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ABSTRACT

Does Job-Search Assistance Affect Search Effort and Outcomes? A Microeconometric Analysis of Public versus Private Search Methods[*]

In this paper, we examine the disincentive effects of the public employment service on the search effort of unemployed workers and on their exit rate from unemployment. For that purpose, we specify a structural search model with fixed and variable costs of search in which unemployed workers select their optimal search intensity given the exogenous arrival rate of job offers coming from the public employment agency. Because the theoretical effect of an increase in this exogenous job offer arrival rate on the structural exit rate from unemployment is ambiguous, we estimate this model using individual unemployment duration data. Our results show that the exit rate from unemployment increases with the arrival rate of job contacts obtained by the public employment service, especially for low-educated and low-skilled workers. They also show that the search effort is more costly for low-educated women and low-skilled adult unemployed workers. This last result suggests that a public employment agency that matches searchers and employers is beneficial, in the sense that it saves searchers in terms of search costs they would otherwise bear.

JEL Classification: C41, J64

Keywords: job search, search intensity, public employment agency, simulated maximum likelihood

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1. Introduction

In most countries, the public employment service and its network of local agencies inform unemployed workers of available job vacancies. The services provided by the agencies are usually free to both employers and unemployed workers. Several empirical studies have already examined the effectiveness and the choice of distinct search methods by employed or unemployed job seekers (see, for instance, Holzer 1987, 1988, Blau and Robins 1990, Osberg 1993, Gregg and Wadsworth 1996, Addison and Portugal 2002). For example, Gregg and Wadsworth (1996) find that "most job seekers who use Jobcentres (i.e. the public employment agencies) do so as part of a comprehensive search strategy that involves the use of additional, complementary search methods", but also that "the greatest beneficial impact of Jobcentres is amongst those, the less skilled and the long-term unemployed, who are more disadvantaged in the labour market". Using Portuguese data, Addison and Portugal (2002) find that the state employment agency has a low hit rate, and leads to lower-paying, shorter-lasting jobs. However, these two studies, as the other papers cited above, rely on reduced-form models of job-search behavior. Consequently, interpreting their results is difficult; in particular, these reduced-form studies do not identify the structural components of the unemployment exit rate, namely the individual search intensity and the probability of accepting a job offer. Identification and estimation of these structural components constitute the main objectives of our paper.

The theoretical framework of our analysis is a partial equilibrium search model in which any unemployed worker may use two search strategies. The first one is to use the services of the public employment agency, seen as an intermediary between employers offering job vacancies and unemployed workers. The rate at which the public employment service offers contacts (i.e. information on job vacancies) to unemployed workers may be considered as the output of a production function whose inputs and parameters are determined outside the model. In other terms, any unemployed worker receives contacts through the public employment agency channel at an exogenous rate λ_o. However, this rate may depend on the observable individual characteristics (age, education, gender, etc.) of the unemployed. Unemployed workers may also use private ("active") search methods, including the use of newspaper advertisements, direct contacts with employers and indirect contacts through friends and relatives. The rate at which the unemployed worker is informed of job vacancies through this "active" channel is an endogenous variable, under the worker's control; strictly speaking, it is the worker's search effort (or intensity).[1]

[1] Many empirical applications of the partial job search equilibrium model consider the worker's search intensity as constant (see, for instance, Flinn and Heckman 1982, Van den Berg 1990a, 1990b, and Wolpin 1987, 1992). Notable exceptions are papers by Stern (1989), Bloemen (2005), and van der Klaauw, van Vuuren and Berkhout (2004).

The main question that we address in this paper is the following: how important are the disincentive effects induced by the public employment service on the individual search effort? For this problem to be non-trivial, we must assume that, at any given arrival rate of job contacts, private search methods are more costly than the use of the public employment service (PES hereafter). More precisely, we assume that using the PES is costless, while the cost of personal search methods is a positive, increasing function of the individual search effort. Under this maintained assumption, the individual search effort is found to be a decreasing function of the exogenous PES rate of job contacts. However, an increase in the exogenous arrival rate of job contacts through the PES has an ambiguous effect on the rate of exit from unemployment. To clarify this point, we can proceed to the maximum likelihood estimation of our theoretical model by using individual data taken from the INSEE Survey "Suivi des Chômeurs".[2] This survey provides information on the search methods used by unemployed workers, the number of job contacts they obtain through each search channel and the total number of job proposals they got during the months preceding the interview.

Results show that an increase in the arrival rate of job vacancies through the public channel implies an increase in the average rate of exit from unemployment, despite the disincentive effects inherent in the model. In this model, the employment agency generates job offers, but crowds out private search investment. To the extent that a public agency can pool informational resources of private agents, we might think that a centralized employment agency that matches searchers and employers could be beneficial. In particular, the public employment agency may save searchers in terms of search costs they would otherwise bear.

These conclusions may be usefully compared to results obtained by studies that use data coming from social experiments on job-search assistance programs. In his survey on U.S. unemployment insurance experiments, Meyer (1995) points out that intensive job-search assistance increases the individual rate of transition to work. Using also data from UI experiments in the U.S., Ashenfelter, Ashmore and Deschênes (2005) find that a more intensive monitoring of the search behavior of unemployed workers has no significant effect on the exit rate from unemployment. Results from these experiments have been recently confirmed by the study conducted by van den Berg and van der Klaauw (2001). Using data from the Dutch "Counseling and Monitoring" experiment, they conclude that (1) the more intensive the job-search assistance, the higher the exit rate to work, and (2) the worse the labor market prospects (individual or macro-economic), the larger the effect of monitoring on the exit rate to work. While we adopt a more structural approach, our main result stays in line with the conclusions of these experimental studies: increasing the number of job contacts offered by the public employment

[2] This survey has been previously used by Bonnal, Fougère and Sérandon (1997) and Brodaty, Crépon and Fougère (2001) to study the impact of French public employment policies on labour market histories of young unemployed workers.

service decreases the average duration of individual unemployment spells, especially for low-educated and low-skilled workers.

Studies of empirical search models with multiple search channels and endogenous search efforts pose particular problems for the econometrician. A convincing model must include the joint determination of the search channel (i.e. the choice at the extensive margin) and the search effort (i.e. the choice at the intensive margin).[3] In our data set, a substantial proportion of unemployed workers declares to use only the services of the public employment agency without undertaking any private search. To reconcile theory and the data, we assume that unemployed workers have to incur a fixed random search cost whenever they use private search methods. This fixed random cost is observed by the unemployed worker but not by the statistician. If this fixed cost is higher than a given threshold, whose value is endogenously determined within the model, the unemployed worker does not use the private search channel.

The next section introduces our theoretical model that describes the search behavior of unemployed workers. Section III presents the data. Section IV explains the procedure we use to estimate the structural parameters from data on search activities of unemployed workers. Section V comments on the estimation results.

2. The Theoretical Model

In this section we present a search model in which the use of a private search channel and the search effort devoted to this channel are jointly determined by the unemployed worker. In this model, we introduce a fixed random search cost to take into account the fact that some unemployed workers may not use private search methods, a null intensity of search appearing whenever the fixed search cost is higher than a given structural threshold level.

Features of this model are as follows. We consider a standard partial equilibrium job search model in which the individual search intensity is endogenous, i.e. the effort devoted to the search activity is controlled by the worker (see, e.g., Burdett and Mortensen 1978, Burdett 1979, Gal, Landsberger and Levykson 1981, Benhabib and Bull 1983, Morgan 1983, Mortensen 1986). We use this framework to consider the case where search intensity is affected by the rate at which the public employment service (PES hereafter) provides job offers to unemployed workers. The search activity takes place in continuous-time and ρ denotes the individual rate of discount. We assume that the PES informs unemployed workers of the job vacancies through a continuous-time Poisson process with a constant rate λ_0. At the individual level, this rate is supposed to be exogenous (but is eventually affected by individually observed characteristics) and

[3] These problems are similar to the ones raised in the econometric literature on the demand for durable goods, where the purchase of the good and the level of its usage are simultaneous decisions by the consumer (see, e.g. Hanemann, 1984).

constant through the unemployment spell. However, unemployed workers can optimally adjust their search effort, denoted s, to the arrival rate of PES job opportunities. The individual search efficiency through the j-th channel ($j = 0$ for the PES channel, and $j = 1$ for the private search channel), which is the conditional probability that a contact between an unemployed worker and a vacancy offered through this channel gives rise to a job proposal, is denoted α_j ($j = 0, 1$). This distinction allows to test if the use of the PES channel modifies the search efficiency and if it is related with some negative signal (if $\alpha_0 < \alpha_1$). The total arrival rate of effective job offers is equal to $(\alpha_0\lambda_0 + \alpha_1 s)$. The search process is assumed to correspond to the following sequence: first, the unemployed worker contacts job vacancies through the j-th channel with a Poisson process of intensity λ_j (with $\lambda_1 = s$), then the employer transforms the contact into a job proposal with probability α_j, and finally the unemployed accepts the proposal if the wage offer is greater than his/her reservation wage. Moreover, we suppose that job vacancies are exclusively offered to unemployed people; on-the-job search is not allowed. A job is associated to a constant wage rate, denoted w, and to a channel-specific fixed separation rate, denoted σ_0 for jobs obtained through the public channel and σ_1 for jobs obtained through the private channel; the wage rate is a random draw from a known channel-specific c.d.f., denoted F_0 (with density f_0) for the public channel and F_1 (with density f_1) for the private channel.

This last assumption is in line with previous theoretical research suggesting that F_1 should first-order stochastically dominate F_0, which implies that wages found along the private channel should be higher on average than wages found along the public channel. For instance, Mortensen and Vishwanath (1994) have proposed an equilibrium search model with a formal and an informal search channel, and fixed search intensities. Under the further assumption of on-the-job search, they find that in equilibrium, wages offered by firms along the informal (private) channel are higher on average because the probability of getting an offer through this channel is proportional to the size of the firm, while this probability is uniform along the formal (public) channel.[4]

Our crucial assumption is that the unemployed worker has to incur some fixed cost when using his/her personal (or private) search channels. This fixed search cost, denoted c_0, is strictly positive, constant through time and paid at each period. It is randomly drawn from a continuous c.d.f. G with support $(0, \infty)$,[5] and it adds to a variable search

[4]Empirical evidence on this point is ambiguous. Using labor force survey data from the Netherlands, Koning, van den Berg and Ridder (1997) do not reject the null hypothesis of equal distributions, while Lindeboom, van Ours and Renes (1994) found that, in the Netherlands, F_1 first-order stochastically dominates F_0 (in fact, the left tail of F_1 is thinner than the left tail of F_0).

[5]This fixed search cost is drawn once for all for each individual: this means in particular that it is constant through the unemployment spell and that it does not change between two successive unemployment spells. The assumption of a random individual-specific fixed search cost introduces unobserved individual heterogeneity into the model. One consequence is that the aggregated hazard rate out of unemployment is a decreasing function of the spell duration: this point will be illustrated in

cost $c_1(s)$ which is a positive, convex, increasing function of the endogenous search intensity s. Hence, this variable cost function has the following properties:

$$c_1(s) \geq 0 \; \forall s \geq 0, \quad c_1(0) = c_1'(0) = 0, \quad c_1'(s) > 0 \text{ and } c_1''(s) > 0 \text{ for } s > 0. \tag{2.1}$$

Consequently, the total instantaneous search cost for an unemployed worker using private search methods with intensity s is equal to:

$$c(s) = c_0 + c_1(s) \text{ with } c_0 \sim G. \tag{2.2}$$

The worker's objective is to maximize his or her expected indirect lifetime utility. If the worker is unemployed, he or she receives unemployment insurance benefits b per unit of time, and his or her instantaneous indirect utility function is equal to $u(b) = b$. In this model, the unemployed worker faces two choices: he or she may decide to search only through the PES channel or to search through both the PES and private channels, knowing that his or her fixed search cost is respectively higher or lower than a given threshold value. To show this point, first let us write the value function V for an unemployed worker whose UI benefits and fixed search costs are b and c_0, respectively:

$$V = \max(V_0, V_1) \tag{2.3}$$

where

$$V_0 = \frac{1}{1+\rho\Delta t}\left[b\Delta t + (1-\alpha_0\lambda_0\Delta t)V_0 + \alpha_0\lambda_0\,\Delta t\, E_{F_0}\max(V_0, W_0(w))\right] + o(\Delta t) \tag{2.4}$$

is the expected value of the unemployment state when no personal search is conducted $(s = 0)$ and

$$\begin{aligned} V_1 \;=\; & \frac{1}{1+\rho\Delta t}\left[(b - c(s))\,\Delta t + (1-\lambda\,\Delta t)V_1 + \alpha_0\lambda_0\,\Delta t\, E_{F_0}\max(V_1, W_0(w))\right. \\ & \left. + \,\alpha_1 s\,\Delta t\, E_{F_1}\max(V_1, W_1(w))\right] + o(\Delta t) \end{aligned} \tag{2.5}$$

is the expected value of the unemployment state when the unemployed workers use their personal search channels with intensity s.[6] In these expressions, E_{F_j} denotes the expectation with respect to the c.d.f. F_j $(j = 0, 1)$, and $W_j(w)$ denotes the expected value of a job obtained through channel j $(j = 0, 1)$ and associated with an instantaneous wage w. It is defined as

$$W_j(w) = \frac{1}{1+\rho\Delta t}[w\Delta t + (1-\sigma_j\Delta t)W_j(w) + \sigma_j\Delta t V] + o(\Delta t)\,, \quad j = 0, 1. \tag{2.6}$$

the last section.

[6] Equation (2.5) shows that V_1 should be indexed by s and thus denoted $V_1(s)$. But, for simplifying notations, we denote it V_1.

Thus if $\Delta t \downarrow 0$,

$$W_j(w) = \frac{w + \sigma_j \max(V_0, V_1)}{(\rho + \sigma_j)} \;, \quad j = 0, 1. \tag{2.7}$$

If the unemployed worker adopts the search strategy V_0, his or her reservation wage ξ_0 is defined by the standard equation:

$$\xi_0 = \rho V_0 = b + \frac{\alpha_0 \lambda_0}{(\rho + \sigma_0)} H_0\left(\xi_0\right) \tag{2.8}$$

where

$$H_0\left(\xi_0\right) = \int_{\xi_0}^{\infty} (x - \xi_0)\, dF_0(x) = \int_{\xi_0}^{\infty} \overline{F}_0(x)\, dx$$

$H_0\left(.\right)$ and $\overline{F}_0(.)$ being respectively the surplus function and the survivor function associated with F_0.

If the search strategy V_1 is preferred, there is still a unique reservation wage, denoted ξ_1, for both channels. To prove this point, let us first assume that the reservation wage for a type$-j$ job is denoted ξ_{1j} $(j = 0, 1)$ and defined as $W_j(\xi_{1j}) = V_1$. Then equation (2.7) implies that

$$\xi_{10} = \xi_{11} = \xi_1 = \rho V_1. \tag{2.9}$$

With $\Delta t \downarrow 0$, equation (2.5) gives

$$\begin{aligned} \rho V_1 \quad &= \quad b - c(s) + \alpha_0 \lambda_0 \int_0^{\infty} \max[0, W_0(x) - V_1]\, dF_0(x) \\ &\qquad + \alpha_1 s \int_0^{\infty} \max[0, W_1(x) - V_1]\, dF_1(x) \end{aligned}$$

Using equation (2.9), it follows that:

$$\xi_1 = b - c(s) + \frac{\alpha_0 \lambda_0}{\rho + \sigma_0} H_0\left(\xi_1\right) + \frac{\alpha_1 s}{\rho + \sigma_1} H_1\left(\xi_1\right) \tag{2.10}$$

Now, the program needs to be solved with respect to s and ξ_1. Note that the previous equation defines an implicit relation $\Psi(V_1, s, \xi_1) = 0$ between V_1, s and ξ_1. Consequently, the first order conditions for maximizing V_1 may be written as

$$c_1'(s) = \frac{\alpha_1}{\rho + \sigma_1} \int_{\xi_1}^{\infty} (x - \rho V_1)\, dF_1(x)$$

and

$$\xi_1 = \rho V_1.$$

If the inverse of $c_1'(s)$ exists and is denoted by $(c_1')^{-1}(s)$, then using simultaneously these two conditions and equation (2.10), we get the system of two equations defining the optimum solutions for s and ξ_1:

$$\left.\begin{aligned} s^* = \phi_1(\xi_1) &= c_1'^{-1}\left[\frac{\alpha_1}{\rho+\sigma_1}\int_{\xi_1}^{\infty}(x-\rho V_1)\,dF_1(x)\right] \\ &= c_1'^{-1}\left[\frac{\alpha_1}{\rho+\sigma_1}H_1(\xi_1)\right] \\ \xi_1 = \phi_2(\xi_1, s^*) &= b - c(s^*) + \frac{\alpha_0\lambda_0}{\rho+\sigma_0}H_0(\xi_1) + s^*\, c_1'(s^*). \end{aligned}\right\} \tag{2.11}$$

Because the function $\upsilon(\xi_1) = \phi_2(\xi_1, \phi_1(\xi_1))$ verifies Blackwell's sufficient conditions, it is a contraction mapping.[7] Thus, a unique reservation wage ξ_1 exists, which is defined as the fixed point of the contraction υ, and which can be calculated by using the Newton algorithm, i.e. the iterative procedure:

$$\xi_{n+1} = \frac{\upsilon(\xi_n) - \xi_n \upsilon'(\xi_n)}{1 - \upsilon'(\xi_n)} \; . \tag{2.12}$$

Then, the optimal search intensity, denoted s^*, may be calculated from the first equation of the system (2.11). In the sequel, we consider the following specification:

$$c_1(s) = \gamma\, s^2 \;, \text{ with } \quad \gamma > 0 \; . \tag{2.13}$$

By the implicit function theorem, we get :

$$\frac{\partial V_1}{\partial c_0} = -\left[\rho\left(1 + \frac{\alpha_0\lambda_0}{\rho+\sigma_0}\left[1 - F_0(\xi_1)\right] + \frac{\alpha_1 s}{\rho+\sigma_1}\left[1 - F_1(\xi_1)\right]\right)\right]^{-1} < 0.$$

Moreover, from equations (2.8) and (2.11), it is easily shown that $V_0 = V_1$ if and only if the fixed cost is equal to the threshold value $\underline{c}_0 = s^*\; c_1'(s^*) - c_1(s^*)$. Hence a sufficient condition for $\underline{c}_0$ to be positive is $s^*\; c_1'(s^*) > c_1(s^*), \forall s > 0$, which is verified if the function $c_1(.)$ is convex. Specification (2.13) satisfies this condition. In that case, using the first-order conditions (2.11), we find that the threshold value is

$$\begin{aligned} \underline{c}_0 &= \frac{1}{4\gamma}\left[\frac{\alpha_1}{\rho+\sigma_1}\int_{\xi_0}^{\infty}(x-\xi_0)\,dF_1(x)\right]^2 \\ &= \frac{1}{4\gamma}\left[\frac{\alpha_1}{\rho+\sigma_1}H_1(\xi_0)\right]^2 \end{aligned} \tag{2.14}$$

[7] This point has been shown by Mortensen (1986, pp. 875-876).

