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A Structural Non-stationary Model of Job Search : Stigmatization of the Unemployed by Job Offers or Wage Offers ?

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A structural non-stationary model of job search: Stigmatization of the unemployed by job offers or wage offers?

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Abstract

We develop a structural non-stationary model of job search in the fashion of van den Berg (1990). Nonstationarity comes from the duration-dependence in benefits, in the arrival rate of job offers, and in wage offers. The model is then estimated using the French sample of the ECHP Survey (1994-2000). This data set provides the variables required to identify the model (reservation wages, job offers arrival rate, accepted wages and rejected wages) and allows to reconstruct the "true" monthly sequence of benefits for each unemployed worker. We find that duration-dependence in job offers is quite limited: the arrival rate of job offers is exactly the same after two years of unemployment than at the beginning of the spell. Duration dependence in wage offers is slightly more pronounced: wages are decreasing during the first two years of unemployment. Nevertheless the most important fall is observed at the beginning of the spell. We also find that the former employed in temporary jobs are more sensitive to duration than the other unemployed. Then we simulate the effects, on the expected duration of unemployment, of four reforms of the unemployment compensation system: (A) a 14% increase in the amount of UI benefits, keeping unchanged the profile of benefits over the unemployment spell; (B) the replacement of the declining time sequence of insurance benefits by a constant sequence; (C) the reform B combined with the imposition of punitive sanctions; (D) a 3 months increase in the maximum duration of UI entitlement.

Résumé

On développe un modèle structurel non stationnaire de recherche d'emploi à la manière de van den Berg (1990). La nonstationarité provient de trois sources : la dégressivité de l'allocation chômage, la diminution du taux d'arrivée des offres d'emploi au cours de l'épisode de chômage et le déplacement de la distribution des salaires offerts. Le modèle est estimé à partir de la version française de l'enquête ECHP (1994-2000). Cette base de données fournit les variables nécessaires à l'identification du modèle (salaires de réserve, taux d'arrivée des offres, salaires acceptés et refusés) ou permet de les reconstituer (profil mensuel d'indemnisation de chaque chômeur). On trouve alors que la dépendance de durée des offres est très faible : le taux d'arrivée des offres est exactement le même après deux ans de chômage qu'au début de l'épisode. Les salaires offerts dépendent davantage de l'ancienneté au chômage. Cependant, la baisse la plus importante intervient au tout début de l'épisode. D'autre part, les anciens employés en contrat temporaire sont plus affectés par la durée de l'épisode de chômage que les autres chômeurs. Enfin, on simule les effets, sur la durée espérée de chômage, de quatre réformes du système d'indemnisation : (A) une hausse de 14 % du montant de l'allocation d'assurance, en maintenant inchangé le profil temporel d'indemnisation ; (B) le remplacement de l'allocation dégressive par une allocation constante ; (C) la réforme B combinée avec la mise en œuvre de sanctions ; (D) une augmentation de 3 mois de la durée maximale d'indemnisation.

JEL Classification: J64, J65

Keywords: unemployment duration, insurance, reservation wages, job search

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Introduction

Various reduced-form empirical studies show a clearly decreasing pattern of the exit rate from unemployment with duration (Narendranathan, Nickell and Stern, 1985), even when unobserved heterogeneity is controlled for (Meyer, 1990). These results support the hypothesis of nonstationarity in job search. This nonstationarity may originate from three sources. First, in most countries the level of benefits falls when the unemployed exhaust their entitlement to insurance and become assistance recipients. In some countries[1], the time sequence of insurance benefits itself is declining. Second, the arrival rate of job offers may fall with the length of the unemployment spell if employers interpret longer spells as a bad signal or if workers' human capital depreciates over time. Finally, for the same two reasons, the distribution of wage offers can be shifted to the left during the unemployment spell.

Reduced-form estimations of job search models do not allow to distinguish the respective effects of the three sources of nonstationarity cited above. Moreover, they do not allow to evaluate different reforms of the unemployment compensation system (as a change in the time sequencing of benefits or in the duration of entitlement). If we want to do it, we need to estimate a structural model of job search in a nonstationary environment. And yet, not many structural nonstationary models have been estimated until now. As far as we know, no one identifies the respective effect of the three possible sources of nonstationarity. The reason for that is simple: the data sets used in these studies do not allow to identify all these effects.

Nevertheless there exists a theoretical model. Van den Berg (1990) proposes a very general theoretical framework to model the three sources of duration-dependence already mentioned.He first shows that the optimal strategy of an unemployed worker is still a reservation strategy. Next he derives a differential equation that describes the evolution of the reservation wage over the unemployment spell. However, in the empirical implementation of the model, only one source of nonstationarity is considered: the decrease in the level of benefits that occurs when the unemployed exhaust their entitlement to insurance and become assistance recipients. The model is not identified if other causes of nonstationarity are examined. The arrival rate of job offers, the amount of insurance benefits and the distribution of wage offers are thus supposed to be constant over the unemployment spell. Cases and Lollivier (1993) are confronted with the same problem. They estimate a structural dynamic model of job search where both the amount of benefits and the arrival rate of job offers are allowed to be duration-dependent. However, they have to suppose constant the distribution of wage offers for the model to be identified.

In an interesting paper, Garcia-Perez (2003) extends the theoretical model developed by van den Berg to take into account that jobs do not last forever. He advocates that considering this fact may

[1] As in France from July 1992 to July 2001.

considerably change the duration-dependence in reservation wages. The extended job search model is then estimated using Spanish data. This confirms the stronger duration-dependence in reservation wages when employment is not an absorbing state. However, one source of nonstationarity, the decrease in benefits over the unemployment spell, is not taken into account. The whole path of unemployment benefits, that would be required for identification, is not available in the data set.

The aim of this paper is twofold. Our first aim is to estimate a structural nonstationary model of job search in the fashion of van den Berg (1990) using the first seven waves of the French sample of the ECHP Survey (1994-2000). Compared with the papers mentioned above, this data set has the advantage of allowing to identify the respective impact of the declining sequence of benefits, the fall in the arrival rate of job offers, and the shifting distribution of wage offers. In particular, beyond the declining sequence of benefits, we are able to assess whether the decrease in reservation wages over the spell of unemployment comes more from the fall in job offers or more from the shift in the distribution of wage offers. Our second aim is to evaluate the impact of different reforms of the unemployment compensation system.

The ECHP Survey used in the study interviews in October of each year between 1994 and 2000 the same group of persons representative of the French population on their income and their job or job search. The characteristic of the French data set is to provide enough information to identify the model. More precisely, at each date of interview, the unemployed have to report their reservation wage, the number of job offers received during the previous month and the corresponding wage (accepted or rejected). The former unemployed are asked to report their post-unemployment wage. In addition, the respondents complete a monthly labor market history from January 1993 to December 2000. Using this information and the French rules on unemployment benefits, we are able to reconstruct the “true” monthly sequence of benefits for each unemployed worker. The three sources of nonstationarity are then identified. Furthemore, the model can be estimated using reported reservation wages and without using them. Comparison of these two estimations allows to evaluate the quality of this variable in the ECHP survey.

Once the structural parameters of the model are estimated, alternative reforms of the 99unemployment compensation system can be simulated and their effects on the expected duration of unemployment and on the path of reservation wages can be evaluated. The different reforms are: (A) a 14% increase in the amount of UI benefits, keeping unchanged the profile of benefits over the unemployment spell; (B) the replacement of the declining time sequence of insurance benefits by a

constant sequence; (C) the reform B combined with the imposition of punitive sanctions if two job offers are refused[2]; (D) a 3 months increase in the maximum duration of UI entitlement.

In reform B, the monthly constant benefit is supposed equal to the "full-rate" benefit in the reference situation. *Ex ante* (i.e. keeping unchanged job search behaviors), this reform increases the financing cost for the UI agency by 14%. Therefore, reforms A and B have *ex ante* the same cost and only differ by the profile of benefits over the spell of unemployment. Comparison of these two reforms will thus allow for assessing the effect of time sequencing of benefits on the expected duration of unemployment. With reform C, our aim is to evaluate the impact of sanctions, such as benefit cuts, on the exit rate from unemployment.

The main results are the following. Duration-dependence in job offers appears quite limited: the arrival rate of job offers is the same after two years of unemployment than at the beginning of the spell. Nevertheless the former employed in temporary jobs are more sensitive to duration than the other unemployed. Duration dependence is slightly more pronounced in wage offers than in job offers. Wages are decreasing during the first two years of unemployment. However, the most important fall is observed at the beginning of the spell. Afterwards, duration has a quite limited negative impact. Once again, the former employed in temporary jobs are far more sensitive to duration than the other unemployed.

