources of these frictions are:

- ignorance among workers about labor market opportunities;
- individual heterogeneity in preferences over jobs;
- mobility costs.

The view that employers have some market power can hardly be controversial: it is undoubtedly true that a wage cut of a cent does not cause all existing workers to instantaneously leave the employer.” (Manning, 2003, p. 360)

Empirical issue: Sensitivity of quits and recruits to the wage?
Special issue of the *Journal of Labor Economics* of April 2010. Conclusion: “significant levels of market power for employers.” But, opposite conclusions for Denmark in van den Berg and van Vuuren (2010).
Limitations and extensions

1. Posting a constant wage and committing not to revise it can be criticized (see Coles, 2001). Extensions:

- A firm would always like to counter an outside offer instead of loosing a worker, if the offered wage is below the marginal product. See Postel-Vinay and Robin (2002). Cahuc, Postel-Vinay and Robin (2006) introduces wage bargaining. However, the prospect of a wage gain creates incentives to search on the job. There isn’t much evidence but it goes against the widespread use of counteroffers (see Barron, Berger and Black, 2006).

- Often firms do not post a single wage, but post contracts where the wage paid can vary with an employee’s tenure (Burdett and Coles, 2003, (introducing risk aversion) and Stevens, 2004). Summary on p. 980 of RSW.

2. Customized wage offers. What if employers have some information about the current contract of workers they try to attract? See Wolthoff (2014).
3. Multiple applications - Multiple job offers:
In continuous time models, the probability that a job-seeker gets more than 1 offer during a small interval of time is negligible. In reality, job-seekers can simultaneously apply to more than one job.
What does this change? The possibility that the job-seekers have more than one offer in hand ⇒ more competition between firms. See Wolthoff (2014) for a synthesis.

4. No job-to-job transitions with wage cuts; relaxed by e.g. Postel-Vinay and Robin (2002).

Extension: Endogeneizing $\lambda$

Up to now, both $q$ and $\lambda$ are exogenous parameters. The latter can be endogeneized (Mortensen 2003, p. 41):

Let $\kappa > 0$ denote the constant cost of contacting a worker.

Since the expected profit per worker contacted verifies in equilibrium:

$$\frac{\Pi(z \mid H)}{\lambda} = \frac{\Pi(w \mid H)}{\lambda} \quad \forall w \in [z, w]$$

The aggregate $\lambda$ consistent with optimality should verify:

$$\frac{\Pi(z \mid H)}{\lambda} = \frac{q}{q + \lambda} \cdot \frac{y - z}{r + q + \lambda} = \kappa$$ (9)

The higher $\kappa$, the lower $\lambda$ conditional on all other parameters.
Exercises

Exercise

1. When $\lambda_e \neq \lambda_u$ (both being exogenous), Eq. (6) becomes

$$\bar{w} = \left[1 - \left(\frac{q}{q + \lambda_e}\right)^2\right] y + \left(\frac{q}{q + \lambda_e}\right)^2 x$$

Use this formula to retrieve the Diamond (1971) paradox.

2. When $\lambda_e = \lambda_u$ (both being exogenous), show that in equilibrium $G(w)$ statistically dominates $H(w)$ (distribution $G$ dominates distribution $H$ stochastically (at first order) if, for any argument $w$, $H(w) \geq G(w)$). Interpret!

Hint: Look at the two extremes of the support. Then consider a wage inside the support, and compute $H(w) - GH(w)$. From there show that $\frac{H(w) - G(w)}{H(w)G(w)} = \frac{\lambda}{q}$. Finally, conclude.
Exercises

Exercise

3. Take \( r \to 0, \lambda_e = \lambda_u \), and look at the impact of a small increase in \( z = b - c \).

3.1 case with exogenous \( \lambda \): (a) Show that the support of the equilibrium wage distribution shifts upwards and shrinks (so that the extent of wage inequalities is smaller). (b) What is the effect on \( H(w) \) and \( G(w) \) within the support? (Interpret!)

3.2 case with endogenous \( \lambda \): Look at (9) and check the direction of change in \( \lambda \) (Interpret!). Then, consider steps (a) and (b) of question 3.1. (without computing the derivatives in (b) as they lead to ambiguous analytical results).
3. Estimating the equilibrium search model

**Note:** Results below come from *structural* estimations of the above stationary model.

◊ To what extent does the equilibrium search model with wage posting provide a good fit of the *cross-sectional* distribution of wages?