Thus an unemployed worker uses his or her personal search channel if and only if the fixed search cost is lower than this threshold value. In this situation, the reservation wage ξ_1 and the optimal search intensity s are defined by system (2.11). Thus, ξ_1 can be calculated by applying the Newton algorithm (2.12) and then s can be found by solving the first equation of the system (2.11). The unemployed worker does not search actively if and only if his or her fixed search cost is higher than the threshold value (2.14); this event has probability $1 - G(\underline{c}_0)$. In this case, the reservation wage ξ_0 is calculated from the standard equation (2.8) and the search intensity is zero.

What is the theoretical effect of a change in the PES job offer arrival rate on the exit rate from unemployment? For an unemployed worker choosing the search strategy V_0, this exit rate is equal to

$$h_0 = \alpha_0 \lambda_0 \left[1 - F_0(\xi_0)\right] \tag{2.15}$$

while, if search strategy V_1 is chosen, the exit rate is

$$h_1 = \alpha_0 \lambda_0 \left[1 - F_0(\xi_1)\right] + \alpha_1 s \left[1 - F_1(\xi_1)\right] \tag{2.16}$$

The first-order derivative of h_0 with respect to λ_0 is

$$\frac{dh_0}{d\lambda_0} = \alpha_0 \left\{ \left[1 - F_0(\xi_0)\right] - \lambda_0 f_0(\xi_0) \frac{d\xi_0}{d\lambda_0} \right\}$$

This last expression is the usual formula for the first-order derivative of the unemployment exit rate with respect to the job offer arrival rate in a partial equilibrium search model with a constant search intensity and a single search channel. In that case, an increase in the exogenous job offer arrival rate has a direct positive effect on h_0, while it has an indirect negative effect through the increase of ξ_0.[8] Flinn and Heckman [1983], Burdett and Ondrich [1985] and Van den Berg [1994] have examined sufficient conditions under which an increase in λ_0 induces an increase in h_0. These conditions basically involve log concavity of F_0. If the unemployed worker uses both search channels, namely if search strategy V_1 is chosen, the first-order derivative of h_1 with respect to λ_0 is

$$\frac{dh_1}{d\lambda_0} = \alpha_0 \left[1 - F_0(\xi_1)\right] + \alpha_1 \frac{ds}{d\lambda_0} \left[1 - F_1(\xi_1)\right] - \frac{d\xi_1}{d\lambda_0} \left[\alpha_0 \lambda_0 f_0(\xi_1) + \alpha_1 s f_1(\xi_1)\right] \tag{2.17}$$

whose sign depends on signs of $ds/d\lambda_0$ and $d\xi_1/d\lambda_0$. From equations (2.11), it is easy to show that

$$\frac{ds}{d\lambda_0} < 0 \text{ and } \frac{d\xi_1}{d\lambda_0} > 0$$

[8] By totally differentiating equation (2.8), it is easy to show that

$$\frac{d\xi_0}{d\lambda_0} = \frac{\alpha_0 H_0(\xi_0)}{\{(\rho + \sigma_0) + \alpha_0 \lambda_0 \left[1 - F_0(\xi_0)\right]\}}$$

which is positive. This means that the searcher's selectivity increases when job opportunities are more frequent.

(see Appendix A). Hence, if $F_0 \neq F_1$, the overall effect of a change in λ_0 on the exit rate is generally uncertain. By substituting expressions (A.1) and (A.2) (see Appendix A) into the equation (2.17), we obtain

$$\frac{dh_1}{d\lambda_0} = \alpha_0 \overline{F}_0(\xi_1) - \left[\frac{\alpha_0 H_0(\xi_1)}{(\rho+\sigma_0)\left[1 + \frac{\alpha_0}{\rho+\sigma_0}\overline{F}_0(\xi_1) + \frac{\alpha_1}{\rho+\sigma_1}\overline{F}_1(\xi_1)\right]} \times \left\{ \frac{\left[\alpha_1 \overline{F}_1(\xi_1)\right]^2}{(\rho+\sigma_1)\, c_1''(s)} + \alpha_0\lambda_0 f_0(\xi_1) + \alpha_1 s f_1(\xi_1) \right\} \right] \quad (2.18)$$

Equations (2.8) and (2.10) imply that

$$\frac{\alpha_0}{\rho+\sigma_0} = \frac{\xi_0 - b}{\lambda_0 H_0(\xi_0)}$$

and

$$\frac{\alpha_1}{\rho+\sigma_1} = \frac{\xi_1 - b + c(s)}{s H_1(\xi_1)} - \frac{\xi_0 - b}{\lambda_0 H_0(\xi_0)} \frac{H_0(\xi_1)}{s H_1(\xi_1)}.$$

By substituting these two expressions into equation (2.18), we find that $dh_1/d\lambda_0$ depends on the fixed search cost c_0, whose value has to be less than the threshold (2.14) for the unemployed to undertake a private search. This threshold depending on the values of the model parameters, it is difficult to find a general sufficient condition insuring that $dh_1/d\lambda_0 > 0$.[9] Thus we must turn to the estimation of the model to test for the equality of wage offer distributions F_0 and F_1 and to determine the sign of the overall effect.

3. Data

The data are taken from the survey "Suivi des Chômeurs" performed between 1986 and 1988 by INSEE (Institut National de la Statistique et des Etudes Economiques, Paris). The sample was built randomly from the files of the French public employment agency ("Agence Nationale pour l'Emploi" or ANPE) in August 1986. About 8,000 people were sampled, but only 7,450 answered the set of questions. The individuals were interviewed four times, in November 1986, May 1987, November 1987 and lastly in May 1988. We have only considered the 6,992 individuals effectively registered at the ANPE in August 1986 and for whom it was possible to observe an accurate and relevant

[9] In particular, we have verified that the condition on the wage distribution functions F_0 and F_1 studied by van den Berg and van der Klaauw (2001), which states that $w f_j(w)$ must be non decreasing in w, is not sufficient anymore here.

date of registration. Questions relative to the search intensity and job finding methods were asked to the 5,988 individuals who were still unemployed in November 1986, and eventually at the following interview dates. The empirical analysis has been restricted to this subsample.

The survey gives information on individual labour market histories between August 1986 and May 1988, and in particular on the duration (in months) of individual spells of employment and unemployment. For instance, Figure 1 represents the histogram of the duration of the first employment spell (including temporary jobs and training programs) experienced by the 5,988 individuals kept in our subsample. This graph incorporates both complete and right-censored durations. The high proportion of employment spells whose duration is less than three months is due to the frequency of transitions from unemployment to temporary jobs with short-term labor contracts.

(Figure 1 around here)

Figure 2 reports the histogram of the duration of the unemployment spell sampled in August 1986 (26.8 percent of these spells were right-censored in May 1988).

(Figure 2 around here)

The survey provides information on grouped monthly wages. Their distribution from the first observed employment spell is given in Figure 3. Most of these wages are less than the monthly net minimum wage, which was approximately equal to 3,800 French Francs in 1986: this is due to the high proportion of part-time jobs and subsidized training programs that appear in the subsample.

(Figure 3 around here)

Contrary to wages, values of the monthly UI benefits received by unemployed workers were precisely observed. In particular, let us notice that in this subsample, 59.84 percent of unemployed people declare to have no UI benefits. The distribution of strictly positive UI benefits is non-parametrically estimated with a biweight kernel function in Figure 4. Its mode is around 2,000 French Francs per month.

(Figure 4 around here)

Because of the sampling scheme, all unemployed workers observed in the analyzed subsample were registered at the public employment agency in November 1986. All of them were asked for their use of four personal search methods (other than the registration at the public employment agency): advertisements (method 2 in Figure 5), direct contacts with firms (method 3 in Figure 5), contacts through personal relationships (method 4) and other methods (denoted method 5 in Figure 5). Figure 5 shows the proportions of unemployed people using each one of these methods according to the length of their ongoing unemployment spell in November 1986, which is grouped in seven intervals (less than 3 months, between 3 and 6 months, between 6 and 9 months, between 9 and 12 months, between 12 and 18 months, between 18 and 24 months, more than 24 months). Apparently, the proportion of unemployed people using at least one of these personal search methods increases up to the fourth time interval (between 9 and 12 months spent unemployed) and then decreases.

(Figure 5 around here)

To make this descriptive analysis more precise, we report in Figure 6 changes in the proportions of unemployed individuals actively searching (i.e. using at least one personal search method) during the unemployment spell sampled in November 1986. These graphs make two distinctions. The first one is between unemployed people who left this unemployment spell between November 1987 and May 1988 and the ones who remained unemployed until the end of the survey. Graphs in Figure 6 also distinguish between different groups of unemployed people according to the time already spent unemployed before November 1986. If we consider two subgroups having spent the same time in the unemployment spell before November 1986 but exiting from unemployment during two different time intervals, Figure 6 makes clear that proportions of individuals actively searching are higher in the subgroup that leaves unemployment first. This seems to confirm that the individual search intensity has a positive impact on the exit rate from unemployment. Moreover, proportions of unemployed workers actively searching seem to decrease through the unemployment spell. According to our model, this could be due to a "mover-stayer" effect, workers with a low fixed cost c_0 leaving unemployment first.

(Figure 6 around here)

To carry out estimation, we have stratified the sample by gender and by age (less than 26 years old, between 26 and 50 years old). For young people (less than 26 years old), we have considered three subgroups according to three different educational levels, which are denoted *level 1* (no diploma, junior high school and non response), *level 2* (vocational and technical schools), and *level 3* (high school, college or university). For adults (between 26 and 50 years old), we have distinguished between four skill levels, denoted *level 1* (for unskilled blue-collar workers), *level 2* (for skilled blue-collar workers), *level 3* (for white-collar workers), and *level 4* (for high-skilled workers). This procedure gives fourteen strata: parameters of the structural model have been separately estimated for each of these subgroups.[10] Sizes of the strata are given in Table 1.

[10] Estimating the model for the whole sample, or at least separately for males and females, by adding new coefficients for educational or skill levels in each parameter, appeared to be a difficult task, the optimization procedure either converging very slowly, or being unable to reach convergence.

TABLE 1

Strata sizes

		Educational or skill level				
		Level 1	Level 2	Level 3	Level 4	Total
Less than	Men	535	249	48	-	832
25 years old	Women	683	349	146	-	1178
Between 26 and	Men	299	515	118	225	1157
50 years old	Women	334	127	707	177	1345
	Total	1851	1240	1019	402	4512

Source: Survey "Suivi des chômeurs", INSEE, 1986-1988.

Table 2 gives the proportions of unemployed workers using personal search methods (i.e. actively searching) at the time of the interview date preceding the exit from the sampled unemployment spell. It also indicates the proportion of unemployed workers who obtained at least one job offer through the public channel or through personal search during the six months preceding the interview (or during the previous month if the interview took place in November 1986). We also report in Table 2 the proportion of unemployed workers who have received at least one job proposal during the previous six months (or during the previous month if the interview took place in November 1986). All these proportions are very low (except the one indicating the number of unemployed workers using personal search methods). However, let us remark that they are generally higher for men and for young people.

TABLE 2

Search methods and outcomes (percentages)

		Young workers		Adult workers	
Interview date		Men	Women	Men	Women
November 86	Actively searching	69.54	68.53	79.25	62.90
	At least one offer through:				
	- the public channel	6.83	5.00	5.74	4.27
	- the private channel	9.11	8.57	9.34	5.82
	At least one hiring proposal	10.55	6.7	7.38	6.57
	(in the previous month)				
May 87	Actively searching	69.18	59.29	70.01	59.63
	At least one offer through:				
	- the public channel	12.89	12.16	7.5	5.02
	- the private channel	11.01	11.49	13.3	10.04
	At least one hiring proposal	7.23	7.09	5.66	4.71
	(in the previous six months)				
November 87	Actively searching	63.96	53.37	64.19	54.55
	At least one offer through:				
	- the public channel	12.61	4.69	6.08	5.07
	- the private channel	10.81	4.69	7.66	6.26
	At least one hiring proposal	10.81	5.57	3.60	2.98
	(in the previous six months)				
May 88	Actively searching	65.45	50.95	62.29	47.63
	At least one offer through:				
	- the public channel	7.27	4.76	5.72	5.17
	- the private channel	3.64	5.24	8.42	4.53
	At least one hiring proposal	5.45	5.24	3.70	2.80
	(in the previous six months)				

Source: Survey “Suivi des chômeurs”, INSEE, 1986-1988.

4. The Econometric Model

In our data set, the variables which are endogenous in the sense of the job-search model developed in Section 1 are the following:

- T_u is the duration (in months) of the spell of unemployment sampled in November 1986;
- T_{ej} is the duration (in months) of the spell of employment occurring just after this unemployment spell ($j = 0$ when the job has been found through the public channel, $j = 1$ when the job has been found through the private channel); under our assumptions, T_{ej} has an exponential distribution with parameter σ_j;
- W_j ($j = 0, 1$) is the monthly net wage associated with this employment spell; W_j is assumed to be randomly drawn alternatively from a Weibull distribution or from a lognormal distribution with positive parameters w_{1j} and w_{2j}. In the Weibull case the surplus function H_j ($j = 0, 1$) associated with the distribution F_j has a relatively simple expression:

$$H_j(x) = -x \exp\left(w_{2j} x^{w_{1j}}\right) + w_{2j}^{-\frac{1}{w_{1j}}} \Gamma\left(1 + \frac{1}{w_{1j}}\right) \left[1 - I_{1+\frac{1}{w_{1j}}}\left(w_{2j} x^{w_{1j}}\right)\right], \ j = 0, 1,$$

where $\Gamma(.)$ and $I_.(.)$ denote the gamma and the incomplete gamma functions, respectively defined as

$$\Gamma(k) = \int_0^\infty e^{-t} t^{k-1} dt$$

and

$$I_k(s) = \int_0^\infty \frac{e^{-t} t^{k-1}}{\Gamma(k)} dt.$$

In the lognormal case the surplus function H_j ($j = 0, 1$) associated with the distribution F_j is

$$\begin{aligned} H_j(x) &= \exp\left(w_{1j} + \frac{w_{2j}^2}{2}\right) \left[1 - \Phi\left(\frac{\ln x - w_{1j}}{w_{2j}} - w_{2j}\right)\right] \\ &= \exp\left(w_{1j} + \frac{w_{2j}^2}{2}\right) \left[1 - \Phi\left(\frac{\ln x - w_{1j} - w_{2j}^2}{w_{2j}}\right)\right], \ j = 0, 1, \end{aligned}$$

where $\ln W_j \sim \mathcal{N}(w_{1j}, w_{2j}^2)$

- D is a variable taking value 1 if the individual uses personal search methods, otherwise 0;

- M_0 indicates the number of job offers received from the public employment agency during the unemployment spell;
- M_1 represents the number of job offers received through the private channel;
- E is the number of hiring proposals among the $(M_0 + M_1)$ job offers received during the unemployment spell.