More generous insurance benefits have a negative, but quite limited, effect on the exit rate from unemployment, resulting in a small increase in unemployment duration. More precisely, the expected duration of unemployment goes from 14.01 months to 14.35 months (i.e. +2.42%) when the level of UI benefit is raised by 14%. Nevertheless, former high-wage workers are far more sensitive than the others.

Replacing a declining time sequence by a flat profile (reform B) lengthens the spell of unemployment, which is in accordance with the theoretical literature. Duration is raised by 1.39 months (+9.92%) with reform B versus 0.34 month (+2.42%) with reform A, for the same *ex ante* cost. Furthermore, a flat profile of benefits has a dramatic impact on the subset of former high-wage workers, whose unemployment duration is raised by 3.92 months (+24.48%).

Compared with reform B, the imposition of sanctions seems to shorten substantially the expected duration of unemployment, which goes from 15.4 months to 13.15 months (i.e. –14.61%). Once more, the effect is stronger on the subset of former high-wage workers, whose unemployment duration is decreased by 6.15 months (-30.85%). Finally, a 3 months increase in the maximum duration of UI entitlement has a quite limited impact on unemployment duration.

[2] Reforms B and C can be seen as the soft and hard versions of the reform of the unemployment compensation system that has been implemented in France in July 2001.

The paper is organized as follows. Section 1 presents the data set used and the method implemented to reconstruct the "true" monthly sequence of insurance benefits for each unemployed worker. The empirical implementation of a structural nonstationary model of job search is proposed in section 2. Section 3 presents the results of the model estimation. In section 4, different reforms of the unemployment compensation scheme are simulated and their effects on the path of reservation wages and the expected unemployment duration are assessed.

1. The data

The data used are drawn from the 1994-2000 waves of the French sample of the ECHP[3]. This sample of households is aimed at studying the dynamics of employment and income. Two types of information are provided.

At each date of interview (in October or November of each year), the 17 years old or more respondents are asked to provide information on their personal characteristics, labor market status and income. If the individual is unemployed, he/she has to report the number of job offers received during the previous month (0, 1, or more than 1) and the corresponding wages[4]. He/she is also interviewed on his/her reservation wage, defined as "the lowest monthly net salary accepted to take a job, divided by the desired number of hours to be worked". If the individual found a job since the last interview, he/she has to report the accepted post-unemployment wage.

In addition, all individuals are asked every year to retrospectively state their monthly labor market status from January of the past year. In that way we obtain the monthly status from January 1993 to December 2000 of 15711 individuals: employed in a permanent full-time job, employed in a permanent part-time job, employed in a temporary full-time job, employed in a temporary part-time job, unemployed, or inactive. 3349 (21.3%) have experienced at least one unemployment spell over the period. Since some labor market histories are incomplete, we selected only 2988 individuals from this last sample, which gives a total number of 5975 unemployment spells.

Identifying the respective effects of the different causes of non-stationarity requires information on the monthly path of unemployment benefits. However, in the ECHP, the amounts of unemployment insurance (UI) and unemployment assistance (UA) benefits are only recorded annually. Moreover, this information is of poor quality: both the proportions of UI and UA recipients are much lower than they should be. As a result, we decided not to use this information and to proceed in a complete different way. We reconstruct, for each unemployment spell, the "true" monthly sequence of

[3] We do no use the 2001 wave because a major reform of unemployment insurance rules was decided in January 2001 and implemented in July of the same year.

[4] Rejected wage offers will be important for the identification of the model. It is worth noting that this information is not available in the European version of the ECHP Survey.

benefits by applying the French legislation on unemployment compensation.

We describe briefly these rules in France. Fortunately, they remained roughly the same over the period 1994-2000 covered by the data set: only a minor change occurred in January 1997. Two compensation systems coexist: insurance and assistance. The unemployment insurance rules are presented in table 1.

- Depending on his/her age and length of contribution to UI, a person who enters into unemployment is assigned to one benefit category and receives insurance benefits for a limited duration. Eligibility for insurance benefits requires 4 months of contribution during the 8 months that preceded the unemployment spell (category 1). The entitlement is then limited to 4 months. The most numerous category is the 5 one: 14 months of contribution during the 24 months that preceded the unemployment spell are required to enter this category; the maximum duration of UI entitlement is then of 30 months.
- The benefit paid at the beginning of the unemployment spell (named "full rate benefit") is the sum of a fixed part and of a part related to the previous before tax labor earnings (40.4%). If this amount is lower than 57.4% of the previous labor earnings then this last value applies. Lastly, the full rate benefit cannot be lower than a minimum value, or higher than 75% of the previous labor earnings.
- The time sequencing of UI benefits is declining: the benefit is first paid "at full rate" and then reduced by a fixed percentage every four months until December 1996 and every 6 months from January 1997. However, a minimum allowance is guaranteed.
- The unemployed who fail to meet the eligibility criteria or have exhausted their entitlement can still receive an assistance benefit, provided they are over 25 years old and the resources of their household, whatever their origin, are under a threshold that depends on family composition. This benefit is not related to previous earnings and is available for an unlimited period of time.

As a result, to reconstruct the "true" sequence of monthly unemployment benefits, we only need to know the employment history during the 24 months preceding the entry into unemployment[5], the age, the past wage, the family composition and the resources of the household. The first variable can be easily computed using the activity history data set and the others are available in the data set. This method should be applied only to the unemployment spells beginning after December 1994. Actually, a great number of the unemployment spells beginning in 1994 can also be reconstructed. Therefore, we restricted the sample to the spells that begin after January 1994, which gives a total

[5] For the unemployed aged 55 or more, the employment history over the 37 months preceding the spell of unemployment is needed to reconstruct the "true" monthly profile of benefits. When this information is not available, they are treated as the unemployed over 50, with a maximum entitlement of 45 months. Note that they represent only 2.5% of the unemployment spells (table 2).

number of 4438 unemployment spells. Among these, 820 (18%) are right censored. The data set is thus an inflow sample and not a stock sample, which saves us having to deal with the problem of left censoring.

Some summary statistics are presented in table 2. The unemployed are young: 38% are less than 25 years old and 30% are between 26 and 35 years old. About 40% have at least completed high-school education. Figure 1 shows that the instantaneous exit rate from unemployment diminishes continuously with the duration of the spell[6]. This goes from about 0.13 for a duration of 1 to 3 months to around 0.02 for a duration of 40 months. The decrease is more pronounced during the first 12 months than after.

Figure 2 depicts the monthly distributions of accepted wages, of reported reservation wages and of rejected wage offers. The average (median) post-unemployment monthly wage is equal to 7496 Frs[7] (6685 Frs) and a large proportion of accepted wages is close to the minimum wage. The average (median) monthly reservation wage is equal to 7201 Frs (6171 Frs). The distribution of reservation wages has the same shape than the distribution of accepted wages, but is slightly shifted to the left. Reservation wages are thus slightly lower than accepted wages. Lastly, 3350 unemployed reported the number of job offers they received the previous month. Among them, 8% have received at least one offer and rejected it. The mean (median) of the 164 rejected wage offers is equal to 6823 Frs (6205 Frs). Logically, the distribution of rejected wage offers is shifted to the left of the distribution of reservation wages.

2. The empirical implementation of a structural nonstationary job search model

2.1 The model

The labor market is described by a structural nonstationary model of job search in the fashion of van den Berg (1990). The workers can be in two states: employed or unemployed. Let t denote the elapsed duration of the unemployment spell[8]. At date t, an unemployed agent receives a duration-dependant unemployment benefit $b(t)$. Job offers arrive according to a Poisson process with parameter $\lambda(t)$. The wage associated to a job offer is a random drawing from a cdf $F_t(w_t)$. When a job offer arrives, the agent has to decide whether to accept or to reject it. If the job offer is accepted, the agent keeps it forever: on-the-job search and the risk of job loss are thus excluded[9]. Otherwise, he

[6] More precisely, this result appears for duration shorter than 40 months. For duration longer than 40 months, the population becomes too small for this result to be confirmed.
[7] 1 Franc is equal to about 0.15 Euro.
[8] For ease of exposition, let assume that calendar time and unemployment duration coincide.
[9] The assumption that the worker remains employed forever at the same wage is unsatisfactory, but usual in this type of structural non-stationary models (Wolpin, 1987, van den Berg, 1990, 1995, Frijters and van der Klaauw, 2004). To our knowledge, there are only two exceptions in the literature. Joutard and Ruggiero (2000) estimate a structural nonstationary model where an employed worker can lose his job and go back to unemployment.

stays unemployed and continues to search for a job. The instantaneous utility function is supposed linear: thus the utility of an employed agent is w_t and that of an unemployed one is $b(t)$. The agent discounts future utility at the subjective rate ρ.