- The equilibrium *density function* of wages paid in steady state is increasing and convex in the wage if $r \to 0$ (easily checked when $r \to 0$).

  This is at odds with observed distributions of wages (DENSITIES).

- Introducing heterogeneities in $y$ helps to reconcile the properties of the model with the data (Bontemps, Robin and van den Berg, 2000).
However, “wage posting fails to describe the empirical relationship between wages and productivity because the relative mildness of between-employer competition toward the top of the productivity distribution inherent to wage posting models implies that those models require implausibly long right tails for productivity distributions in order to match the long right tails of wage distributions.” (Bagger, Fontaine, Postel-Vinay and Robin, 2014, p. 1552)

Hence, other wage formation mechanisms where firms can counter outside offers do a better job (meaningful for sufficiently high-skilled occupations?): Postel-Vinay and Robin (2002), Cahuc, Postel-Vinay and Robin (2006).
Returning to the critique of Hornstein et al. (2011) mentioned in the introduction, some equilibrium search models lead to a higher “mean-min ratio” than the basic job-search model:

- Already the main model of this section (Burdett-Mortensen, 1998) does a better job with a mean-min ratio $\approx 1.25$ (through firms’ competition to attract workers).
- Extending the framework to on-the-job (general) learning by doing, Burdett, Carrillo-Tudela and Coles (2011) conclude that the equilibrium search model can generate reasonable wage differentials.

◊ A growing equilibrium search literature studies individual wage dynamics: See e.g. Burdett et al. (2011), Postel-Vinay and Turon (2010), Bagger et al. (2014).
"Index of search frictions" $\lambda_e/q$ (Ridder and van den Berg, 2003):
Over a given (short) length $d$ of the employment spell, the expected number of offers equals $\lambda_e \cdot d$.

Then, the unconditional expectation of the number of offers equals $\lambda_e \cdot E[d] = \lambda_e/q$ in a simple setting where jobs end only because of a layoff (at constant rate $q$).

If $\lambda_e/q \to +\infty$, degenerate distribution (competitive case).

Estimations by Ridder and van den Berg (2003), Table 3: $\lambda_e/q$ from $\approx 5$ (France) to $\approx 20$ (U.S.).

Estimations by Christensen, Lentz, Mortensen, Neumann and Werwatz (2005), Table 2: $\lambda_e/q \approx 2$ for Denmark.
Estimation of the “index of search frictions”

To improve the fit of the model more recent work extends the model by
- considering heterogenous workers and firms
- endogeneizing search effort and recruiting efforts
- introducing more complex labor contracts

Then, $\lambda_e/q$ can be quite different according to the occupation. For France, variation between 1 and 6.4 according to the sector and the occupation in Table III of Cahuc, Postel-Vinay and Robin (2006).
Estimating the equilibrium search model

Other estimations of the “index of search frictions”

The partial job-search model is also used to estimate an “index of search frictions”:

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<th>Country</th>
<th>Index of Frictions</th>
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<tr>
<td>ESP</td>
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</tr>
<tr>
<td>USA</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Table: Index of search friction $\lambda_e/(q + \lambda_2)$, where $\lambda_2 =$ rate of layoff immediately followed by a job offer. Source: Table 2 of Jolivet, Postel-Vinay and Robin (2006).

Note

- The European data are taken from the European Community Household Panel survey (ECHP 1994-7), and the U.S. data are from the Panel Study of Income Dynamics (PSID 1993-6).
- With Current Population Survey data for the US, Jolivet (2009) estimates an average index of frictions of 0.5!
A precursor: Equilibrium search unemployment under *perfect* competition (Lucas and Prescott, 1974).
Main question: “Why is it that workers *choose* (under some conditions) to be unemployed rather than to take employment at lower wage rates?” (p. 188). Basic assumptions:

- The labor market is segmented in a large number of islands.
- On each island there is a competitive firm subject to idiosyncratic productivity shocks.
- Wages are set competitively to clear the market on each island.
- At the beginning of each period, productivity and the number of workers are revealed on each island.
- A worker who leaves an island to go to another one gets no wage and spends one period unemployed. There is free mobility between islands. No on-the-job search. Search is directed.

The paper provides a full description of the equilibrium time path. This setting is still influential; see e.g. by Alvarez and Shimer (2011).


References II


References IV


References V


Moscarini, G. and F. Postel-Vinay (2013) “Stochastic search equilibrium”. 


*Journal of the European Economic Association*, 1:224–244.
References VIII


Wolthoff, R. (2014) “It’s about time: Implications of the period length in an equilibrium search model”.