The model introduced in Section 1 is a job-search stationary model with an infinite horizon. For a given level of the UI benefit b and a given fixed search cost c_0, this model determines a unique reservation wage rule implying that the wage accepted by the unemployed worker must be greater than his or her reservation wage. Thus, the distribution of accepted wages is the wage distribution truncated at ξ_1 (ξ_0, respectively) when $D = 1$ (when $D = 0$ respectively).[11] Under the assumptions of this model, the endogenous variables D, M_0, M_1, E and T_u are independent of T_{ej} and W_j given the optimal search intensity $s^*$and the reservation wage ξ_j $(j = 0, 1)$. Moreover, the length T_{ej} of the subsequent employment spell is assumed to be independent of the wage W_j earned in that job. Hence, for a given value of the fixed search cost c_0, the contribution to the likelihood function for individual i $(i = 1, ..., N)$ consists of five parts: (i) the density (or survivor) function of the duration of the sampled unemployment spell, (ii) the density of the accepted wage, (iii) the density (or survivor) function of the duration of the subsequent employment spell, (iv) the Poisson distribution for the observed number of job offers received through search channel j $(j = 0, 1)$, and (v) the binomial distribution for the observed number of hiring proposals given the total number of job offers. Now let us give the expression of each of these five contributions.

(i) When the unemployed worker does not activate personal search (namely when $c_0 > \underline{c}_0$), the likelihood contribution of her unemployment spell duration is either $L_{1,0} = h_0 \exp(-h_0 T_u)$ if the unemployment spell is complete, or $L_{1,0} = \exp(-h_0 T_u)$ if it is right-censored, where h_0 is the hazard function defined in equation (2.15). When the unemployed worker uses both search channels, the similar contribution is $L_{1,1} = \exp(-h_1 T_u)$ if the unemployment spell is right-censored, h_1 being the hazard function defined in equation (2.16). If the unemployment spell is observed to be complete, the contribution of her unemployment duration to the likelihood function is either $L_{1,1} = \alpha_0 \lambda_0 [1 - F_0(\xi_1)] \exp(-h_1 T_u)$ if the accepted job is found through the public channel, or $L_{1,1} = \alpha_1 s [1 - F_1(\xi_1)] \exp(-h_1 T_u)$ if the accepted job is found through the private channel.

[11] According to the theoretical model, D is equal to 1 (respectively, to 0) if the fixed search cost c_0 is lower than $\underline{c}_0$ (respectively, greater than $\underline{c}_0$).

(*ii*) The generic contribution of the accepted wage is

$$L_{2,j} = \Pr(w \in [W_{l-1}, W_l) \mid w > \xi, c_0) = \begin{cases} [F_j(W_l) - F_j(W_{l-1})] \times [1 - F_j(\xi)]^{-1}, \\ \qquad\qquad \text{if } \xi < W_{l-1}, \\ [F_j(W_l) - F_j(\xi)] \times [1 - F_j(\xi)]^{-1}, \\ \qquad\qquad \text{if } \xi \in [W_{l-1}, W_l), \end{cases}$$

where $[W_{l-1}, W_l)$ is the l-th interval for the observed grouped wage. If the unemployed worker does not use the private search channel, ξ stands for ξ_0 and F_j is equal to F_0. If she uses both search channels, ξ stands for ξ_1, and F_j is either F_0 or F_1 depending on the channel through which the job has been found.

(*iii*) When the accepted job is found through the j-th channel ($j = 0, 1$), the likelihood contribution of the subsequent employment spell duration is either $L_{3,j} = \sigma_j \exp(-\sigma_j T_e)$ if the unemployment spell is complete, or $L_{3,j} = \exp(-\sigma_j T_e)$ if it is right-censored, where σ_j is the separation rate in a job of type j. When the sampled unemployment spell is right-censored, contributions L_2 and $L_{3,j}$ are irrelevant.

(*iv*) The number of job contacts M_j obtained through the j-th channel ($j = 0, 1$) is generated by a Poisson process with parameter λ_0 if $j = 0$, or with parameter s^* if $j = 1$. This implies that

$$\begin{aligned} L_4 &= \Pr(M_0 = m_0) \times [\Pr(M_1 = m_1)]^D \\ &= \frac{e^{-\lambda_0 T_u} \times (\lambda_0 T_u)^{m_0}}{m_0!} \times \left[\frac{e^{-s^* T_u} \times (s^* T_u)^{m_1}}{m_1!} \right]^D \end{aligned}$$

where the optimal search intensity s^* is defined by the first equation of the system (2.11).

(*v*) The contribution of the number E of hiring proposals among $M = M_0 + M_1$ job contacts (with $E \leq M$) is equal to

$$\begin{aligned} L_5 &= \Pr(E = e \mid M = m_0 + m_1) \\ &= \sum_{k=0}^{e} \binom{k}{m_0} \alpha_0^k (1 - \alpha_0)^{m_0 - k} \binom{e-k}{m_1} \alpha_1^{e-k} (1 - \alpha_1)^{m_1 - e - k} \end{aligned}$$

The final likelihood function is obtained first by multiplying these five contributions and then by integrating out their product with respect to c_0 over the relevant region. Thus, if the unemployed worker uses private search methods and if the job has been found through channel j $(j = 0, 1)$, the individual likelihood function is:

$$\begin{aligned} L &= \int_0^{\underline{c}_0} \left(L_{1,1} \times L_{2,j} \times L_{3,j} \times L_4 \times L_5\right) \, dG(c_0) \\ &= G(\underline{c}_0) \times E\left[L_{1,1} \times L_{2,j} \times L_{3,j} \times L_4 \times L_5 \mid c_0 < \underline{c}_0\right] \end{aligned} \tag{4.1}$$

Otherwise, it is equal to

$$\begin{aligned} L &= \int_{\underline{c}_0}^{+\infty} \left(L_{1,0} \times L_{2,0} \times L_{3,0} \times L_4 \times L_5\right) \, dG(c_0) \\ &= \left(L_{1,0} \times L_{2,0} \times L_{3,0} \times L_4 \times L_5\right) \times \left[1 - G(\underline{c}_0)\right] \end{aligned} \tag{4.2}$$

otherwise. Due to this integral form, we use a simulated maximum likelihood (SML) procedure[12] first by choosing a particular c.d.f. G for c_0 and then by drawing, for each individual i using personal search methods, K_1 independent simulated values c_0^k $(k = 1, ...K_1)$ from the c.d.f. G truncated from below at $\underline{c}_0$. In our application, the c.d.f. G is assumed to be the exponential distribution with parameter $\varsigma > 0$.[13] The number of replications was set at $K_1 = 50$.

Parts (i) and (ii) of the likelihood function constitute the usual likelihood of the single-spell search unemployment model (see Flinn and Heckman, 1982). Observation of accepted wages W_j is required to identify parameters w_{1j} and w_{2j} of the wage offer distribution F_j (part (ii) of the likelihood function). Part (i) identifies either the product $(\alpha_0\lambda_0)$ when the subsequent job has been found through the public employment service, or the parameter α_1 when the subsequent job has been found through personal search method. The arrival rate λ_0 is identified by the number M_0 of job contacts offered by the public employment agency. As search intensity is endogenous, the parameter γ_0 of the search cost function is identified by the number M_1 of contacts received through personal search channels (contribution L_4). The search efficiency parameters α_j are identified by the number E of hiring proposals (contribution L_5). Separation rates σ_j are identified by the duration T_{ej} of the subsequent employment spell (part (iii) of the likelihood function). Finally, the parameter ς of the distribution of the fixed search cost G is identified by the dichotomous variable D indicating if the unemployed worker uses

[12] See, for instance, Gouriéroux and Monfort (1997) for a presentation of the definition and the properties of simulated maximum likelihood estimators.

[13] We have also estimated the model under the assumption that c_0 has a lognormal distribution, namely that $\ln c_0 \sim \mathcal{N}(\varsigma, 1)$. Under that alternative assumption, the fit of the model (measured, for instance, by the value of the log-likelihood function calculated with the parameter estimates) was generally worst.

personal search methods. The whole set of parameters jointly determines the solution $(s^*, \xi_0, \xi_1, \underline{c}_0)$ of the system (2.11).

Because all individuals in our sample are initially registered as unemployed in August 1986, our data set is subject to a stock sampling bias.[14] We show in Appendix B that correction of this bias can be done by dividing individual likelihood contributions (4.1) and (4.2) by the term

$$\begin{aligned} & \int_0^{\underline{c}_0} \exp\left(-h_1 T_0\right) \; dG(c_0) + \exp\left(-h_0 T_0\right) \; \left[1 - G(\underline{c}_0)\right] \\ = \; & G(\underline{c}_0) E_G \left[\exp\left(-h_1 T_0\right) \mid c_0 < \underline{c}_0\right] + \exp\left(-h_0 T_0\right) \; \left[1 - G(\underline{c}_0)\right] \qquad (4.3) \end{aligned}$$

where T_0 denotes the time already spent in unemployment at the sampling date ($T_u > T_0$), h_0 and h_1 being the theoretical hazard functions defined in equations (2.15) and (2.16). The first component of the denominator (4.3) is once again estimated using a simulation method with $K_2 = 50$ replications.[15]

For a given amount b of the UI benefit, the ML parameter estimates allow us to calculate the expected rate of exit from unemployment (at the beginning of the unemployment spell) is estimated by a Monte-Carlo procedure as

$$\begin{aligned} \widehat{E(h)} \; &= \; \widehat{\alpha}_0 \, \widehat{\lambda}_0 \left[1 - \widehat{F}_0(\widehat{\xi}_0)\right] \left[1 - \widehat{G}(\widehat{\underline{c}}_0)\right] \\ & \quad + \int_0^{\widehat{\underline{c}}_0} \left(\widehat{\alpha}_0 \, \widehat{\lambda}_0 [1 - \widehat{F}_0(\widehat{\xi}_1)] + \widehat{\alpha}_1 \widehat{s}^* [1 - \widehat{F}_1(\widehat{\xi}_1)]\right) \, d\widehat{G}(c_0) \qquad (4.4) \end{aligned}$$

where

$$\begin{aligned} \widehat{s}^* \; &= \; \frac{\widehat{\alpha}_1}{2\widehat{\gamma}\,(\rho + \widehat{\sigma}_1)} \int_{\widehat{\xi}_1}^{\infty} (x - \widehat{\xi}_1) \, d\widehat{F}_1(x) \\ &= \; \frac{\widehat{\alpha}_1 \, \widehat{H}_1(\widehat{\xi}_1)}{2\widehat{\gamma}\,(\rho + \widehat{\sigma}_1)} \end{aligned}$$

In these latter expressions, $\widehat{F}_j$ $(j = 0, 1)$ is the c.d.f. of the wage distribution with parameters $\widehat{w}_{1j}$ and $\widehat{w}_{2j}$, and $\widehat{G}$ is the parametric estimate of the c.d.f. of the fixed search cost c_0. For an unemployed worker with UI benefits equal to b, the probability to search actively (i.e. to use personal search channels) is estimated as $\widehat{G}(\widehat{\underline{c}}_0)$.

[14] For the statistical treatment of the stock sampling bias in duration and transition models, see, for instance, contributions by Ridder (1984) and Lancaster (1990), and, for applications to the survey we use, papers by Bonnal, Fougère and Sérandon (1997), and Brodaty, Crépon and Fougère (2001).

[15] The simulated maximum likelihood estimator is computed by applying the first order correction for the asymptotic bias suggested by Gouriéroux and Monfort (1996, p. 45, equation 3.4).

5. Results

5.1. Parameter estimates

Tables 3 and 4 give estimates of the structural parameters for young people[16] while Tables 5 and 6 give them for adults. In these tables, fixed search costs are assumed to be exponentially distributed with parameter $\varsigma > 0$. All positive parameters are estimated under the exponential link function to insure their positivity during the iterative maximization process; once the maximization process has converged to the optimum value, we try to run one or a few iterations more by using as initial values the estimated positive values of the parameters; thus we can obtain the estimated standard errors of the estimated positive parameters. Efficiency parameters α_j $(j = 0, 1)$, which are probabilities, are estimated under the logistic form during the whole process; we use the same procedure (rather than the Delta method) to obtain the estimated value of this probability and of the standard error of its estimated value. The individual discount rate is set equal to $\rho = 0.02$. The only covariate that we have introduced here is the local unemployment rate, which is assumed to influence the job arrival rate along the public channel. However, its coefficient is always found to be statistically not different from zero. We have also tried to introduce parsimoniously this covariate and some others in different model parameters (especially, family covariates in the cost function), but all these attempts were unsuccessful (in these exercises, the procedure convergence was not reached).

The estimated job arrival rate along the public channel, denoted λ_0, is estimated to be lower for low-educated young workers and low-skilled unemployed adults. It is generally higher for young people, especially for young men having a vocational or technical diploma.[17] The probability of transformation of a contact into a hiring proposal, denoted α_j $(j = 0, 1)$, is higher for job contacts found by the public employment service. For instance, for adult unskilled blue-collar males, it is estimated to be equal to 60 percent with the Weibull model and to 59 percent with the lognormal one, while the transformation rate of contacts along the private channel is equal to 42 percent with the Weibull model and to 41 percent with the lognormal one. For adult unskilled blue-collar women, the transformation rate along the public channel (respectively, along the private channel) is estimated to be equal to 86 percent with both models (respectively, 60 per-

[16] Due to the very low number of observations in the third stratum for young unemployed men (highly educated young males), we were unable to estimate the model by the simulated maximum likelihood procedure for this stratum.

[17] This result should be detailed in a further study, by distinguishing between temporary jobs (including jobs subsidized through public policies for youth employment) and permanent ones. Using a reduced-form transition model estimated with the same data set, Bonnal, Fougère and Sérandon (1997) have already shown that young men having a technical degree move more frequently from unemployment to training programs and to temporary jobs.

cent). For highly-skilled adult unemployed workers, the transformation rate of contacts through the public channel is still found to be high (79 percent for women, 65 percent for men), while the transformation rate through the private channel is much lower (40 percent for women, and only 16 percent for men). At younger ages, transformation rates of men and women are still differentiated. For instance, for medium-educated young women, the transformation rate along the public channel (respectively, along the private channel) is equal to 84 percent with both models (respectively, 59 percent with the Weibull model and 57 percent with the lognormal one). However, for young medium-educated males, the transformation rates through public and private channels are equal (approximately 45 percent with both models). High transformation rates through the public channel may be due to the previous selection that case-workers of the public employment service do among the pool of unemployed workers before initiating a contact with a job vacancy. At the opposite, low transformation rates through the private channel may be due to higher competition among workers applying for posted vacancies. However, let us recall that we do not distinguish between private search methods with different levels of efficiency. For instance, we may expect that contacts through relatives and friends should be potentially more efficient than advertisement or direct contacts with firms.

The average duration of jobs found along the public channel, which is equal to σ_0^{-1} under the assumption of a time-constant job separation rate, is lower only in the case of low-educated (below 26 years old) and low-skilled (above 26 years old) unemployed workers. This may be explained by the fact that the public employment service offers more frequently public employment programs or short-term subsidized jobs[18] to low-skilled workers. But this result is also found in other strata, especially for white-collar and highly-skilled adult males. In other subgroups, the average duration of jobs found along the public channel is either similar or even higher than the average duration of jobs found along the private channel. Hence, our results confirm partially the general conclusion obtained by Addison and Portugal (2002). Using a reduced-form model, they find that the probability to get a job under a short-term labour contract is higher along the public channel, but they do not consider interactions between job search methods and skill or educational levels.

[18]See Fougère, Kramarz and Magnac (2000) for a description of employment programs in France and a synthesis of empirical results on their effects.

TABLE 3

Parameter estimates for young unemployed males

(less than 26 years old, $\rho = 0.02$)

		Level 1		Level 2	
	ς	1.863*	(0.280)	1.766*	(0.279)
	$\ln \lambda_0$	-2.249*	(0.060)	-1.861*	(0.061)
	Unemployment rate	-0.275	(0.195)	0.061	(0.267)
	α_0	0.755*	(0.025)	0.448*	(0.029)
	α_1	0.350*	(0.029)	0.447*	(0.031)
	$\ln w_{10}$	1.164*	(0.130)	1.561*	(0.138)
Wage	$\ln w_{20}$	-4.136*	(0.600)	-6.738*	(0.968)
distribution :	$\ln w_{11}$	-0.048	(0.199)	0.467*	(0.213)
Weibull	$\ln w_{21}$	-1.718*	(0.519)	-2.862*	(0.750)
	σ_0	0.198*	(0.017)	0.134*	(0.016)
	σ_1	0.173*	(0.016)	0.139*	(0.016)
	γ	24.51*	(3.710)	25.62*	(3.869)
	N	535		249	
	$(\ln L)/N$	-7.381		-8.170	
	ς	1.783*	(0.265)	1.720*	(0.267)
	$\ln \lambda_0$	-2.258*	(0.058)	-1.865*	(0.061)
	Unemployment rate	-0.273	(0.194)	0.062	(0.268)
	α_0	0.752*	(0.025)	0.445*	(0.029)
	α_1	0.332*	(0.026)	0.431*	(0.028)
	w_{10}	1.153*	(0.036)	1.301*	(0.030)
Wage	w_{20}	0.307*	(0.042)	0.230*	(0.032)
distribution :	w_{11}	1.451*	(0.196)	1.566*	(0.112)
lognormal	w_{21}	1.003*	(0.131)	0.656*	(0.092)
	σ_0	0.195*	(0.017)	0.132*	(0.016)
	σ_1	0.174*	(0.016)	0.143*	(0.017)
	γ	27.14*	(3.858)	27.89*	(3.96)
	N	535		249	
	$(\ln L)/N$	-7.348		-8.160	

Source: "Suivi des chômeurs" Survey, INSEE, 1986-1988.