Nonstationarity thus originates from the duration-dependence in benefits, in the arrival rate of job offers, and in wage offers. The benefit is duration-dependant for two reasons. First, because unemployment insurance pays a declining compensation. Second, because two compensation systems coexist: insurance, that pays relatively high benefits at the beginning of the unemployment spell, and assistance, that gives a relatively low compensation to those who are no more eligible for UI. The arrival rate of job offers may fall with the length of the unemployment spell if employers interpret longer spells as a bad signal or if workers' human capital depreciates during spells ofunemployment. For the same two reasons, the distribution of wage offers can be shifted to the left over time.

In the rest of the paper, workers' observable characteristics will be constant over the duration of unemployment. Consequently, stigmatization is the only possible source of duration-dependence in job offers and wage offers. Compared to a short-term unemployed agent, a long-term one can suffer from two types of stigmatization: he or she can receive fewer job offers; the wage associated to a job offer can be lower. We are able to test whether the first type or the second type of stigmatization occurs actually, and, if both occur, which one dominates the other.

Let $U(t)$ denote the expected flow of income for an agent who is unemployed for t units of time. Under the hypothesis that at most one job offer arrives in the small interval $[t, t+h]$, the Bellman's equation for $U(t)$ verifies (van den Berg, 1990):

$$U(t) = \frac{hb(t)}{1+\rho h} + \frac{(1-\lambda(t)h)U(t+h)}{1+\rho h} + \lambda(t)h\frac{E_{w_t}\max\left(\frac{w_t}{\rho}, U(t+h)\right)}{1+\rho h} \quad (1)$$

At date *t*, the policy that maximizes the expected return from unemployment is to accept any job offer if the associated wage exceeds $\rho U(t)$. Let $R(t) = \rho U(t)$ denote the reservation wage. Rewriting equation (1), we obtain the value of the reservation wage at date *t*:

However, they have to make strong hypotheses on the behavior of job search: the horizon is limited to three spells of unemployment; the environment becomes stationary as soon as the second spell begins. These hypotheses complicate importantly the model. A second exception is a paper by Garcia-Perez (2003) that extends the theoretical model developed by van den Berg to take into account that jobs do not last forever. The difficulty with this kind of model is that the present value of employment must integrate all the future possibilities of new unemployment spells. In Garcia-Perez, UI entitlement is not explicitly modelized and does not depends on the past employment history. This simplifies the computation of the present value of employment. In our paper, at the opposite, we take into account that the whole monthly sequence of benefits depends on the past employment history. If jobs do not last forever, the present value of employment becomes extremely complicated to compute. For this reason, we prefer to assume, as usual, that employment is an absorbing state.

$$(1+\rho h)R(t) - R(t+h) = h\rho b(t) + \lambda(t)h\int_{R(t+h)}^{\infty} w_t dF_t(w_t) - R(t+h)(1-F_t(R(t+h))) \quad (2)$$

We assume that there exists some date T such that the environment remains stationary after T. The variables $b(t)$, $\lambda(t)$ and $F_t(w_t)$ are thus supposed to be constant on $[T,\infty[$ and to take the respective values b, λ and $F(w)$. Before T, the environment is nonstationary and the sequence of reservation wages is described by equation (2). After T, the optimal strategy is stationary. If $\overline{R}$ denotes the constant reservation wage, then $\overline{R}$ is the solution of:

$$\rho\overline{R} = \rho b + \lambda\int_{\overline{R}}^{\infty} wdF(w) - \overline{R}(1-F(\overline{R})) \quad (3)$$

Since the left-hand side is increasing and the right-hand side decreasing in $\overline{R}$, it follows that this equation has a unique finite solution. It is worth noting that this solution can be computed only numerically and not analytically. Moreover, since the agents differ from one another in the amount of benefit, the arrival rate of job offers and the distribution of wage offers, the computation of $\overline{R}$ has to be made for each individual of the sample.

In the data set, the unit of time is the month. We thus make the hypothesis that all the variables are constant over this unit time interval and we estimate a discrete time dynamic programming model. Using backward induction, the sequence of optimal reservation wages in discrete time can then be rewritten as:

$$\begin{aligned} &(1+\rho)R_t = R_{t+1} + \rho b_t + \lambda_t \int_{R_{t+1}}^{\infty} w_t dF_t(w_t) - R_{t+1}\left(1-F_t(R_{t+1})\right) \\ &\text{for } t = 1,\ldots, T\text{-}1 \text{ with } R_T = \overline{R} \end{aligned} \quad (4)$$

The probability of getting a job after an unemployment spell of length t is:

$$\theta_t = \lambda_t\left(1-F_t(R_t)\right) \quad (5)$$

Hence the integrated hazard at date t is given by:

$$h_t = \sum_{\tau=1}^{t}\theta_\tau$$

2.2 Parametrization

The arrival rate of job offers is:

$$\lambda_t = \lambda_{0t}\exp(Zc) \quad (6)$$

where Z is a vector of observable characteristics and λ_{0t} is the baseline rate. Z is constant over the duration of unemployment, which means that the agents do not suffer from any loss of human capital.

This leads us to interpret any change in the arrival rate of job offers over the spell of unemployment as "stigmatization" of the long-term unemployed by employers.

The distribution of wage offers is supposed log-normal (Wolpin, 1987) and to have the following form:

$$\log w_t = Xb + \delta_t + \sigma_u u \tag{7}$$

where X is a vector of observable individual characteristics, δ_t a parameter that captures the effects of duration dependence and u an error term that is normally distributed with mean 0 and variance 1. Thus we restrict the change in the distribution of wage offers to a shift in the mean of the distribution, holding variance constant.

Duration dependence in both λ_{0t} and in δ_t is captured by a piecewise linear function defined by 4 thresholds ($t_1=7$, $t_2=13$, $t_3=25$, $t_4=36$) and 4 different inclinations, and constant after $t_4=36$. Note that the parameters λ_{0t} will be estimated under the exponential link function to insure their positivity.

Combining equations (5), (6) and (7), the hazard rate can be rewritten:

$$\theta_t = \lambda_{0t} \exp(Zc)\left[1 - \Phi\left(\frac{\log(R_t) - Xb - \delta_t}{\sigma_u}\right)\right] \tag{8}$$

We assume that the observed wage is measured with a multiplicative error term that is independent of the "true" wage offer received by the worker (Wolpin, 1987, Eckstein and Wolpin, 1995)[10]. Denoting the observed wage by $\tilde{w}_t$ and the "true" wage by w_t, the two are supposed related by:

$$\log(\tilde{w}_t) = \log(w_t) + \sigma_v v, \text{ with } v \to N(0,1)$$

The measurement error, v, is distributed $N(0,1)$ and independent of u.

With the above assumptions, the observed wage offer distribution can be rewritten as:

$$\log(\tilde{w}_t) = Xb + \delta_t + \sqrt{\sigma_u^2 + \sigma_v^2}\, s, \text{ with } s \to N(0,1)$$

Individuals who are unemployed at the date of the interview are asked for their lowest acceptable net wage in a job at that date. These observed reservation wages ($\tilde{R}_t$) may differ from the true ones (R_t) because of a measurement error (van den Berg, 1990). This error term is supposed normally distributed (with mean zero and variance 1) and independent of duration. Thus,

$$\log(\tilde{R}_t) = \log(R_t) + \sigma_w w, \text{ with } w \to N(0,1)$$

The error terms u, v and w are supposed independent.

[10] If observed wages are measured without error, the maximum likelihood estimator for the reservation wage is the minimum accepted wage. The existence of very low wages in the data has thus a very large impact on the estimated reservation wages (Flinn and Heckman, 1982). In order to deal with this problem, we assume that the observed wages are measured with a multiplicative error term.

Finally, we take into account that macro-economic events, like economic policy changes or business cycle effects, may occur. In this aim, we include a dummy variable for each calendar year. We thus consider two distinct calendars (the duration of the spell of unemployment and the usual calendar), which complicates the procedure of estimation.

2.3 Likelihood of the sample

Three types of information are available on a spell of unemployment: its duration, the monthly amount of benefit and the post-unemployment wage. Moreover, at each date of interview, the unemployed report their reservation wage, the number of job offers they received during the previous month and the wage corresponding to each rejected offer. Both types of information are used to write the likelihood.