Remarks: Estimated standard errors are in parentheses; estimates which are significant at the 5 percent level are indicated by *.

Educational levels: level 1: no diploma, junior high school and non response; level 2: vocational and technical schools; level 3: high school, college or university.

TABLE 4

Parameter estimates for young unemployed females

(less than 26 years old, $\rho = 0.02$)

		Level 1		Level 2		Level 3	
	ς	2.041*	(0.344)	1.726*	(0.326)	1.574*	(0.473)
	$\ln\lambda_0$	-2.493*	(0.056)	-2.604*	(0.097)	-1.928*	(0.099)
	Unemployment rate	-0.236	(0.204)	-0.009	(0.296)	-0.074	(0.253)
	α_0	0.717*	(0.022)	0.843*	(0.038)	0.578*	(0.061)
	α_1	0.537*	(0.032)	0.591*	(0.050)	0.244*	(0.043)
	w_{10}	2.026*	(0.094)	3.393*	(0.827)	3.462*	(0.674)
Wage	w_{20}	0.081*	(0.019)	0.021	(0.022)	0.008	(0.008)
distribution:	w_{11}	0.892*	(0.163)	0.984*	(0.239)	1.166*	(0.454)
Weibull	w_{21}	0.259*	(0.107)	$0.213^{\diamond}$	(0.125)	0.122	(0.141)
	σ_0	0.189*	(0.016)	0.146*	(0.016)	0.123*	(0.020)
	σ_1	0.123*	(0.013)	0.150*	(0.017)	0.163*	(0.033)
	γ	76.12*	(13.55)	46.08*	(9.728)	6.972*	(2.119)
	N	683		349		146	
	$(\ln L)/N$	-6.925		-7.011		-8.116	
	ς	2.060*	(0.343)	1.585*	(0.308)	1.428*	(0.441)
	λ_0	-2.516*	(0.052)	-2.614*	(0.095)	-1.931*	(0.097)
	Unemployment rate	-0.218	(0.194)	-0.009	(0.290)	-0.080	(0.249)
	α_0	0.711*	(0.021)	0.841*	(0.038)	0.576*	(0.060)
	α_1	0.508*	(0.031)	0.573*	(0.049)	0.232*	(0.039)
	w_{10}	1.130*	(0.039)	1.019*	(0.060)	1.269*	(0.062)
Wage	w_{20}	0.339*	(0.017)	0.284*	(0.070)	0.307*	(0.073)
distribution:	w_{11}	1.132*	(0.215)	1.250*	(0.253)	1.534*	(0.335)
lognormal	w_{21}	1.056*	(0.143)	0.979*	(0.179)	0.849*	(0.232)
	σ_0	0.181*	(0.016)	0.144*	(0.016)	0.122*	(0.020)
	σ_1	0.124*	(0.013)	0.150*	(0.016)	0.162*	(0.033)
	γ	84.65*	(14.48)	54.53*	(10.99)	7.992*	(2.417)
	N	683		349		146	
	$(\ln L)/N$	-6.870		-6.977		-8.087	

Source: “Suivi des chômeurs” Survey, INSEE, 1986-1988.

Remarks: Estimated standard errors are in parentheses; estimates which are significant at the 5 (respectively, 10) percent level are indicated by * (respectively, by $^{\diamond}$).

Educational levels: level 1: no diploma, junior high school and non response; level 2: vocational and technical schools; level 3: high school, college or university.

TABLE 5

Parameter estimates for adult unemployed males

(between 26 and 50 years old, $\rho = 0.02$)

		Level 1		Level 2		Level 3		Level 4	
	ς	1.268*	(0.307)	1.492*	(0.218)	1.258*	(0.401)	0.040*	(0.009)
	$\ln\lambda_0$	-2.496*	(0.093)	-2.721*	(0.085)	-2.605*	(0.186)	-2.460*	(0.112)
	Unemployment rate	-0.328	(0.303)	-0.413	(0.280)	-0.803	(0.591)	0.134	(0.328)
	α_0	0.600*	(0.045)	0.826*	(0.033)	0.686*	(0.075)	0.656*	(0.046)
	α_1	0.419*	(0.049)	0.492*	(0.038)	0.343*	(0.065)	0.159*	(0.015)
	$\ln w_{10}$	1.237*	(0.119)	1.369*	(0.108)	0.761*	(0.219)	0.842*	(0.315)
Wage	$\ln w_{20}$	-5.522*	(0.868)	-6.611*	(0.843)	-3.807*	(1.255)	-6.636*	(2.047)
distribution :	$\ln w_{11}$	0.015	(0.314)	0.165	(0.269)	0.080	(0.509)	0.652	(0.421)
Weibull	$\ln w_{21}$	-2.256*	(0.942)	-2.677*	(0.885)	-2.401	(1.608)	-8.446*	(3.744)
	σ_0	0.134*	(0.018)	0.121*	(0.012)	0.105*	(0.026)	0.121*	(0.020)
	σ_1	0.104*	(0.017)	0.126*	(0.012)	0.083*	(0.017)	0.046*	(0.009)
	γ	110.51*	(27.92)	100.44*	(16.68)	71.64*	(21.35)	130.17*	(24.28)
	N	299		515		118		225	
	$(\ln L)/N$	-6.971		-6.861		-7.276		-8.059	
	ς	1.228*	(0.314)	1.451*	(0.212)	1.225*	(0.402)	0.047*	(0.010)
	$\ln\lambda_0$	-2.510*	(0.092)	-2.740*	(0.083)	-2.620*	(0.167)	-2.486*	(0.113)
	Unemployment rate	-0.307	(0.301)	-0.402	(0.278)	-0.764	(0.580)	-0.091	(0.333)
	α_0	0.595*	(0.045)	0.823*	(0.033)	0.681*	(0.072)	0.640*	(0.048)
	α_1	0.406*	(0.047)	0.474*	(0.034)	0.324*	(0.061)	0.160*	(0.014)
	w_{10}	1.459*	(0.051)	1.562*	(0.031)	1.614*	(0.112)	2.222*	(0.101)
Wage	w_{20}	0.273*	(0.029)	0.242*	(0.020)	0.356*	(0.045)	0.513*	(0.119)
distribution :	w_{11}	1.846*	(0.273)	1.955*	(0.179)	1.867*	(0.405)	4.014*	(0.285)
lognormal	w_{21}	0.872*	(0.210)	0.853*	(0.150)	0.917*	(0.309)	0.634*	(0.227)
	σ_0	0.129*	(0.018)	0.116*	(0.011)	0.100*	(0.025)	0.131*	(0.020)
	σ_1	0.105*	(0.017)	0.128*	(0.012)	0.081*	(0.018)	0.055*	(0.009)
	γ	121.09*	(31.42)	109.71*	(17.61)	78.81*	(22.65)	111.24*	(22.59)
	N	299		515		118		225	
	$(\ln L)/N$	-6.928		-6.818		-7.199		-8.091	

Source: “Suivi des chômeurs” Survey, INSEE, 1986-1988.

Remarks: Estimated standard errors are in parentheses; estimates which are significant at the 5 percent level, are indicated by *.

Skill levels: level 1: unskilled blue-collar workers; level 2: skilled blue-collar workers; level 3: white-collar workers; level 4: high-skilled workers.

TABLE 6

Parameter estimates for adult unemployed females

(between 26 and 50 years old, $\rho = 0.02$)

		Level 1		Level 2		Level 3		Level 4	
	ς	1.401*	(0.404)	1.831$^\diamond$	(1.046)	1.574*	(0.243)	1.107*	(0.035)
	$\ln \lambda_0$	-2.815*	(0.118)	-2.892*	(0.200)	-2.722*	(0.063)	-2.592*	(0.131)
	Unemployment rate	0.116	(0.429)	0.336	(0.697)	0.140	(0.172)	-0.557	(0.390)
	α_0	0.857*	(0.036)	0.900*	(0.047)	0.778*	(0.023)	0.789*	(0.059)
	α_1	0.601*	(0.079)	0.365*	(0.092)	0.374*	(0.029)	0.402*	(0.057)
	w_{10}	5.061*	(0.816)	6.362*	(1.501)	3.585*	(0.370)	3.100*	(0.567)
Wage	w_{20}	0.001	(0.001)	0.001	(0.001)	0.005$^\diamond$	(0.003)	0.006	(0.007)
distribution :	w_{11}	0.717*	(0.217)	0.801	(0.574)	0.913*	(0.201)	1.131*	(0.416)
Weibull	w_{21}	0.234	(0.190)	0.169	(0.298)	0.163$^\diamond$	(0.092)	0.084	(0.094)
	σ_0	0.182*	(0.022)	0.164*	(0.030)	0.128*	(0.011)	0.091*	(0.016)
	σ_1	0.141*	(0.027)	0.183*	(0.059)	0.132*	(0.013)	0.108*	(0.019)
	γ	317.90*	(147.4)	100.57$^\diamond$	(59.11)	68.24*	(11.25)	66.75*	(17.34)
	N	334		127		707		177	
	$(\ln L)/N$	-6.007		-6.387		-6.792		-7.165	
	ς	1.410*	(0.403)	1.795$^\diamond$	(0.964)	1.524*	(0.228)	0.916*	(0.252)
	$\ln \lambda_0$	-2.827*	(0.117)	-2.896*	(0.203)	-2.729*	(0.062)	-2.586*	(0.123)
	Unemployment rate	0.122	(0.428)	0.332	(0.701)	0.148	(0.172)	-0.582	(0.405)
	α_0	0.855*	(0.036)	0.899*	(0.047)	0.777*	(0.023)	0.790*	(0.058)
	α_1	0.591*	(0.078)	0.353*	(0.081)	0.358*	(0.025)	0.396*	(0.052)
	w_{10}	1.265*	(0.039)	1.366*	(0.058)	1.287*	(0.028)	1.505*	(0.072)
Wage	w_{20}	0.216*	(0.036)	0.191*	(0.050)	0.282*	(0.031)	0.338*	(0.052)
distribution :	w_{11}	1.506*	(0.536)	1.719*	(0.718)	1.603*	(0.206)	1.892*	(0.280)
lognormal	w_{21}	1.252*	(0.267)	1.204*	(0.520)	1.049*	(0.152)	0.946*	(0.220)
	σ_0	0.180*	(0.022)	0.161*	(0.029)	0.126*	(0.011)	0.087*	(0.016)
	σ_1	0.141*	(0.026)	0.188*	(0.061)	0.135*	(0.013)	0.110*	(0.018)
	γ	334.78*	(148.6)	107.12$^\diamond$	(61.21)	75.47*	(11.92)	82.71*	(20.54)
	N	334		127		707		177	
	$(\ln L)/N$	-5.992		-6.377		-6.771		-7.100	

Source: "Suivi des chômeurs" Survey, INSEE, 1986-1988.

Remarks: Estimated standard errors are in parentheses; estimates which are significant at the 5 (respectively, at the 10) percent level, are indicated by * (respectively, by $^\diamond$)..

Skill levels: level 1: unskilled blue-collar workers; level 2: skilled blue-collar workers; level 3: white-collar workers; level 4: high-skilled workers.

The mean and variance of fixed search costs, which are respectively equal to $\varsigma^{-1}$and ς^{-2}, are estimated to be increasing functions of the education level (for young workers),or the skill level (for adult workers). The slope parameter γ of the variable cost function $c_1(s)$ is estimated to be higher for adult unemployed workers and low-educated young women. This means that the search effort is more costly for these categories of workers.

Estimates of integrated hazard functions of unemployment durations are plotted in Figures 7 and 8. In each stratum, these estimates are obtained by generating 10,000 unemployment durations from the estimated structural model parameters. These estimates are plotted against the nonparametric maximum likelihood estimate (NPMLE) of the integrated hazard function of unemployment duration. This NPMLE is obtained by estimating a piecewise hazard model (without covariates) and by correcting for the stock sampling bias (see Brodaty, Crépon and Fougère, 2001, for the expression of the likelihood function in that case). Comparing the structural and nonparametric estimates of the integrated hazard function can be seen as a way to evaluate the fit of the structural model. Figures 7 and 8 show that for men, the structural models underestimate generally the integrated hazard function, while for women, they overestimate frequently this function. These differences may be explained by some nonstationary aspects which are not incorporated in our model. The best "fits" are obtained for highly-skilled adult men (see Figure 7) and low-educated young women (see Figure 8). However, the estimates obtained with the two structural models (with Weibull and lognormal distributions for wages) are very close. Thus it seems very difficult to choose between these two models on the basis of such estimates.

(Figures 7 and 8 around here)

Figure 9 shows that the distributions of wage offered along the private channel are generally more dispersed than the distributions of wages offered along the public search channel. The right-tail of the distribution F_1 of wages contacted by private search is thicker than the right tail of the distribution F_0 of wages found along the public channel. Thus, in most of the strata, we find that the public employment service leads less frequently to high-wage jobs. But a higher dispersion implies also that the left-tail of the distribution F_1 is thicker than the left tail of the distribution F_0. Private search leads also more frequently to low-wage jobs: this result may be due to some particular search channels, such as advertisement, that could be more frequently used by firms wanting to fill low-wage vacancies. Finally, it should be noticed that the distribution of wages contacted along the public channel has a high mode around the net monthly minimum wage level (approximately 3,800 French Francs for a full-time job in 1986).[19] Graphs

[19] This result is corroborated by the fact that, in the whole sample, 22 per cent of the jobs obtained through the public employment service are observed to be associated with a monthly net wage between 3,000 FF and 4,000 FF, while only 15 per cent of the jobs obtained by personal search methods are associated with monthly net wages belonging to this interval.

in Figure 9 show that the assumption of a Weibull distribution for wages implies that the density function of wages offered along the private channel decreases monotonically from zero, which is unlikely. This drawback disappears with the lognormal distribution, for which the estimated mode is between 1,000 and 2,000 FF (which corresponds more or less to a part-time job paid at the minimum wage level). We can also remark that for highly-skilled men, the c.d.f. of wages offered along the private channel dominates the c.d.f. of wages offered along the public channel. This means that, for these workers, the public employment service offers lower wages than the private channel.

(Figure 9 around here)

5.2. Estimates of search intensities, reservation wages and exit rates from unemployment

The estimated values of the threshold level $\underline{c_0}$ above which no private search is undertaken, of the proportion of unemployed workers using private search channel, of the average optimal search intensity s^*, of the average reservation wage ξ, of the average probability of accepting a wage offer (received either through the public or the private channel), and of the average exit rate from unemployment h are given in Table 7 for young unemployed workers, and in Table 8 for adult unemployed workers. These calculations have been made by using the estimates obtained under the assumption of a lognormal distribution for wages, and by considering two levels for the monthly UI benefit: a zero benefit and a benefit equal to the average positive benefit level observed in the sample (which is approximately equal to 2,000 French Francs). The mean search intensity, reservation wage and exit rate are obtained by generating 1,000 drawings of c_0 from the distribution $\exp(\widehat{\varsigma})$ for the model with exponentially distributed fixed search costs. At any given educational or skill level, the proportion of male unemployed workers who search actively is higher than the same proportion for women. This proportion increases with the educational or skill level, and it is higher for unemployed workers receiving no UI benefit. For unemployed individuals using private search, the value of the mean search intensity is higher than the job offer arrival rate through the public channel, especially for the high-skilled or high-educated workers. Consequently, the mean probability of contacting at least one job vacancy through the public channel during one month is low; it is comprised between 6 and 10 %, but slightly higher for men at any age (see Tables 7 and 8). This probability is higher with private search methods; in general, it is between 30% and 50% higher. It is even much higher (i.e. three times higher) for high-educated young women and high-skilled adult workers (see Tables 6 and 7).

TABLE 7

Estimates of average reservation wage, search intensity and exit rate (less than 26 years old, $\rho = 0.02$)

		Level 1		Level 2		Level 3	
		Men	Women	Men	Women	Men	Women
No UI benefit	Threshold of the fixed cost	1.028	0.808	1.423	1.228	-	1.427
	Proportion of active searchers	0.851	0.815	0.921	0.853	-	0.874
	Offer rate in the public channel	0.105	0.081	0.155	0.073	-	0.145
	Mean search intensity	0.156	0.076	0.187	0.117	-	0.340
	Probability of contacting at least one vacancy during the month:						
	- through the public channel	0.099	0.078	0.143	0.071	-	0.135
	- through the private channel	0.167	0.088	0.184	0.1129	-	0.322
	Mean reservation wage	1,234	1,000	1,633	1,172	-	1,793
	Probability of accepting a wage:						
	- offered through the public channel	0.997	0.999	0.999	0.996	-	0.982
	- offered through the private channel	0.882	0.846	0.944	0.858	-	0.860
	Mean exit rate	0.124	0.090	0.145	0.119	-	0.150
Mean UI benefit	Threshold of the fixed cost	0.659	0.452	0.766	0.704	-	0.908
	Proportion of active searchers	0.693	0.616	0.748	0.674	-	0.738
	Offer rate in the public channel	0.105	0.081	0.155	0.073	-	0.145
	Mean search intensity	0.104	0.044	0.116	0.073	-	0.235
	Probability of contacting at least one vacancy during the month:						
	- through the public channel	0.099	0.078	0.143	0.071	-	0.135
	- through the private channel	0.139	0.068	0.144	0.102	-	0.273
	Mean reservation wage	2,562	2,421	2,759	2,453	-	2,903
	Probability of accepting a wage:						
	- offered through the public channel	0.752	0.765	0.887	0.664	-	0.744
	- offered through the private channel	0.683	0.582	0.789	0.626	-	0.698
	Mean exit rate	0.083	0.058	0.101	0.067	-	0.100

Educational levels: level 1: no diploma, junior high school and non response; level 2: vocational and technical schools; level 3: high school, college or university. Wages are in 1986 French Francs.