2.3.1 *Information on the spell of unemployment*

There are three different cases: the spell of unemployment can be right-censored; it can be completed but the accepted wage is unobserved; it can be completed and the accepted wage is observed.

The likelihood contribution of a censored spell at date t is simply given by the survivor function:

$$l = \exp(-h_t)$$

If the wage offer is unobserved, the likelihood contribution of a completed spell at date t is equal to the density of completed unemployment duration:

$$l = \theta_t \exp(-h_t)$$

Finally, if the offered wage is observed, the likelihood contribution of a completed spell at date t is obtained by multiplying the conditional density function of accepted wages and the density function of unemployment duration. The accepted wage is drawn from the wage offer distribution truncated at the reservation wage. We need also to take into account that the observed wage is measured with error and thus different from the offered wage.

The probability that the observed wage is $\tilde{w}_t$ given that the offered wage exceeds the reservation wage is then given by:

$$P\left(\tilde{w}_t \middle| w_t \geq R_t\right) = \frac{P\left(\tilde{w}_t ; w_t \geq R_t\right)}{P\left(w_t \geq R_t\right)} = \frac{P\left(\tilde{w}_t\right) P\left(w_t \geq R_t \middle| \tilde{w}_t\right)}{P\left(w_t \geq R_t\right)}$$

where

$$P\left(\tilde{w}_t\right) = \frac{1}{\tilde{w}_t \sigma_s} \varphi\left(\frac{\log(\tilde{w}_t) - Xb - \delta_t}{\sigma_s}\right)$$

$$P\left(w_t \geq R_t\right) = 1 - \Phi\left(\frac{\log(R_t) - Xb - \delta_t}{\sigma_u}\right)$$

Since u and s are normally distributed, $\begin{pmatrix} u \\ s \end{pmatrix} \rightarrow N\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \psi \\ \psi & 1 \end{pmatrix}\right)$ where $\psi^2 = \frac{{\sigma_u}^2}{{\sigma_s}^2}$ represents the share of observed wage variation which is not explained by the measurement error.

The density function associated to the conditional distribution of u given s thus verifies:

$$\frac{1}{\sqrt{2\pi}\sqrt{1-\psi^2}} \exp\left[-\frac{(u-\psi s)^2}{2(1-\psi^2)}\right]$$

This leads to:

$$P\left(w_t \geq R_t \middle| \tilde{w}_t\right) = 1 - \Phi\left[\left(\frac{\log(R_t) - Xb - \delta_t}{\sigma_u} - \psi^2 \frac{\log(\tilde{w}_t) - Xb - \delta_t}{\sigma_u}\right) \frac{1}{\sqrt{1-\psi^2}}\right]$$

2.3.2 *Information provided by the annual interview*

Since the arrival rate of job offers follows a Poisson process with parameter λ_t and since we assume that at most one job offer arrives per month, the probability of receiving a job offer between the months $t-1$ and t is:

$$l = \lambda_{t-1}$$

while the probability of receiving no offer is:

$$l = 1 - \lambda_{t-1}$$

If a job offer has been received, the unemployed are asked to report the offered wage. This wage is lower than the reservation wage, since the offer has been rejected. The offered wage is thus drawn from the truncated wage offer distribution. Let $\hat{w}_{t-1}$ denote the observed rejected wage at $t-1$. Some computations lead to the likelihood contribution of a rejected wage offer at $t-1$:

$$P\left(\hat{w}_{t-1} \middle| w_{t-1} < R_{t-1}\right) =$$

$$\frac{\varphi\left[\psi \frac{\log(\hat{w}_{t-1}) - Xb - \delta_{t-1}}{\sigma_u}\right] \frac{\psi}{\hat{w}_{t-1}\sigma_u} \Phi\left[\left(\frac{\log(R_{t-1}) - Xb - \delta_{t-1}}{\sigma_u} - \psi^2 \frac{\log(\hat{w}_{t-1}) - Xb - \delta_{t-1}}{\sigma_u}\right) \frac{1}{\sqrt{1-\psi^2}}\right]}{\Phi\left(\frac{\log(R_{t-1}) - Xb - \delta_{t-1}}{\sigma_u}\right)}$$

Finally, if the reported reservation wage at the date of interview is $\tilde{R}_t$, then the likelihood contribution is given by:

$$P\left(\tilde{R}_t\right) = \frac{1}{\tilde{R}_t \sigma_w} \varphi\left(\frac{\log(\tilde{R}_t) - \log(R_t)}{\sigma_w}\right)$$

2.3.3 *Likelihood of the sample*

If the observations are assumed independent, the final likelihood of an unemployment spell is obtained by multiplying the different likelihood contributions. For instance, take the case of a completed unemployment spell of length t with an observed accepted wage $\tilde{w}_t$. Furthermore, assume that a reservation wage $\tilde{R}_{t-3}$ is reported at date $t-3$, and a job offer with an associated wage $\hat{w}_{t-4}$ is rejected at date $t-4$. Then the likelihood can be written as:

$$
\begin{aligned}
L = \; & \theta_t \exp(-h_t)(1-\lambda_{t-4}) \frac{1}{\tilde{R}_{t-3}\sigma_w} \varphi\left(\frac{\log(\tilde{R}_{t-3}) - \log(R_{t-3})}{\sigma_w} \right) \\
& \frac{\varphi\left[\psi \frac{\log(\tilde{w}_t) - Xb - \delta_t}{\sigma_u} \right] \frac{\psi}{\tilde{w}_t \sigma_u} \left(1 - \Phi\left[\left(\frac{\log(R_t) - Xb - \delta_t}{\sigma_u} - \psi^2 \frac{\log(\tilde{w}_t) - Xb - \delta_t}{\sigma_u} \right) \frac{1}{\sqrt{1-\psi^2}} \right] \right)}{1 - \Phi\left(\frac{\log(R_t) - Xb - \delta_t}{\sigma_u} \right)} \\
& \frac{\varphi\left[\psi \frac{\log(\hat{w}_{t-4}) - Xb - \delta_{t-4}}{\sigma_u} \right] \frac{\psi}{\hat{w}_{t-4}\sigma_u} \Phi\left[\left(\frac{\log(R_{t-4}) - Xb - \delta_{t-4}}{\sigma_u} - \psi^2 \frac{\log(\hat{w}_{t-4}) - Xb - \delta_{t-4}}{\sigma_u} \right) \frac{1}{\sqrt{1-\psi^2}} \right]}{\Phi\left(\frac{\log(R_{t-4}) - Xb - \delta_{t-4}}{\sigma_u} \right)}
\end{aligned}
$$

2.3.4 Identification

The identification is very much in line with Flinn and Heckman (1982). The main difference is that we observe rejected wage offers. This means that the wage offer distribution below the reservation wage can be identified.

Two other points are worth to be noted. First, both reported post-unemployment wages and reservation wages are supposed measured with error. Yet the data do not allow to separately identify σ_u, σ_w and ψ^2 (the share of observed wage variation which is not explained by the measurement error). In the literature, this problem is usually solved by supposing only one type of measurement error, either in observed reservation wages (van den Berg, 1990) or in observed accepted wages (Wolpin, 1987, Eckstein and Wolpin, 1995, Petrongolo and Pissarides, 2002, or Garcia-Perez, 2003). It seems difficult to believe that post-unemployment wages can be observed without error. It seems even more difficult to believe that reservation wages can be correctly reported by the unemployed, while a measurement error is supposed in observed accepted wages. This leads us to proceed in a different way: estimate the model conditionally on ψ^2. We will thus make different hypotheses on ψ^2 (25%, 50%, 75%, and 90%) and estimate the other structural parameters for each of these identifying assumptions. The large set of values for ψ^2 is justified by the very different results found in the literature. For instance, Eckstein and Wolpin (1995) show that a very small fraction of the

variance of accepted wages is due to measurement error ($\psi^2 > 86\%$). The opposite result is found by Garcia-Perez (2003) ($\psi^2 = 8\%$).

It is also worth to note that reported reservation wages are needed only to identify σ_w. The model can thus be estimated under two alternative specifications: one using reported reservation wages data and the other one not using them. Comparison of these two estimations allows to test the quality of reported reservation wages.

The structural parameters of the model are estimated by maximizing the log-likelihood of the sample with respect to $b, c, \delta_t, \lambda_{0t}, \rho, \sigma_u, \sigma_w$, under the restriction imposed by equation (4) and the hypothesis on ψ^2. We proceed in the following way. First, the duration of unemployment T after which all exogenous variables are supposed constant is taken equal to 36 months[11]. Equation (3) is then numerically solved for the stationary value $\overline{R}$ at the point T. $\overline{R} = R(T)$ serves as an initial condition for the differential equation (4). Using backward induction, the whole sequence of optimal reservation wages $R(t), t = 1,...,T$ is then obtained. The likelihood contribution is next deduced as a complicated function of the unknown parameters. This procedure has to be repeated for each unemployed individual since the agents differ from one another in the time sequence of benefit and in observable characteristics.

3. Results

The results for different values of ψ^2 (the share of observed wage variation which is not explained by the measurement error) are presented in table 3. Comparison of columns 1 to 4 reveals that the choice of ψ^2 has a limited impact on the parameters estimates, apart from the discount rate[12]. We will thus only discuss the case where $\psi^2 = 50\%$. In this case, the estimated monthly discount rate is equal to 0.0079, which corresponds to a quite reasonable rate of 9.5% a year.

[11] This hypothesis seems quite reasonable for insurance benefits since the maximum duration of UI entitlement is equal to 30 months for the unemployed less than 50 years old (tables 1-A and 1-B). After 30 months of unemployment, these latter are eligible to unemployment assistance (RMI or ASS). Unlike insurance benefits, assistance benefits are constant over the spell of unemployment and are paid as long as the person is unemployed. Only the unemployed over 50 may still be entitled to UI after 36 months of unemployment, provided their cumulated employment duration during the 24 months preceding their entry into unemployment is longer than 14 months. Few people combine all these requirements in the sample.

[12] The discount rate is strongly sensitive to the hypothesis made on ψ^2. The monthly estimation goes from 0.0033 for $\psi^2 = 25\%$ to 0.0160 for $\psi^2 = 90\%$.

We first examine the duration dependence in job offers. The former employed in temporary jobs are likely to differ in their job search behavior from the other unemployed. In particular, they are likely to be more sensitive to unemployment duration. This explains why they are distinguished from the rest of the population in the estimation. Their probability of receiving a job offer remains stable during the first six months and decreases during the following six months. Thus after one year of unemployment the arrival rate of job offers is 30% lower than initially and does not change during the second year of unemployment. A decrease is observed during the third year of unemployment. Nevertheless, this last result has to be considered with caution, given the small number of persons with more than 2 years of unemployment in the sample.

Let us now examine the rest of the population. For them, duration-dependence in job offers appears quite limited. More precisely, the initial increase in the arrival rate of job offers observed during the first six months is exactly offset by a movement in the opposite sense during the following six months. Afterwards, their probability of receiving an offer remains stable. As a consequence, the arrival rate of job offers is exactly the same after two years of unemployment than at the beginning of the spell.

Not surprisingly, men and high-educated workers are offered more jobs than women and less-skilled workers. The effect of education is nevertheless lower than expected: college graduates are the only ones to receive significantly more job offers than junior high-school graduates (the reference situation). The past labor market state is also an important variable. In particular, the unemployed who were previously employed in a temporary full time job receive much more job offers (+49%) than those who were employed in a permanent full time job. The local unemployment rate affects negatively the arrival rate of job offers. Lastly, the dummy variables included to capture macroeconomic events become significant and positive at the end of the period, because of the more favorable economic situation at this time.

Let us now examine the duration dependence in wage offers. Wages are decreasing during the first two years of unemployment. However, the most important fall is observed at the beginning of the spell (1-6 months). Afterwards, duration has a quite limited negative impact. After two years of unemployment, the impact becomes even positive. This result, which has to be considered with caution, is due to unobserved heterogeneity. The former employed in temporary jobs can again be distinguished from the other unemployed: the decrease in wage offers is more pronounced for them.

Besides duration dependence, the equation of wage offers presents a fairly familiar picture. Not surprisingly, men and inhabitants of Ile-de-France sample wage offers from a distribution that statistically dominates that for women and inhabitants outside of Ile-de-France, respectively. For instance, all other things being equal, the wages offered to women are 10% lower than that offered to men. Living in Ile-de France gives a gain of 16%, which is close to what is usually found in wage equations. Some other variables have a smaller impact than in usual wage equations. Among them, age

(only 0.95% per year) and education: college graduates are the only ones to receive significantly higher wage offers.

The model is also estimated without using reported reservation wages. Table 4 presents the estimation results for $\psi^2 = 50\%$. Comparison of columns 1 and 2 reveals that the estimated parameters are close under the two alternative specifications. In particular, the duration dependence in the arrival rate of job offers is not at all affected by the choice of using or not using reported reservation wages. Concerning the duration dependence in wage offers, the only significant change occurs for the third year of unemployment[13]. The discount rate is the only other variable strongly affected. This leads us to conclude that reported reservation wages are rather consistent with the reservation wages implied by the theoretical model. Nevertheless the measurement error in observed reservation wages is high (σ_w=0.24).

To test the validity of the parameters estimates, the model is simulated on the whole sample for $\psi^2 = 50\%$. Figure 3 graphically depicts the observed and simulated exit rates from unemployment and the simulated arrival rate of job offers as functions of duration. The simulated arrival rate of job offers is clearly increasing during the first six months of unemployment, decreasing over the following six months, and constant during the second year. This means that the unemployed receive one job offer per period of 3.95 months during the first six months and one per period of 4.61 months during the following six months. For a duration between 12 and 24 months, the arrival rate goes to one offer per period of 5.54 months and diminishes to one per period of 7.94 months for longer durations.

The simulated exit rate from unemployment decreases with duration during the first year of unemployment (from an initial value equal to 0.12). Afterwards, this remains constant, around 0.05. The simulated hazard rate is quite close to the observed one. The differences between them occur at the very beginning of the spell (the observed hazard rate is increasing and above the simulated one) and after two and a half years of unemployment (the simulated hazard rate remains constant while the observed one is clearly decreasing).

Comparison between the arrival rate of job offers and the exit rate from unemployment reveals that an important share of job offers are rejected by the unemployed (more than 50%). This result is at variance with several estimations (van den Berg, 1990, Garcia-Perez, 2003). For instance, Garcia-Perez (2003) finds that in Spain acceptance probabilities are roughly equal to one after four months of unemployment, even if, at the beginning of the spell, only 40% of job offers are accepted. How can this difference be interpreted? Van den Berg (1990) or Garcia-Perez (2003) do not know the number

[13] The coefficient is significant when using the reported reservation wages and non significant under the alternative specification. But remember that number of persons with more than 2 years of unemployment in the sample is small.

of rejected offers. We have this information and, according to the data set, roughly one job offer over two received the previous month has been rejected. Note that this high rejection rate is in line with that found by Cases and Lollivier (1993) and Joutard and Ruggiero (2000) on French data.

Finally, figure 4 presents the exit rate from unemployment simulated for different values of ψ^2 (25%, 50%, 75%, and 90%). The choice of ψ^2 appears to have a very limited impact on the hazard.

4. Simulation of different economic policy changes

Once the structural parameters of the model have been estimated, we can simulate the effects, on the behavior of job search and on unemployment duration, of different reforms of the unemployment compensation system. Four policy changes are examined: (A) a 14% increase in the amount of unemployment insurance benefits, keeping unchanged the declining time sequence of benefits; (B) the replacement of the declining time sequence of insurance benefits by a constant sequence; (C) the reform B combined with the imposition of punitive sanctions if two job offers are refused[14]; (D) a three months increase in in the duration of UI entitlement.

(A) A 14% increase in insurance benefits, keeping unchanged the declining time sequence

More generous insurance benefits have a negative, but quite limited, impact on the exit rate from unemployment, resulting in a small increase in duration (table 5, column 2). More precisely, the expected duration of unemployment goes from 14.01 months to 14.35 months (i.e. +2.42%) when the level of UI benefit is raised by 14%.

This result is in line with various studies[15] that find a positive, but small, impact of the generosity of UI benefits on unemployment duration in the 80's (Layard, Nickell and Jackman (1991), van den Berg (1990)). However, evidence on the 90's indicates a larger elasticity of expected duration with respect to benefits. For instance, Carling, Holmlund and Vejsiu (2001), using Swedish data in the 90's, try to assess the effect of a decrease from 80 percent to 75 percent in the replacement rate on the exit rate from unemployment. Their estimates suggest that the reform caused an increase in the transition rate of roughly 10 percent. Compared with this estimation, our simulation suggests a quite smaller impact of UI benefits on unemployment duration.