TABLE 8

Estimates of average reservation wage, search intensity and exit rate
(between 26 and 50 years old, $\rho = 0.02$)

		Level 1		Level 2		Level 3		Level 4	
		Men	Women	Men	Women	Men	Women	Men	Women
No UI benefit	Threshold of the fixed cost	1.784	0.839	1.802	0.768	2.245	1.045	42.557	2.120
	Proportion of active searchers	0.892	0.698	0.931	0.750	0.939	0.807	0.871	0.864
	Offer rate in the public channel	0.081	0.059	0.065	0.055	0.073	0.065	0.083	0.075
	Mean search intensity	0.100	0.034	0.110	0.063	0.144	0.090	0.439	0.128
	Probability of contacting at least one vacancy during the month:								
	- through the public channel	0.078	0.057	0.063	0.054	0.070	0.063	0.080	0.073
	- through the private channel	0.106	0.047	0.111	0.079	0.142	0.106	0.395	0.138
	Mean reservation wage	1,742	987	2,051	1,117	2,375	1,312	13,322	2,320
	Probability of accepting a wage:								
	- through the public channel	0.998	0.999	0.999	1	0.977	0.999	0.354	0.966
	- through the private channel	0.899	0.870	0.921	0.900	0.857	0.887	0.972	0.857
	Mean exit rate	0.085	0.068	0.101	0.070	0.088	0.079	0.087	0.101
Mean UI benefit	Threshold of the fixed cost	1.292	0.619	1.300	0.588	1.625	0.730	40.626	1.608
	Proportion of active searchers	0.805	0.594	0.853	0.661	0.869	0.679	0.855	0.783
	Offer rate in the public channel	0.081	0.059	0.065	0.055	0.073	0.065	0.083	0.075
	Mean search intensity	0.079	0.025	0.087	0.048	0.116	0.064	0.422	0.103
	Probability of contacting at least one vacancy during the month:								
	- through the public channel	0.078	0.057	0.063	0.054	0.070	0.063	0.080	0.073
	- through the private channel	0.093	0.041	0.097	0.070	0.125	0.091	0.389	0.123
	Mean reservation wage	3,034	2,491	3,262	2,601	3,547	2,669	14,350	3,454
	Probability of accepting a wage:								
	- through the public channel	0.888	0.942	0.933	0.980	0.831	0.856	0.318	0.778
	- through the private channel	0.765	0.670	0.810	0.728	0.736	0.712	0.966	0.743
	Mean exit rate	0.067	0.058	0.083	0.061	0.069	0.059	0.082	0.077

Skill levels: level 1: unskilled blue-collar workers; level 2: skilled blue-collar workers; level 3: white-collar workers; level 4: high-skilled workers. Wages are in 1986 French Francs.

At any given educational or skill level, women have lower mean reservation wages than men, and their mean optimal search intensity (when they search) is also lower. The mean reservation wage increases with the UI benefit level, but also with the educational or skill level. The average probability of accepting a wage offer contacted by the public employment service is often close to one for unemployed workers receiving no UI benefits, and slightly lower for unemployed workers receiving UI benefits. The average probability of accepting a wage offer contacted through the private search channel is generally lower, due to the fact that the left-tail of the distribution F_1 of wage offers contacted through the private search channel is thicker than the left tail of the distribution F_0 of wage offers contacted through the public employment service. The exit rate from unemployment increases with the educational and skill levels; it is generally much higher for men and for young workers. One exception is the group of highly-skilled adult men whose mean exit rate is relatively low when they are not qualified to UI benefit. These workers have a very low probability to accept wage offers contacted by the public employment service, while their probability of accepting a wage offer contacted through the private search channel is high. This means that the public employment service is doing a relatively poor job for highly-skilled adult male workers. Because the optimal search intensity s^* and the reservation wage ξ respectively decreases and increases with the UI benefit level, the mean exit rate from unemployment h is higher for unemployed workers who are not qualified to receive UI benefits.

Figures 10, 11 and 12 represent the mean search intensity, the mean reservation wage, and the mean exit rate from unemployment as functions of the exogenous contact rate λ_0 for six strata. To produce graphs in these figures, we have calculated the search intensity and the reservation wage for each of 1,000 drawings of c_0 from the distribution $\exp(\widehat{\varsigma})$. Then we have calculated their averages and the average exit rate at each value of the parameter λ_0. Values of λ_0 vary on a grid between 0.02 and 0.24. These figures show that the average exit rate from unemployment is an increasing function of the arrival rate of job offers through the state employment agency. This result has an important consequence for public policy: it means that increasing the intensity of contacts obtained by the state employment agency may notably reduce the mean duration of unemployment spells.

(Figures 10, 11 and 12 around here)

To illustrate this last result, we have calculated the average relative variation of the transition rate from unemployment to employment due to an increase of 10% of the estimated public contact rate for our different strata. Results of this exercise are given below in Table 9. Standard errors of these estimated relative variations (in percentage) have been calculated by drawing 500 parameter vectors from a multivariate normal distribution with mean equal to the estimated parameter vector and variance-covariance matrix equal to the estimated variance-covariance matrix of the estimated parameter vector. For each drawing, we calculate as previously the mean search intensity, reservation wage and exit rate under the assumption of a lognormal wage distribution and by generating 1,000 drawings of c_0 from the distribution $\exp(\widehat{\varsigma})$ for the model with exponentially distributed fixed search costs. The relative variation of the transition rate is calculated by averaging the 500 exit rates provided by this procedure. Table 9 reports the empirical means and standard errors of these 500 estimated values. The average relative variation of the transition rate due to a 10% increase of the public contact rate is generally very precisely estimated. It ranges from 2 per cent (for adult high-skilled male workers) to 7 per cent (for adult unskilled blue-collar female workers). Its estimated value is more frequently comprised between 5 and 6 per cent, which is relatively high. It is higher for women, for low-educated or unskilled persons, and for unemployed workers eligible to UI (see Table 9).

TABLE 9

Average relative variation (in percentage) of the transition rate from unemployment to employment due to a 10% increase of the estimated public contact rate ($\rho = 0.02$)

			Educational or skill level			
			Level 1	Level 2	Level 3	Level 4
Less than 25 years old	Men	Mean UI	6.112 (0.316)	5.161 (0.423)	-	-
		No UI	5.821 (0.305)	3.889 (0.490)	-	-
	Women	Mean UI	6.757 (0.258)	5.279 (0.544)	4.630 (0.711)	-
		No UI	5.787 (0.265)	4.496 (0.420)	4.291 (0.775)	-
Between 26 and 50 years old	Men	Mean UI	5.565 (0.476)	5.250 (0.322)	4.631 (0.826)	1.976 (0.457)
		No UI	5.181 (0.510)	4.651 (0.389)	4.445 (0.850)	2.078 (0.489)
	Women	Mean UI	7.469 (0.982)	6.556 (2.195)	6.388 (0.285)	4.680 (0.617)
		No UI	6.955 (0.920)	6.234 (2.000)	5.954 (0.293)	4.698 (0.677)

Educational levels: level 1: no diploma, junior high school and non response;
level 2: vocational and technical schools; level 3: high school, college and above.
Skill levels: level 1: unskilled blue-collar workers; level 2: skilled blue-collar workers; level 3: white-collar workers; level 4: high-skilled workers.
Remark: estimated standard errors are in parentheses.

6. Conclusion

In a partial equilibrium search model in which the arrival rate of job offers through the public employment service is exogenous but the personal search intensity is endogenous, the effect of a variation of the exogenous arrival rate has an ambiguous effect on the exit rate from unemployment. Our paper has proved that estimating such a structural model with individual data on search activities of unemployed people helps to remove this ambiguity : an increase in the rate of contacts obtained through the public employment service channel is estimated to increase the exit rate from unemployment, especially for low-educated and unskilled workers. This result is obtained in spite of a decrease of the optimal search intensity and of an increase in the reservation wage. Estimates also show that the search effort is more costly for low-educated young women and low-skilled adult unemployed workers. This last result suggests that a public employment agency that matches searchers and employers is beneficial, in the sense that it saves searchers in terms of search costs they would otherwise bear. These conclusions are in line with the conclusions of studies that use data coming from social experiments on job-search assistance programs, in particular those surveyed by Meyer (1995) or those obtained by van den Berg and van der Klaauw (2001).

Moreover, our estimates show that the job arrival rate along the public channel is lower for low-educated young workers and low-skilled unemployed adults. However, the probability of transformation of a contact into a hiring proposal is higher for job contacts obtained through the public employment service. High transformation rates through the public channel may be due to the previous selection that case-workers of the public employment service do among the pool of unemployed workers before initiating a contact with a job vacancy. At the opposite, low transformation rates through the private channel may be due to higher competition among workers applying for posted vacancies. The average duration of jobs found along the public channel is found to be lower only in the case of low-educated (below 26 years old) and low-skilled (above 26 years old) unemployed workers. In other subgroups, the average duration of jobs found along the public channel is either similar or even higher than the average duration of jobs found along the private channel. The distributions of wage offered along the private channel are generally more dispersed than the distributions of wages offered along the public search channel.

At all education and skill levels, the proportion of male unemployed workers who search actively is higher than the same proportion for women. Women have lower mean reservation wages than men, and their mean optimal search intensity (when they search) is also lower. The mean reservation wage increases with the UI benefit level, but also with the educational or skill level. The average probability of accepting a wage offer contacted by the public employment service is often close to one for unemployed workers receiving no UI benefits, and slightly lower for unemployed workers receiving UI benefits. The average probability of accepting a wage offer contacted through the private search channel is generally lower, due to the fact that the left-tail of the distribution of wage offers contacted through the private search channel is thicker than the left tail of the distribution of wage offers contacted through the public employment service. The exit rate from unemployment increases with the educational and skill levels; it is generally much higher for men and for young workers.

Finally, let us insist on two limitations of our approach:

1. we have noticed that for men, our model underestimates generally the integrated hazard function of unemployment spell durations, while for women, they overestimate frequently this function. These differences may be explained by some nonstationary aspects which are not incorporated in our model (such as exhaustion of UI benefit entitlement, or decreasing arrival rates of job offers);

2. our model is probably too partial, since it does not explicitly take into account the use of the different search channels by employers. Indeed, for some categories of workers, it is likely that employers use the personal search channels more frequently, while for others, they use mainly the state employment agency.

Further research should be devoted to build and to estimate search models that incorporate these two features.

REFERENCES

ADDISON, J.T. and PORTUGAL P. (2002), "Job Search Method and Outcomes", *Oxford Economic Papers, 54,* 505-533.

ASHENFELTER, O., ASHMORE and DESCHENES (2005), "Do Unemployment Insurance Recipients Actively Seek Work? Randomized Trials in Four U.S. States", *Journal of Econometrics*, 125, 53-76.

BARRON, J. M. and GILLEY, O. (1981), "Job Search and Vacancy Contacts: A Note", *American Economic Review,* 71, 747-52.

BARRON, J. M. and MELLOW, W. (1979), "Search Effort in the Labor Market", *Journal of Human Resources,* 14, 389-404.

BENHABIB, J. and BULL, C. (1983), "Job Search: The Choice of Intensity", *Journal of Political Economy,* 91, 747-64.

BLAU, D. M. and ROBINS, P. K. (1990), "Job Search Outcomes for the Employed and Unemployed", *Journal of Political Economy,* 98, 637-655.

BLOEMEN, H. G. (2005), "Job Search, Search Intensity and Labour Market Transitions: An Empirical Exercice", *The Journal of Human Resources,* 231-269.

BONNAL, L., FOUGERE, D. and SERANDON, A. (1997), "Evaluating the Impact of French Employment Policies on Individual Labour Market Histories", *Review of Economic Studies,* 64, 683-713.

BRODATY, T., CREPON, B., and FOUGERE, D. (2001), "Using Kernel Matching Estimators to Evaluate Alternative Youth Employment Programs: Evidence from France, 1986-1988", in M. Lechner and F. Pfeiffer, *Econometric Evaluation of Labour Market Policies*, (Heidelberg: Physica Verlag), 85-123.

BURDETT, K. (1979), "Search, Leisure and Individual Labor Supply", in S. J. Lippman and J. J. McCall (ed.), *Studies in the Economics of Search* (Amsterdam: North Holland).

BURDETT, K. and MORTENSEN, D. T. (1978), "Labor Supply under Uncertainty", in R. Ehrenberg (ed.), *Research in Labor Economics,* vol. 2 (London: JAI Press).

BURDETT, K. and ONDRICH, J. I. (1985), "How Changes in Labor Demand Affect Unemployed Workers", *Journal of Labor Economics,* 3, 1-10.

FLINN, C. J. and HECKMAN, J. J. (1982), "New Methods for Analysing Structural Models of Labor Force Dynamics", *Journal of Econometrics,* 18, 115-68.

FLINN, C. J. and HECKMAN, J. J. (1983), "Are Unemployed and Out of the Labor Force Behaviorally Distinct Labor Force States?", *Journal of Labor Economics*, 1, 28-42.

FOUGERE, D., KRAMARZ, F. and MAGNAC T. (2000), "Youth Employment Policies in France", *European Economic Review,* 44, 928-942.

GAL, S., LANDSBERGER, M. and LEVYKSON, B. (1981), "A Compound Strategy for Search in the Labor Market", *International Economic Review,* 22, 597-608.

GOURIEROUX, C. and MONFORT, A. (1997), *Simulation-Based Econometric Methods* (Oxford: Oxford University Press).

GREGG, P. and WADSWORTH, J. (1996), "How Effective are State Employment Agencies? Jobcentre Use and Job Matching in Britain", *Oxford Bulletin of Economics and Statistics,* 58, 443-67.

HANEMANN, M. W. (1984), "Discrete-Continuous Models of Consumer Demand", *Econometrica,* 52, 541-61.

HOLZER, H. J. (1987), "Job Search by Employed and Unemployed Youth", *Industrial and Labor Relations Review,* 40, 601-11.

HOLZER, H. J. (1988), "Search Method Use by Unemployed Youth", *Journal of Labor Economics,* 6, 1-20.

KONING, P., VAN DEN BERG, G. AND G. RIDDER (1997), "A Structural Analysis of Job Search Methods and Subsequent Wages" (Mimeo, Tinbergen Institutre, Amsterdam).

LANCASTER, T. (1990), *The Econometric Analysis of Transition Data.* (Cambridge: Cambridge University Press).

LANCASTER, T. and CHESHER, A. (1983), "An Econometric Analysis of Reservation Wages", *Econometrica,* 51, 1661-76.

LINDEBOOM, M., VAN OURS J. AND G. RENES (1994), "Matching Employers and Workers: An Empirical Analysis on the Effectiveness of Search", *Oxford Economic Papers*, 46, 45-67.

MEYER, B. (1995), "Lessons from the U.S. Unemployment Insurance Experiments", *Journal of Economic Literature*, 33, 91-131.

MORGAN, P. (1983), “Search and Optimal Sample Sizes”, *Review of Economic Studies,* 50, 659-75.

MORTENSEN, D. T. (1986), “Job Search and Labor Market Analysis”, in O. Ashenfelter and R. Layard (ed.), *Handbook of Labor Economics,* vol. 2 (Amsterdam: North Holland).

MORTENSEN, D. T., AND T. VISHWANATH (1994), “Personal Contacts and Earnings”, *Labour Economics*, 1, 187-201

OSBERG, L. (1993), “Fishing in Different Pools: Job Search Strategies and Job Finding Success in Canada in the Early 1980s”, *Journal of Labor Economics,* 11, 348-86.

RIDDER, G. (1984), “The Distribution of Single-Spell Duration Data”, in G. R. Neumann and N. Westergard-Nielsen (eds.), *Studies in Labor Market Analysis*, (Berlin: Springer-Verlag).

SHIMER, R. (2004), “Search Intensity”, Working Paper, University of Chicago.

STERN, S. (1989), “Estimating a Simultaneous Search Model”, *Journal of Labor Economics,* 7, 348-69.

VAN DEN BERG, G. (1990), “Nonstationarity in Job Search Theory”, *Review of Economic Studies,* 57, 255-77.

VAN DEN BERG, G. (1990), “Search Behaviour, Transitions to Nonparticipation and the Duration of Unemployment”, *Economic Journal,* 100, 842-65.

VAN DEN BERG, G. (1994), “The Effects of Changes of the Job Offer Arrival Rate on the Duration of Unemployment”, *Journal of Labor Economics,* 12, 478-98.

VAN DEN BERG, G., and VAN DER KLAAUW, B. (2001), “Counseling and Monitoring of Unemployed Workers: Theory and Evidence from a Controlled Social Experiment”, *IZA Discussion Paper* No. 374, forthcoming in *International Economic Review.*

VAN DER KLAAUW, B., VAN VUUREN, A., and BERKHOUT, P. (2004), “Labor Markets Prospects, Search Intensity and the Transition from College to Work”, *IZA Discussion Paper* No. 1176.