This impact may nevertheless be stronger for some sub-populations. The study by Dormont, Fougère and Prieto (2001) suggests that high-wage workers are the more likely to be affected by more generous benefits. For this reason, the simulation exercise is repeated for the top quartile of the UI

[14] Reform B is the soft version of the reform of the unemployment compensation system that has been implemented in France in July 2001, while reform C can be seen as the hard version.
[15] See Atkinson and Micklewright (1991) for a survey of the literature on UI and unemployment in the 80's.

benefits distribution. Column 2 in table 6 shows that their expected unemployment duration goes from 16.01 months to 16.7 months (i.e. +4.31%) when the level of UI benefit is raised by 14%. These unemployed are thus more sensitive to the amount of benefits than the rest of the population.

(B) The replacement of the declining time sequence of UI benefits by a constant sequence

The question of the optimal profile of insurance benefits over the unemployment spell has recently attracted much attention in the theoretical literature. Most of these papers show that insurance benefits should decrease with the spell of unemployment (Hopenhayn and Nicolini, 1997, Friedriksson and Holmlund, 2001, Coles and Masters, 2001)[16]. The empirical evidence on the effect of the time sequencing of benefit is less numerous. Moreover, most papers are interested in one particular issue: the duration of UI entitlement. The main result is that the exit rate from unemployment increases for workers who have come close to benefit exhaustion (Meyer, 1990, Katz and Meyer, 1990). Very few papers try to assess the impact of the whole profile of benefits on unemployment duration. Among them, one can cite Dormont, Fougère and Prieto (2001).

The replacement of the declining time sequence of benefits by a constant sequence can be simulated and its impact evaluated in our structural nonstationary model of job search. The monthly constant benefit is supposed equal to the benefit at full rate in the reference situation. This simulated reform is thus very close to the one implemented in France in July 2001[17]. *Ex ante* (i.e. keeping unchanged job search behaviors), reform B increases the financing cost for the UI agency by 14%. Therefore, reforms A and B have *ex ante* the same cost and only differ by the profile of benefits over the spell of unemployment. Comparison of these two reforms will thus allow us to assess the effect of time sequencing of benefits on the expected duration of unemployment.

The simulation results are in accordance with the theoretical literature: replacing a declining time sequence by a flat profile lengthens the spell of unemployment. Duration is raised by 1.39 months (+9.92%) with reform B versus 0.34 month (+2.42%) with reform A, for the same *ex ante* cost (table 5, column 3). Reform B is also simulated on the top quartile of the UI benefits distribution. A flat profile of benefits has a dramatic impact on this subset. Indeed, the expected duration of unemployment is raised by 3.92 months (+24.48%) (table 6, column 3). Former high-wage workers

[16] For instance, in a search and matching model with both endogenous wage and search effort, Friedriksson and Holmlund (2001) find that a declining time sequence of unemployment benefits is socially optimal, that is maximizes a utilitarian welfare function. This idea has nevertheless been challenged by Cahuc and Lehmann (2000) in a paper closely related to the preceding one. Focusing on the long-term unemployed, they show that a more declining time-sequence of benefits may strongly reduce their welfare.

[17] In fact, the rules of eligibility in reform B and in the reform implemented in France differ on only one point. In the implemented reform, to be entitled to UI a worker must have been employed for a minimal duration of 4 months over the last 18 months, while in the simulated reform, the requirement is of 4 months over the last 8 months.

are thus far more sensitive to the time sequencing of benefits than the rest of the population. This result is in line with Dormont, Fougère and Prieto (2001).

(C) The reform B combined with the imposition of punitive sanctions if two job offers are refused

UI recipients are supposed to comply with guidelines on job search effort that are imposed by the UI agency. They have to search for a job, accept appropriate job offers, register at the public employment office, participate in education and training. If they fail to meet certain requirements, they may be exposed to a sanction. This sanction can be a temporary or a permanent, a full or a partial reduction in benefits. So far, the effect of sanctions has not attracted much attention in the literature. Yet a recent study by Grubb (2001) shows that sanctions are now an important policy tool in many OECD countries. The empirical evidence is mixed. However, after correction for selectivity in the imposition of sanctions, Abbring, van den Berg and van Ours (2000) find that sanctions substantially raise individual re-employment rate. It should be noted, furthermore, that the studied sanction is a temporary and limited cut in benefits.

The reform of UI implemented in France in July 2001 allows for sanctions if UI recipients fail to comply with guidelines on job search. However, the way this sanction policy can be implemented is not very clear and is actually left to the discretion of the UI agency. We choose to simulate a "hard" sanction policy: a permanent suppression of UI benefits if two job offers are refused. As in reform B, the declining time sequence of benefits is replaced by a constant sequence. Therefore, reform C can be seen as a "hard" version of the 2001 French reform of UI.

Compared with reform B, the imposition of sanctions seems to shorten substantially the expected duration of unemployment, which goes from 15.4 months to 13.15 months (i.e. –14.61%) (table 5, column 4). The arrival rate of job offers is relatively high. When sanctions are not used, about one job offer over two is accepted. But when the rejection of two job offers results in a sanction, things are quite different, since this event occurs relatively early in the spell of unemployment[18]. This explains why sanctions affect in an important way the behavior of job search. Of course, the agents differ from one another in their sensitivity to sanctions. Again, former high-wage workers are the more sensitive. Implementing a sanction policy leads their expected duration of unemployment to decrease from 19.93 months to 13.78 months (-30.85%) (table 6, column 4).

(D) A three months increase in the duration of UI entitlement

A 3 months increase in the maximum duration of UI entitlement has a quite limited impact: the expected unemployment duration goes from 14.01 months to 14.07 months (table 5, column 5). This time, the result is the same for the top quartile of the UI benefits distribution (table 6, column 5).

[18] On average for the survivors, the probability of having received two job offers after six months of unemployment is close to 47%; this goes to 76% after one year and to 92% after two years.

Conclusion

As far as we know, this paper is the first one that identifies the respective effects of three sources of nonstationarity in a structural job search model. These three sources are the duration-dependence in benefits, in the arrival rate of job offers, and in wage offers. We find a quite limited duration dependence in job offers and a slightly more pronounced duration dependence in wage offers. Another important result is that the former employed in temporary jobs are far more sensitive to duration than the other unemployed.

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Table 1 - **The unemployment insurance rules in France**

A - **July 1993-December 1996**

Category	Contribution duration	Age	Duration at full rate (months)	Stage duration (months)	% of decrease	Compensation duration (months)
1	4 months during the last 8 months	Indifferent	0	4	25%	4
2	6 months during the last 12 months	Indifferent	4	4	15%	7
3	8 months during the last 12 months	< 50 years	4	4	17%	15
4		≥ 50 years	7	4	15%	21
5’	14 months during the last 24 months	< 25 years	7	4	17%	30
5		25-50 years	9	4	17%	30
6		≥ 50 years	15	4	15%	45
7	27 months during the last 36 months	50-55 years	20	4	15%	45
8		≥ 55 years	27	4	8%	60

B **–January 1997-December 2000**

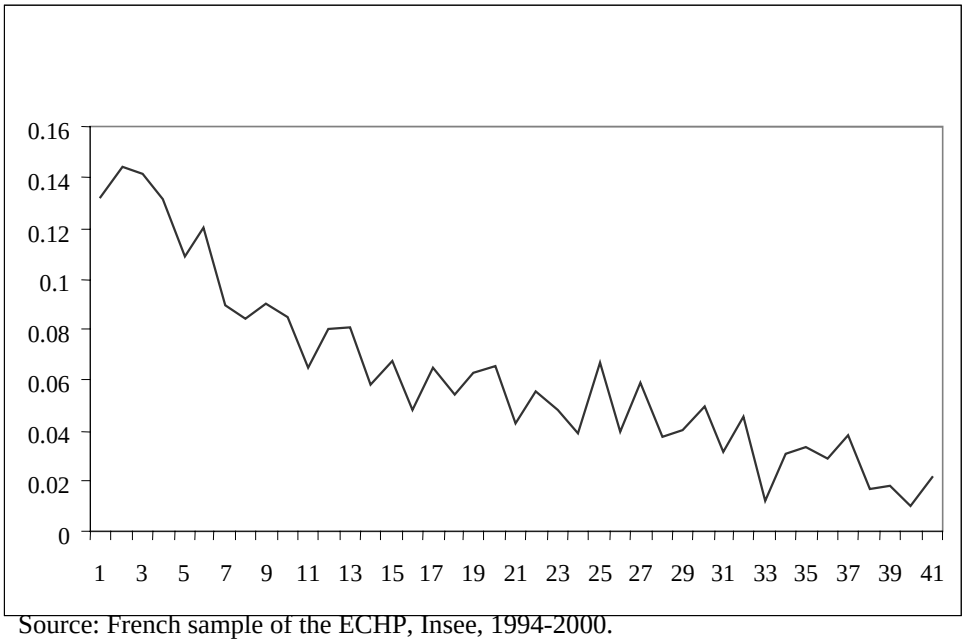
Category	Contribution duration	Age	Duration at full rate (months)	Stage duration (months)	% of decrease	Compensation duration (months)
1	4 months during the last 8 months	Indifferent	4	0	0%	4
2	6 months during the last 12 months	Indifferent	4	6	15%	7
3	8 months during the last 12 months	< 50 years	4	6	17%	15
4		≥ 50 years	7	6	15%	21
5	14 months during the last 24 months	< 50 years	9	6	17%	30
6		≥ 50 years	15	6	15%	45
7	27 months during the last 36 months	50-55 years	20	6	15%	45
8		≥ 55 years	27	6	8%	60