WOLPIN, K. I. (1987), “Estimating a Structural Search Model: The Transition from School to Work”, *Econometrica,* 55, 801-18.

WOLPIN, K. I. (1992), "The Determinants of Black-White Differences in Early Employment Careers: Search, Layoffs, Quits and Endogenous Wage Growth", *Journal of Political Economy,* 100, 535-60., "

YOON, B. J. (1981), "A Model of Unemployment Duration with Variable Search Intensity", *The Review of Economics and Statistics*, 63, 599-609.

APPENDIX A

By setting

$$J_1 = \xi_1 - b + c(s) - \frac{\alpha_0\lambda_0}{\rho+\sigma_0}\int_{\xi_1}^{\infty}(x-\xi_1)\,dF_0(x) - s\,c_1'(s)$$

and

$$J_2 = c_1'(s) - \frac{\alpha_1}{\rho+\sigma_1}\int_{\xi_1}^{\infty}(x-\xi_1)\,dF_1(x)$$

we get

$$\frac{\partial J_1}{\partial s} = -s\,c_1''(s), \quad \frac{\partial J_1}{\partial \xi_1} = 1 + \frac{\alpha_0\lambda_0}{\rho+\sigma_0}\left[1-F_0(\xi_1)\right],$$

$$\frac{\partial J_1}{\partial \lambda_0} = -\frac{\alpha_0}{\rho+\sigma_0}\int_{\xi_1}^{\infty}(x-\xi_1)\,dF_0(x),$$

and

$$\frac{\partial J_2}{\partial s} = c_1''(s), \quad \frac{\partial J_2}{\partial \xi_1} = \frac{\alpha_1}{\rho+\sigma_1}\left[1-F_1(\xi_1)\right], \quad \frac{\partial J_2}{\partial \lambda_0} = 0.$$

The implicit function theorem implies that

$$\begin{pmatrix} \dfrac{\partial s}{\partial \lambda_0} \\ \\ \dfrac{\partial \xi_1}{\partial \lambda_0} \end{pmatrix} = -\begin{bmatrix} \dfrac{\partial J_1}{\partial s} & \dfrac{\partial J_1}{\partial \xi_1} \\ \\ \dfrac{\partial J_2}{\partial s} & \dfrac{\partial J_2}{\partial \xi_1} \end{bmatrix}^{-1} \times \begin{pmatrix} \dfrac{\partial J_1}{\partial \lambda_0} \\ \\ \dfrac{\partial J_2}{\partial \lambda_0} \end{pmatrix}$$

which gives

$$\frac{\partial s}{\partial \lambda_0} = \frac{1}{\Delta}\frac{\alpha_0\alpha_1}{(\rho+\sigma_0)(\rho+\sigma_1)}\left[1-F_1(\xi_1)\right]H_0(\xi_1) \tag{A-1}$$

and

$$\frac{\partial \xi_1}{\partial \lambda_0} = -\frac{1}{\Delta}\frac{\alpha_0}{\rho+\sigma_0}c_1''(s)H_0(\xi_1) \tag{A-2}$$

where

$$\Delta = -c_1''(s)\left\{1 + \frac{\alpha_0\lambda_0}{\rho+\sigma_0}\left[1-F_0(\xi_1)\right] + \frac{\alpha_1\ s}{\rho+\sigma_1}\left[1-F_1(\xi_1)\right]\right\}$$

Inspection of these three last formulas shows that, if $c_1''(s) > 0\ \forall s$,

$$\frac{\partial s}{\partial \lambda_0} < 0 \text{ and } \frac{\partial \xi_1}{\partial \lambda_0} > 0.$$

It is also easy to verify that $ds\,/\,db < 0$ if and only if $c_1''(s) > 0, \forall s$. This last result is in line with the reduced-form results obtained by Barron and Mellow [1981] who found that UI benefits have a negative impact on the search intensity.[20]

APPENDIX B

To correct for the stock sampling bias, we have to derive the joint stock sample density of unemployment duration and fixed search costs. For that purpose, let us denote $g(c_0)$ the density function of the fixed search cost and $\psi(t_u \mid c_0)$ the conditional density function of the unemployment duration given the value of the fixed search cost. The latter may be derived from the expressions (2.15) and (2.16) of the theoretical hazard functions as

$$\psi(t_u \mid c_0) = h_1 \exp(-h_1 t_u) \quad \text{if } c_0 < \underline{c}_0 \text{ (i.e. } D = 1\text{)},$$

and

$$\psi(t_u \mid c_0) = h_0 \exp(-h_0 t_u) \quad \text{if } c_0 > \underline{c}_0 \text{ (i.e. } D = 0\text{)}.$$

Hence, the joint flow density of the unemployment duration and the fixed search cost is $\psi(t_u \mid c_0)\, g(c_0)$ for $0 < t_u < \infty$ and $0 < c_0 < \infty$. Now let us denote $q(\tau - t_0)$ the inflow rate into unemployment at the date $(\tau - t_0)$, τ being the sampling date (August 1986). In this last expression, t_0 represents the elapsed sojourn duration in unemployment for an individual sampled in the stock of unemployed at date τ. To simplify, we assume that the inflow rate is independent of the fixed search cost. In our framework, the conditional survivor function of the unemployment duration at t_0 is equal to

$$\Psi(t_0 \mid c_0) = \Pr(T_u > t_0 \mid c_0) = [\exp(-h_1 t_0)]^D\,[\exp(-h_0 t_0)]^{1-D}$$

The probability that an individual is in the stock of unemployed people at τ equals

$$P_s = \int_0^\infty \int_0^\infty q(\tau - t_0)\ \Psi(t_0 \mid c_0)\ g(c_0)\ dt_0\ dc_0$$

Then the joint stock density function of the unemployment spell duration, the elapsed sojourn time in unemployment and the fixed search cost is

$$\varphi(t_u, t_0, c_0) = \frac{q(\tau - t_0)\ \psi(t_u \mid c_0)\ g(c_0)}{P_s}$$

$$\text{for } 0 < t_0 < \infty,\ t_0 < t_u < \infty \text{ and } 0 < c_0 < \infty$$

[20] However, with separate regressions for benefit recipients and nonrecipients, Barron and Gilley [1981] found that benefits have no significant impact on the search intensity.

Consequently, the conditional stock density function of the unemployment spell duration and the fixed search cost given the elapsed sojourn time in unemployment is

$$\varphi\left(t_u, c_0 \mid t_0\right) = \frac{\varphi\left(t_u, t_0, c_0\right)}{\varphi\left(t_0\right)}$$

where

$$\begin{aligned}
\varphi\left(t_0\right) &= \varphi\left(t_0, t_0, 0\right) = \int_{t_0}^{\infty} \int_0^{\infty} \varphi\left(t_u, t_0, c_0\right) \; dt_u dc_0 \\
&= \frac{q\left(\tau - t_0\right) \displaystyle\int_{t_0}^{\infty} \int_0^{\infty} \psi\left(t_u \mid c_0\right) \; g\left(c_0\right) \; dt_u dc_0}{P_s} \\
&= \frac{q\left(\tau - t_0\right) \displaystyle\int_0^{\infty} \Psi\left(t_0 \mid c_0\right) \; g\left(c_0\right) \; dc_0}{P_s}
\end{aligned}$$

Thus

$$\varphi\left(t_u, c_0 \mid t_0\right) = \frac{\psi\left(t_u \mid c_0\right) \; g\left(c_0\right)}{\displaystyle\int_0^{\infty} \Psi\left(t \mid c\right) \; g\left(c\right) \; dc}$$

Then the individual likelihood contribution has to be written as the conditional density of the endogenous variables given the elapsed sojourn time t_0 in unemployment, which is observed for each sampled unemployed individual. Because in a stationary search model the distributions of accepted wages F_j, of employment spell durations T_j, of the numbers of job contacts M_j and of the number of hiring proposals E, are independent of the elapsed unemployment duration, the individual likelihood contribution is similar to expressions (4.1) and (4.2), except for terms $L_{1,j}$ $(j = 0, 1)$ which are now equal to

$$\begin{aligned}
L_{1,j}^{(s)} &= \frac{L_{1,j}}{\displaystyle\int_0^{\infty} \Psi\left(t \mid c\right) \; g\left(c\right) \; dc} \\
&= \frac{L_{1,j}}{\displaystyle\int_0^{\underline{c}_0} \exp\left(-h_1 T_0\right) \; dG(c_0) + \int_{\underline{c}_0}^{\infty} \exp\left(-h_0 T_0\right) \; dG(c_0)} \\
&= \frac{L_{1,j}}{G(\underline{c}_0) \, E_G \left[\exp\left(-h_1 T_0\right) \mid c_0 < \underline{c}_0\right] + \exp\left(-h_0 T_0\right) \; \left[1 - G(\underline{c}_0)\right]} \quad \text{for } j = 0, 1
\end{aligned}$$

Figure 1: Histogram of the duration of the first observed unemployment spell

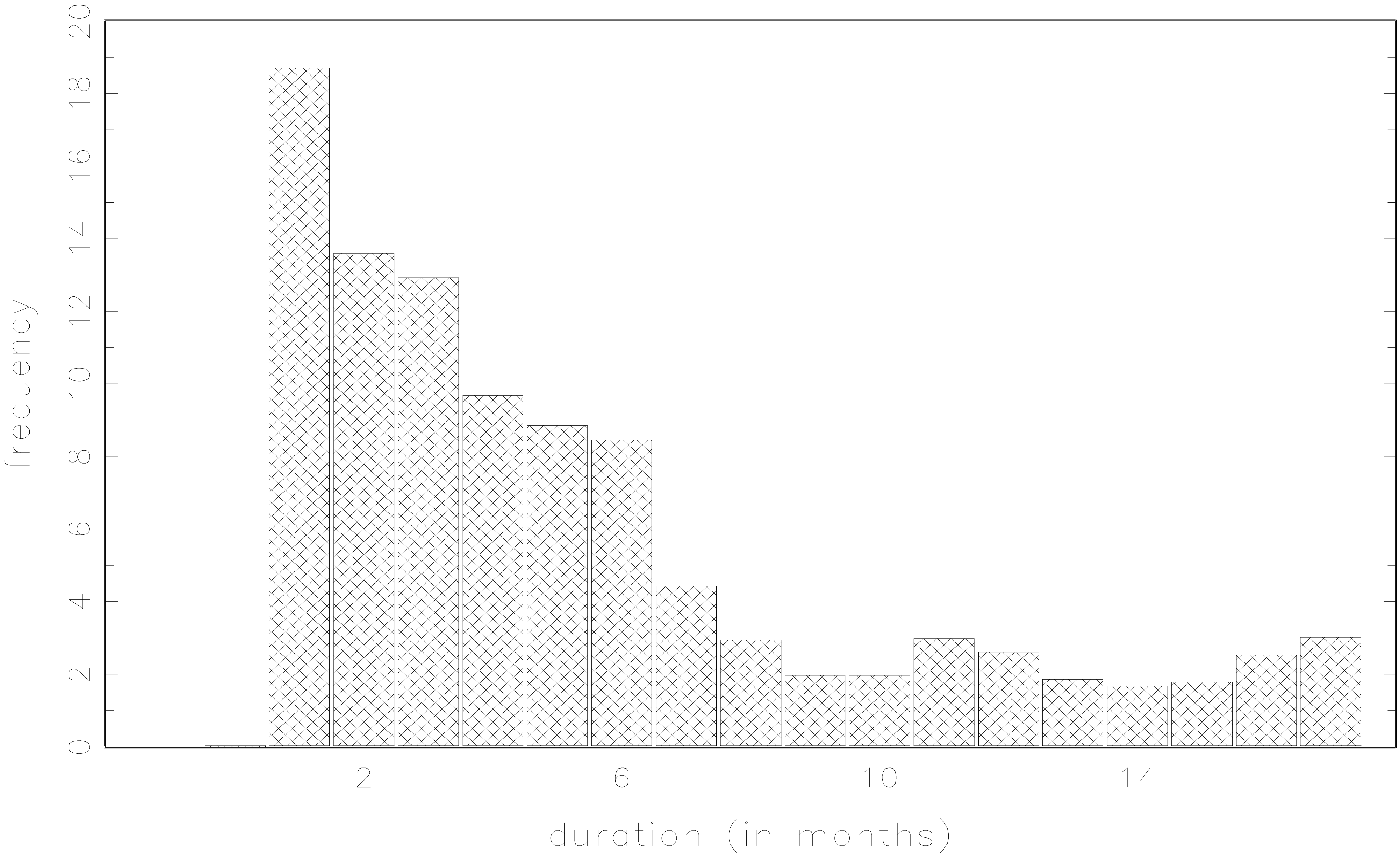


Figure 2: Histogram of the duration
of the first observed unemployment spell

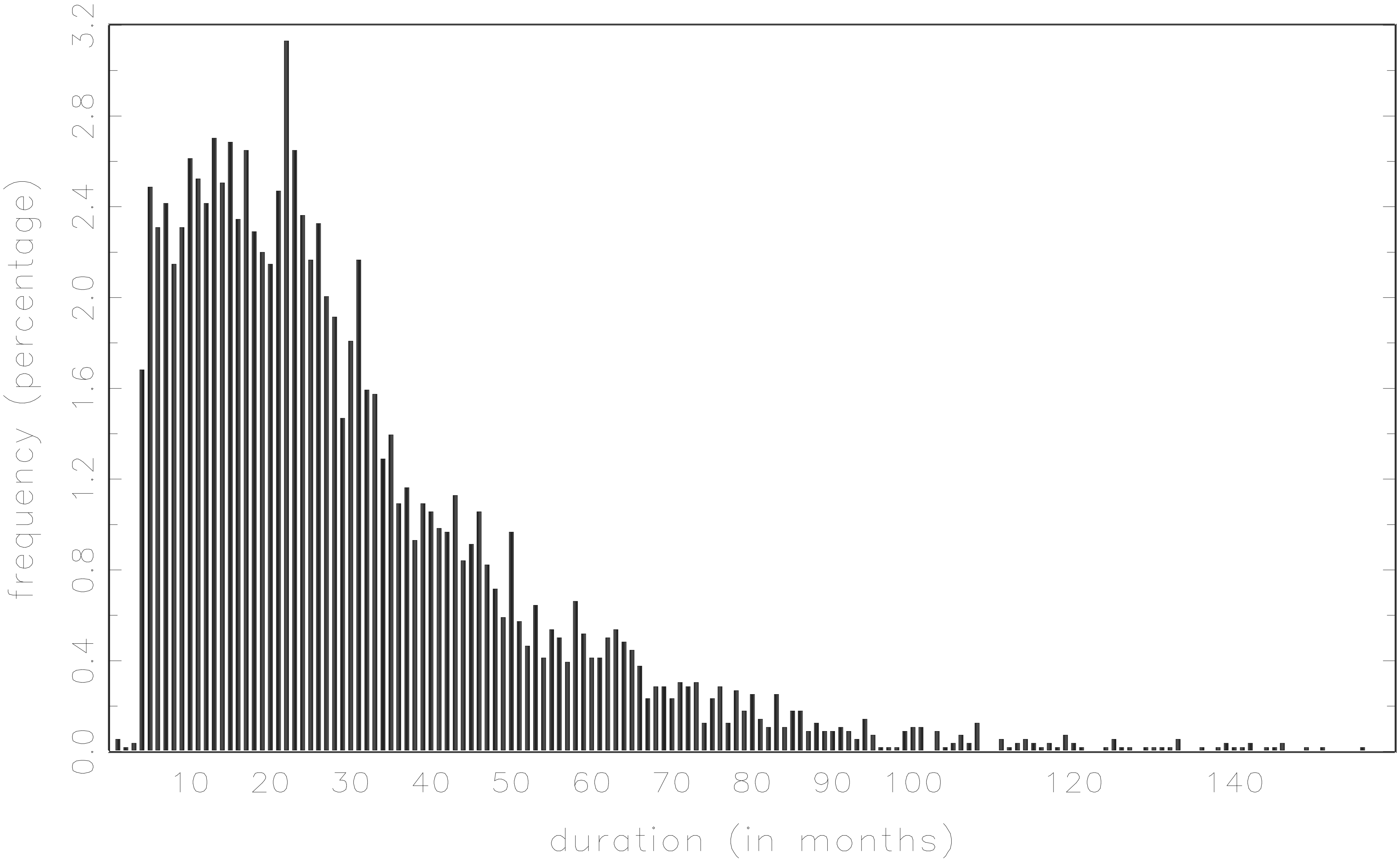


Figure 3: Histogram of the monthly net wage in the first observed employment spell

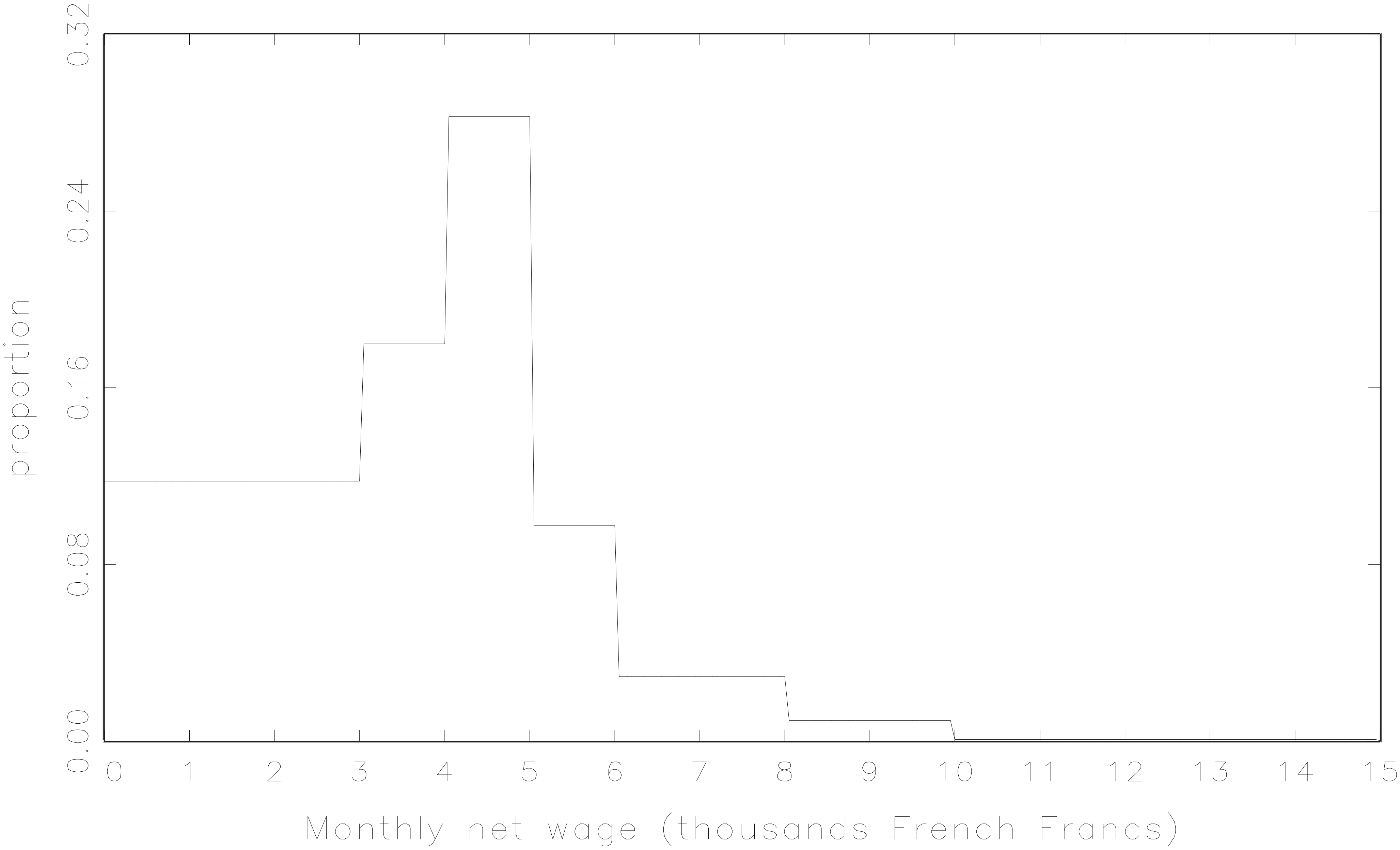


Figure 4: Kernel estimate of the density function of the monthly sample UI benefits

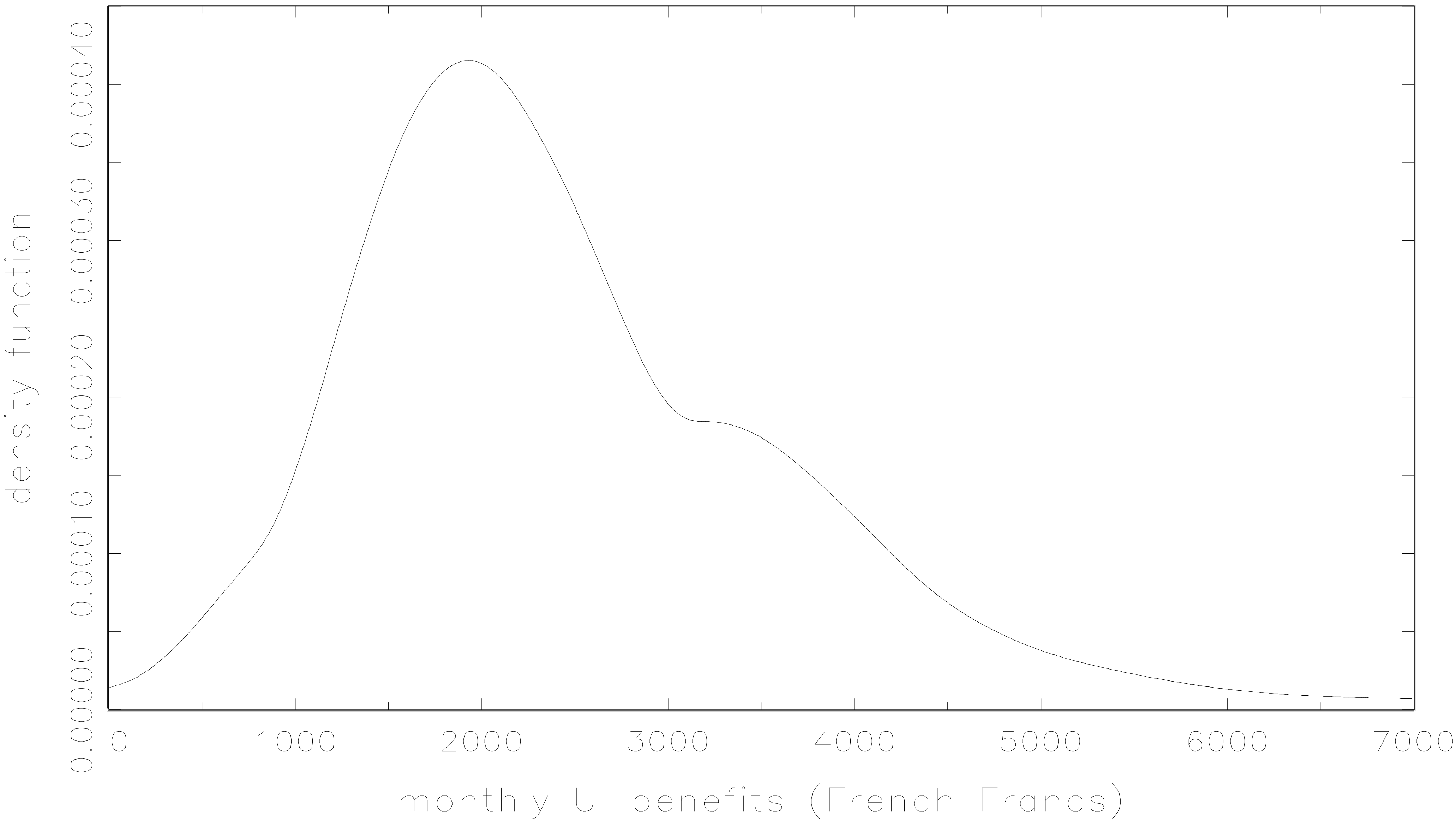


Figure 5: Proportions of unemployed persons actively searching in nov. 1986

Elapsed time: (1) 0–3 months (2) 3–6 (3) 6–9 (4) 9–12 (5) 12–18 (6) 18–24 (7) more than 24

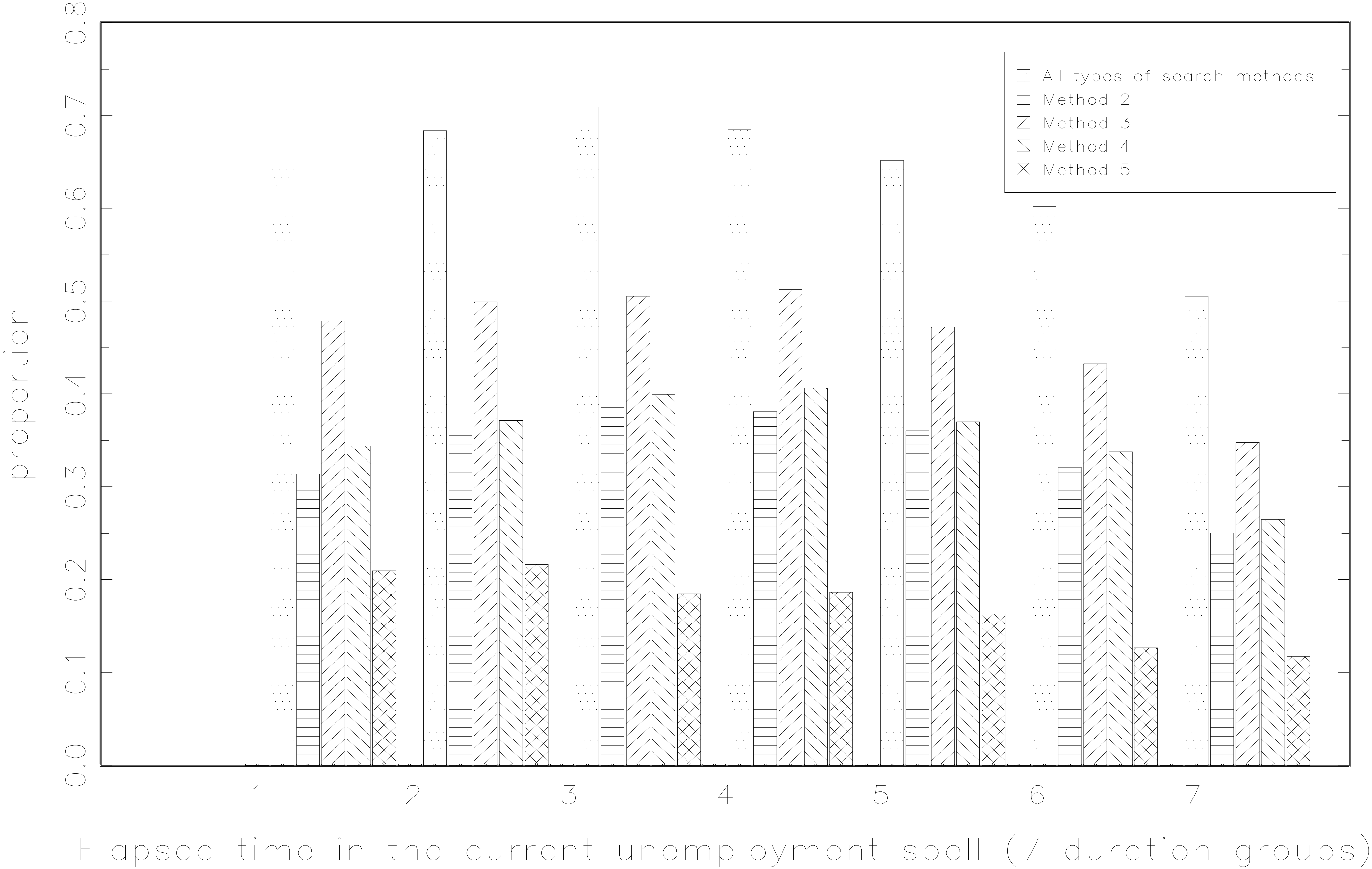


Figure 6: Changes in the proportions of unemployed workers actively searching

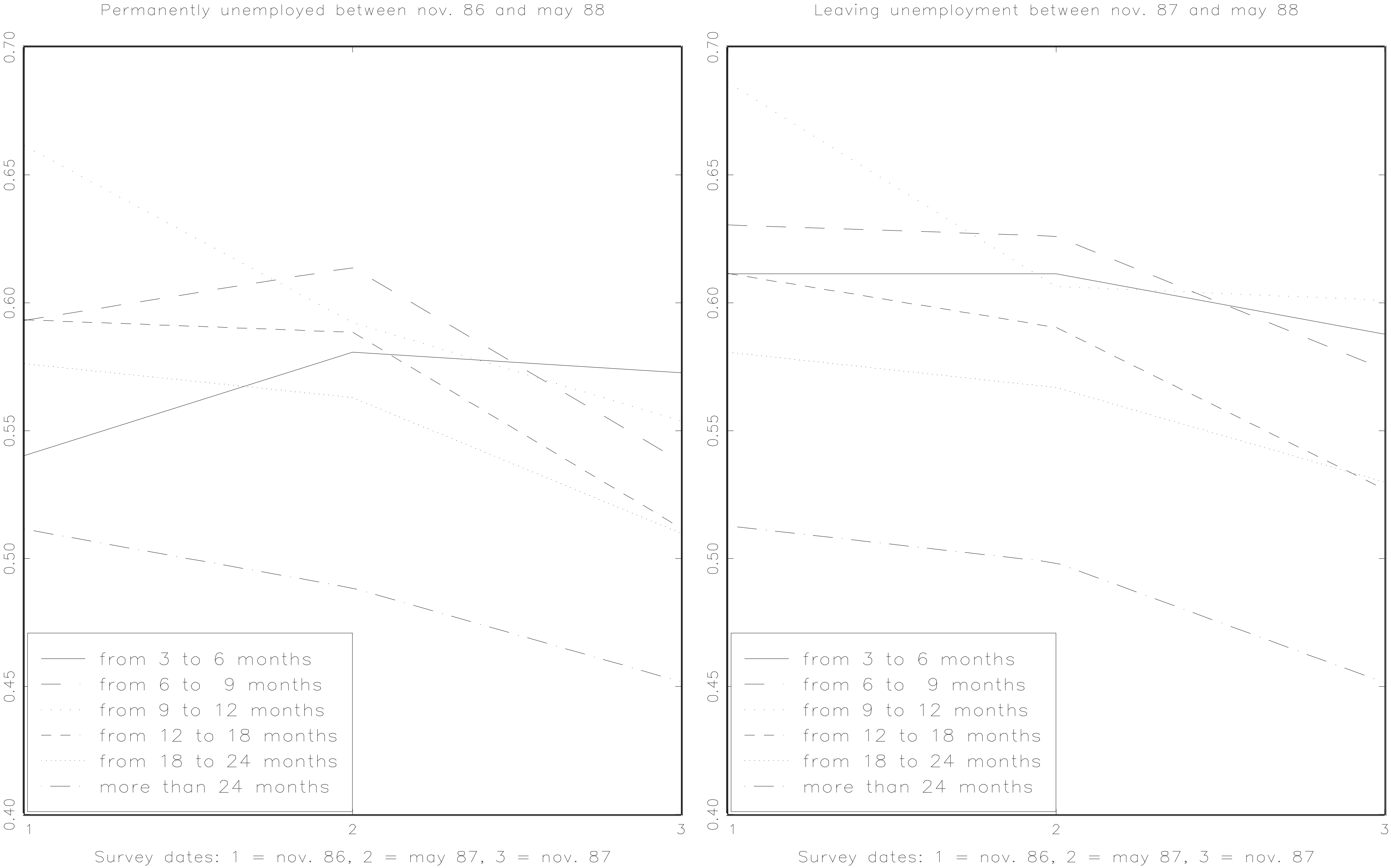
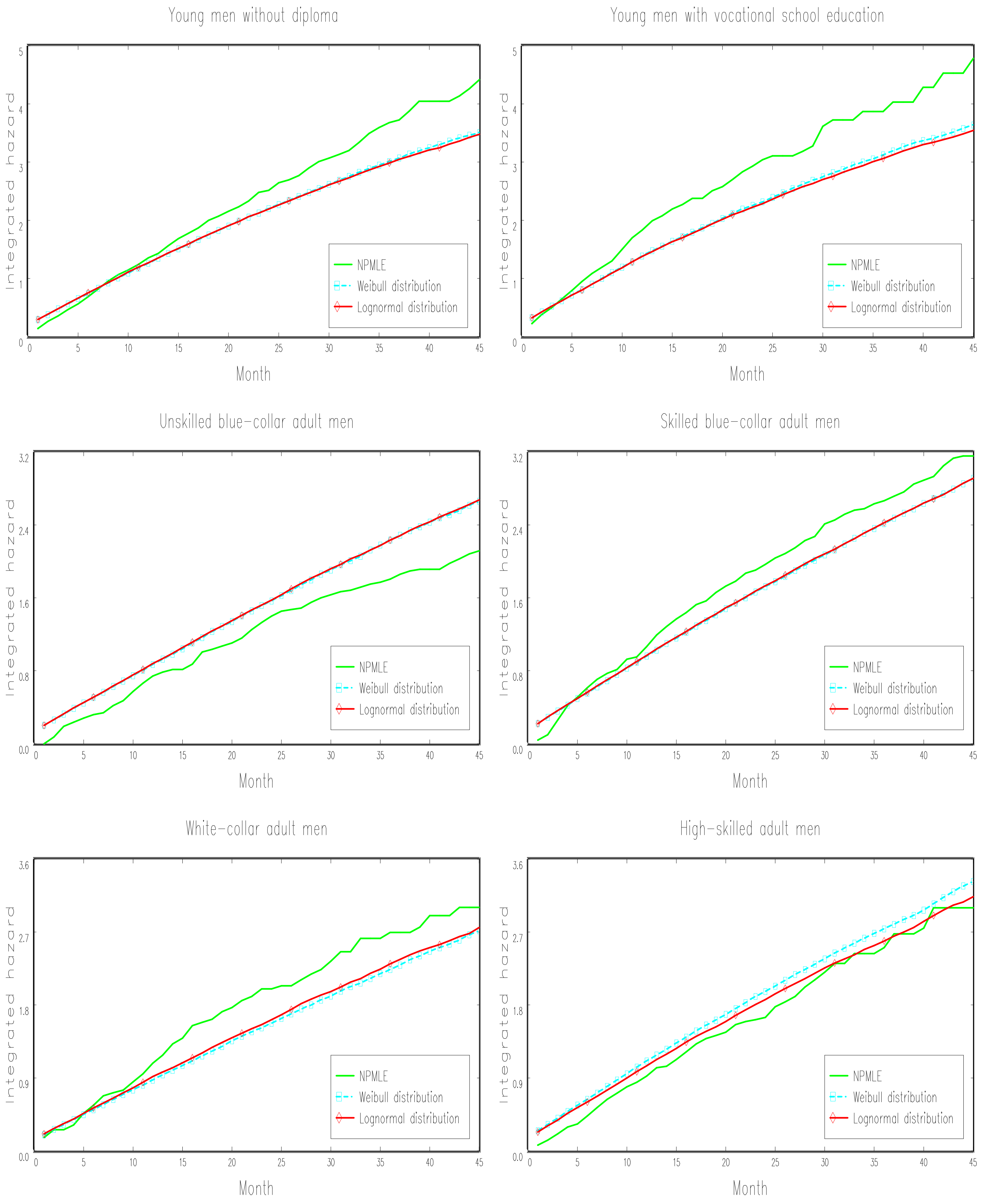