Table 2 – **Descriptive statistics**

	%
Gender	
Men	49.03
Women	50.97
Educational level	
No diploma	16.34
Elementary school	5.9
Vocational diploma	19.13
Junior high school	18.54
Technical school	10.79
High school graduate	6.94
College	22.35
Age	
≤ 25 years	37.56
26-35 years	29.92
36-45 years	18.3
46-55 years	11.69
≥ 55 years	2.52
Beginning yearof the unemployment spell	
1994	17.69
1995	19.96
1996	18.16
1997	15.53
1998	11.81
1999	9.51
2000	7.35
N	4438

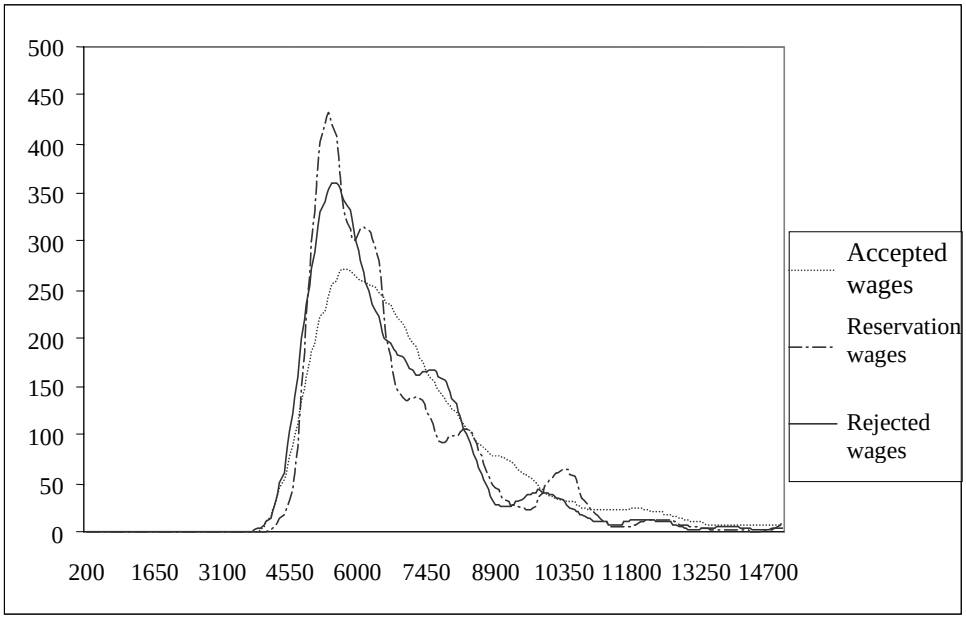
Source: French sample of the ECHP, Insee, 1994-2000.
Sample: unemployment spells beginning after December 1993.

Figure 1 – **Instantaneous exit rate from unemployment**



Source: French sample of the ECHP, Insee, 1994-2000.
Sample: unemployment spells beginning after December 1993.

Figure 2 – **Density functions of monthly accepted wages, reservation wages and rejected wages**



Source: French sample of the ECHP, Insee, 1994-2000.
Sample: unemployment spells beginning after December 1993.

Table 3 **– Estimated parameters of the structural model**

	ψ^2=25%		ψ^2=50%		ψ^2=75%		ψ^2=90%	
Wage offers equation								
Constant	8.72	(204.9)	8.69	(170.6)	8.61	(143.1)	8.53	(121.0)
Age	0.0092	(5.8)	0.0095	(5.2)	0.0088	(4.1)	0.0075	(3.1)
Age^2	-0.00007	(-1.4)	-0.00003	(-0.6)	0.00002	(0.3)	0.00008	(1.0)
Women	-0.13	(-13.2)	-0.10	(-9.3)	-0.07	(-5.9)	-0.05	(-3.5)
Born out of France	0.02	(1.0)	0.04	(2.0)	0.06	(2.7)	0.08	(3.2)
Living in Ile-de-France	0.16	(11.8)	0.16	(10.2)	0.16	(8.6)	0.16	(7.6)
Educational level								
No diploma or elementary school	-0.05	(-3.3)	-0.03	(-2.0)	-0.02	(-1.0)	0.00	(-0.2)
Vocational diploma	-0.04	(-2.9)	-0.05	(-2.9)	-0.06	(-2.9)	-0.07	(-2.9)
Technical school graduate	0.01	(0.7)	0.01	(0.4)	0.00	(0.0)	-0.01	(-0.3)
High school graduate	0.04	(1.8)	0.04	(1.7)	0.03	(1.2)	0.02	(0.8)
College graduate	0.17	(11.6)	0.16	(9.7)	0.14	(7.7)	0.13	(6.3)
Local labor market								
Unemployment rate	-0.0039	(-1.9)	-0.0019	(-0.8)	0.0002	(0.1)	0.00222	(0.7)
Long-term unemployment rate	0.0015	(1.1)	0.0017	(1.1)	0.0018	(1.0)	0.00140	(0.7)
Past labor market state								
Permanent part-time job	-0.17	(-7.1)	-0.15	(-5.3)	-0.13	(-3.8)	-0.12	(-2.8)
Temporary full-time job	-0.01	(-0.6)	0.01	(0.2)	0.02	(0.4)	0.02	(0.4)
Temporary part-time job	0.03	(1.1)	0.10	(2.9)	0.16	(3.6)	0.21	(3.8)
Military service	-0.20	(-7.5)	-0.21	(-7.6)	-0.22	(-7.4)	-0.24	(-7.4)
Occasionnal activities	-0.04	(-1.9)	-0.03	(-1.3)	-0.02	(-0.8)	-0.02	(-0.5)
Inactivity	-0.08	(-3.2)	-0.02	(-0.7)	0.03	(0.7)	0.08	(1.7)
Temporal dummy								
1994	-0.11	(-6.7)	-0.13	(-5.6)	-0.12	(-4.4)	-0.11	(-3.8)
1996	0.00	(0.3)	-0.04	(-1.8)	-0.03	(-1.4)	-0.03	(-1.1)
1997	0.14	(5.4)	0.12	(4.9)	0.10	(4.1)	0.10	(3.6)
1998	0.12	(4.6)	0.06	(2.3)	0.04	(1.6)	0.02	(0.8)
1999	0.13	(7.0)	0.05	(2.0)	0.02	(1.0)	0.01	(0.5)
2000	0.242	(12.9)	0.138	(6.0)	0.09	(3.4)	0.05	(1.9)
Duration (except for the previous employed in a temporary job)								
1-6 months	-0.016	(-4.3)	-0.020	(-3.4)	-0.027	(-3.3)	-0.035	(-3.4)
7-12 months	-0.006	(-1.9)	-0.006	(-1.1)	-0.004	(-0.5)	-0.002	(-0.2)
13-24 months	-0.007	(-3.6)	-0.010	(-3.0)	-0.012	(-2.7)	-0.014	(-2.4)
25-36 months	0.005	(1.8)	0.017	(4.3)	0.028	(5.4)	0.036	(5.7)
Duration (for the previous employed in a temporary job)								
1-6 months	-0.029	(-7.6)	-0.040	(-7.4)	-0.052	(-7.6)	-0.066	(-8.0)
7-12 months	-0.015	(-4.2)	-0.017	(-3.2)	-0.017	(-2.4)	-0.015	(-1.8)
13-24 months	-0.005	(-1.9)	-0.005	(-1.3)	-0.004	(-0.8)	-0.002	(-0.4)
25-36 months	0.002	(0.6)	0.011	(2.4)	0.020	(3.2)	0.026	(3.4)
Standard error σ_u	0.13	(55.9)	0.21	(54.1)	0.31	(52.5)	0.42	(50.7)