Figure 7: Estimates of the integrated hazard function (men)



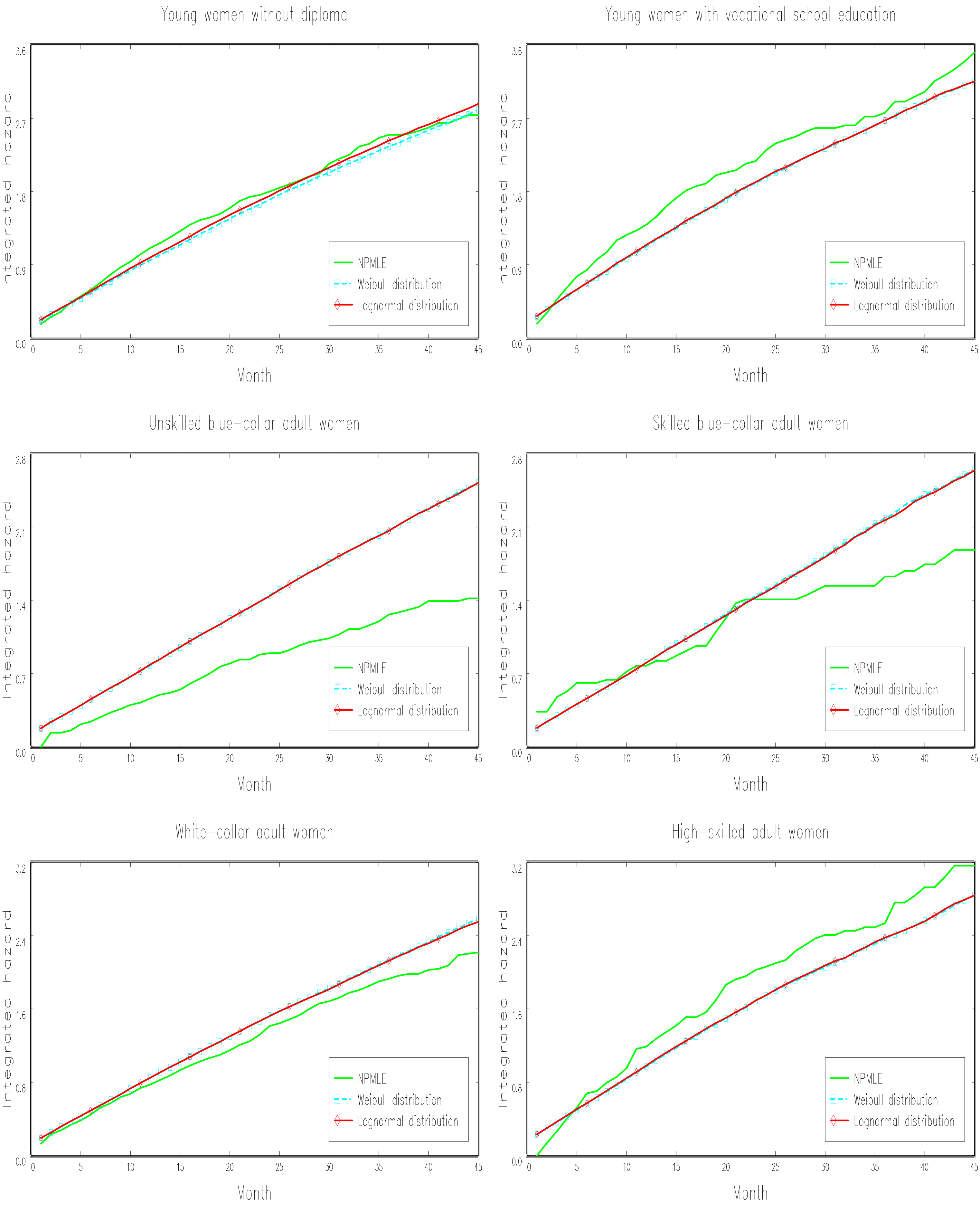


Figure 8: Estimates of the integrated hazard function (women)

Figure 9: Estimated wage distributions

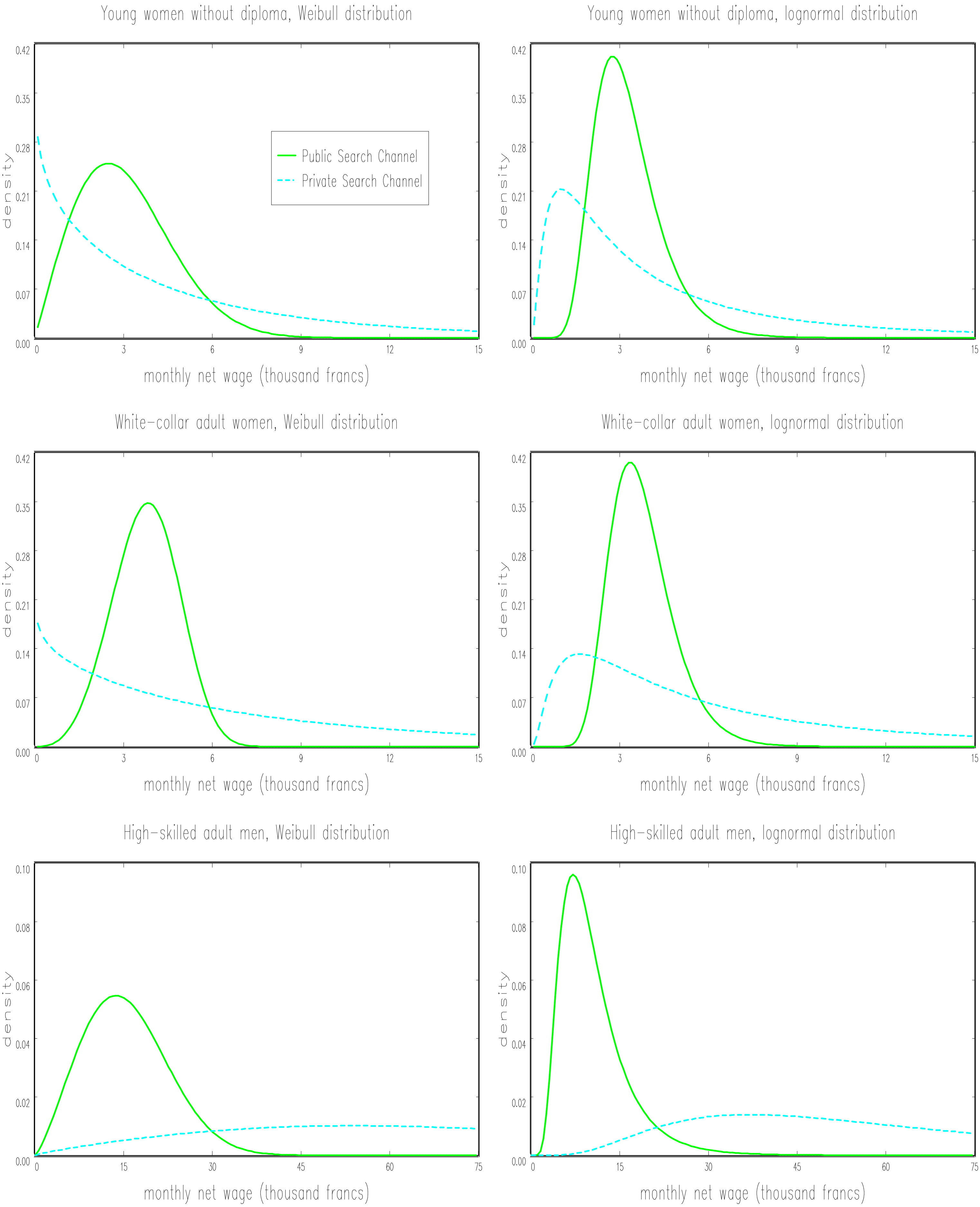


Figure 10: Effects of the PES contact rate on the search strategies of young workers (Lognormal distribution for wages)

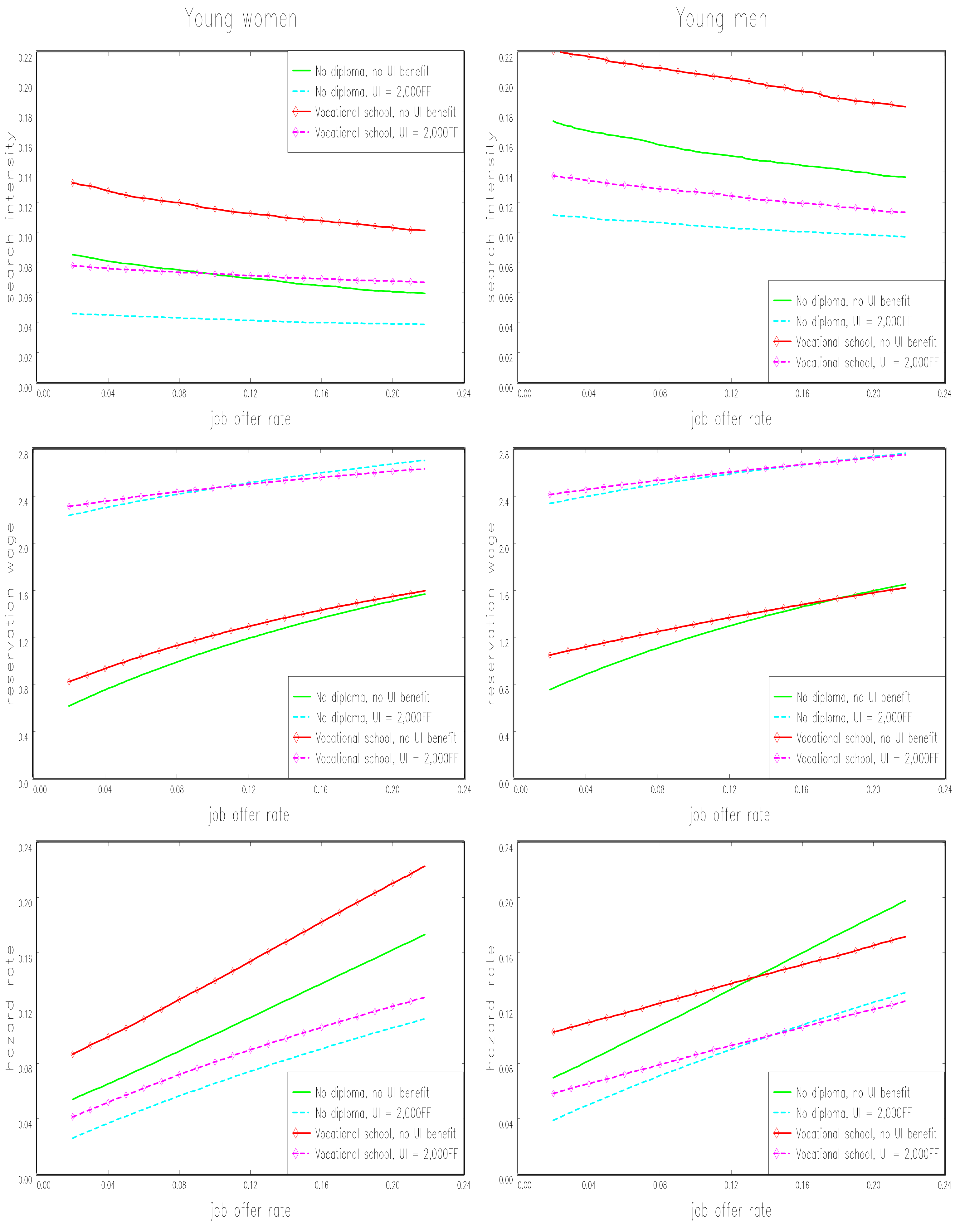


Figure 11: Effects of the PES contact rate on the search strategies of blue-collar adult workers (Lognormal distribution for wages)

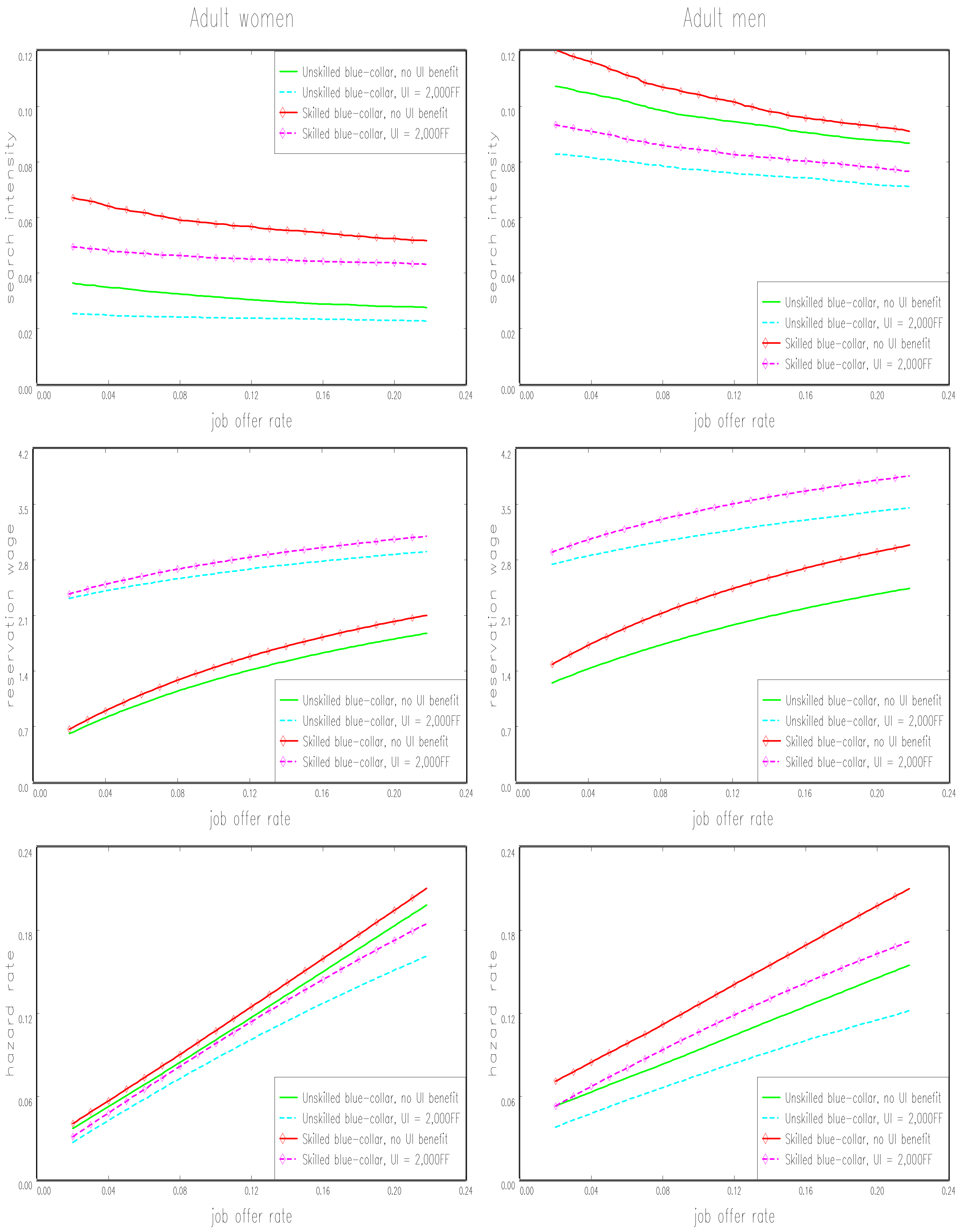


Figure 12: Effects of the PES contact rate on the search strategies of skilled adult workers (Lognormal distribution for wages)