Job offers equation								
Constant	-1.19	(-5.0)	-1.15	(-4.9)	-1.11	(-4.9)	-1.13	(-5.1)
Age	-0.0005	(-0.1)	-0.0018	(-0.2)	-0.0014	(-0.2)	0.0009	(0.1)
Age^2	-0.00057	(-2.2)	-0.00063	(-2.4)	-0.00067	(-2.7)	-0.00073	(-2.9)
Women	-0.23	(-4.5)	-0.25	(-4.8)	-0.25	(-5.0)	-0.25	(-5.2)
Born out of France	-0.253	(-2.8)	-0.251	(-2.8)	-0.24	(-2.8)	-0.25	(-2.9)
Living in Ile-de-France	0.00	(0.0)	-0.02	(-0.2)	-0.03	(-0.4)	-0.03	(-0.4)
Educational level								
No diploma or elementary school	-0.13	(-1.6)	-0.14	(-1.7)	-0.13	(-1.6)	-0.13	(-1.7)
Vocational diploma	0.05	(0.7)	0.07	(0.9)	0.09	(1.2)	0.10	(1.3)
Technical school graduate	0.08	(0.8)	0.10	(1.1)	0.12	(1.3)	0.12	(1.3)
High school graduate	0.05	(0.5)	0.05	(0.5)	0.06	(0.6)	0.06	(0.6)
College graduate	0.13	(1.7)	0.15	(1.9)	0.16	(2.1)	0.17	(2.3)
Local labor market								
Unemployment rate	-0.03	(-2.5)	-0.03	(-2.4)	-0.03	(-2.4)	-0.03	(-2.5)
Long-term unemployment rate	0.00	(0.4)	0.00	(0.0)	0.00	(-0.1)	0.00	(0.1)
Past labor market state								
Permanent part-time job	-0.19	(-1.4)	-0.20	(-1.5)	-0.20	(-1.5)	-0.20	(-1.5)
Temporary full-time job	0.44	(3.3)	0.49	(3.7)	0.52	(4.1)	0.53	(4.3)
Temporary part-time job	-0.11	(-0.7)	-0.08	(-0.6)	-0.05	(-0.3)	-0.03	(-0.2)
Military service	0.47	(3.7)	0.51	(4.0)	0.51	(4.2)	0.50	(4.3)
Occasionnal activities	0.07	(0.6)	0.08	(0.6)	0.08	(0.7)	0.08	(0.7)
Inactivity	-0.44	(-2.8)	-0.47	(-3.2)	-0.47	(-3.3)	-0.46	(-3.3)
Temporal dummy								
1994	0.09	(1.0)	0.10	(1.2)	0.05	(0.6)	0.02	(0.3)
1996	0.16	(1.8)	0.16	(1.9)	0.09	(1.1)	0.05	(0.7)
1997	-0.17	(-1.4)	-0.13	(-1.3)	-0.09	(-1.0)	-0.06	(-0.8)
1998	0.00	(0.0)	0.04	(0.4)	0.04	(0.4)	0.06	(0.7)
1999	0.15	(1.6)	0.17	(1.8)	0.12	(1.3)	0.10	(1.2)
2000	0.12	(1.1)	0.27	(2.5)	0.27	(2.7)	0.25	(2.7)
Duration (except for the previous employed in a temporary job)								
1-6 months	0.07	(2.5)	0.06	(2.3)	0.07	(2.5)	0.07	(2.8)
7-12 months	-0.06	(-2.4)	-0.06	(-2.5)	-0.07	(-2.8)	-0.07	(-3.1)
13-24 months	0.01	(0.6)	0.01	(0.7)	0.01	(0.7)	0.01	(0.6)
25-36 months	-0.06	(-2.6)	-0.07	(-3.4)	-0.07	(-3.7)	-0.07	(-3.7)
Duration (for the previous employed in a temporary job)								
1-6 months	0.02	(1.0)	0.02	(0.9)	0.02	(1.1)	0.03	(1.5)
7-12 months	-0.05	(-1.7)	-0.05	(-2.0)	-0.06	(-2.4)	-0.07	(-2.7)
13-24 months	-0.01	(-0.6)	-0.01	(-0.6)	-0.01	(-0.6)	-0.02	(-0.8)
25-36 months	-0.03	(-1.2)	-0.04	(-1.4)	-0.04	(-1.6)	-0.04	(-1.8)
Standard deviation of measurement error of reservation wage σ_w	0.25	(67.4)	0.24	(68.5)	0.24	(68.5)	0.25	(67.9)
Discount rate ρ	0.0033	(8.1)	0.0079	(11.8)	0.0126	(15.7)	0.0160	(18.2)

Source: French sample of the ECHP, Insee, 1994-2000.
Sample: unemployement spells beginning after December 1993.
Note: t-ratio are in parentheses. Estimation by maximum likelihood. Reference: a man, born in France, junior high school graduate, unemployed in 1995, previously employed in a permanent full-time job.

Table 4 – **Estimations using and not using reported reservation wages (ψ^2=50%)**

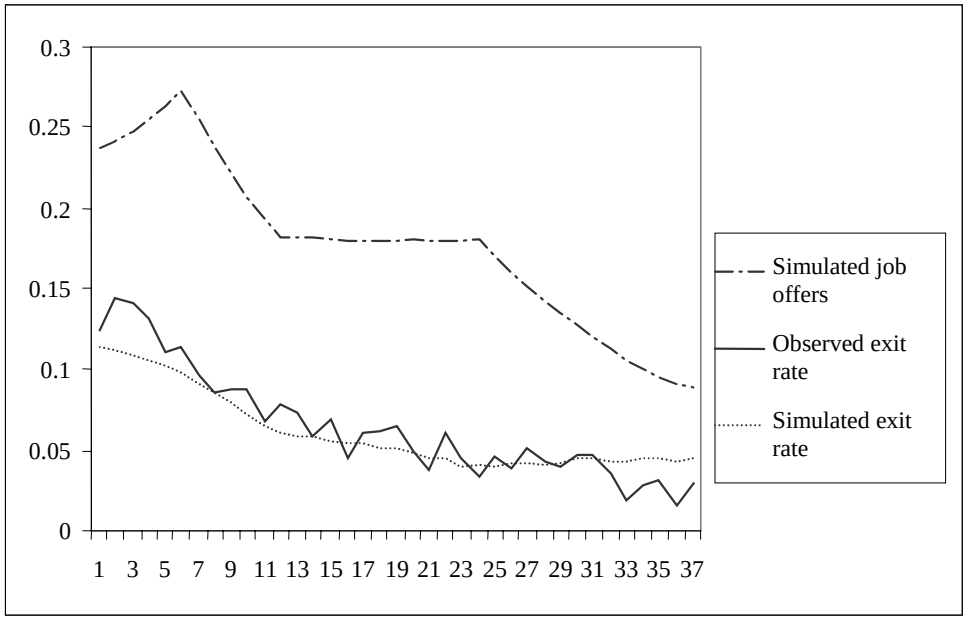
	Not using reported reservation wages		**Using reported reservation wages**	
Wage offers equation				
Constant	8.65	(129.4)	8.69	(170.6)
Age	0.0125	(4.4)	0.0095	(5.2)
Age^2	-0.00016	(-1.7)	-0.00003	(-0.6)
Women	-0.11	(-6.7)	-0.10	(-9.3)
Born out of France	0.05	(1.7)	0.04	(2.0)
Living in Ile-de-France	0.16	(7.2)	0.16	(10.2)
Educational level				
No diploma or elementary school	-0.05	(-2.0)	-0.03	(-2.0)
Vocational diploma	-0.07	(-2.9)	-0.05	(-2.9)
Technical school graduate	-0.01	(-0.3)	0.01	(0.4)
High school graduate	-0.04	(-1.0)	0.04	(1.7)
College graduate	0.13	(5.5)	0.16	(9.7)
Local labor market				
Unemployment rate	-0.0083	(-2.4)	-0.0019	(-0.8)
Long-term unemployment rate	0.0031	(1.4)	0.0017	(1.1)
Past labor market state				
Permanent part-time job	-0.07	(-1.5)	-0.15	(-5.3)
Temporary full-time job	0.02	(0.7)	0.01	(0.2)
Temporary part-time job	0.05	(1.1)	0.10	(2.9)
Military service	-0.20	(-5.6)	-0.21	(-7.6)
Occasionnal activities	-0.04	(-1.0)	-0.03	(-1.3)
Inactivity	-0.09	(-1.9)	-0.02	(-0.7)
Temporal dummy				
1994	-0.13	(-4.9)	-0.13	(-5.6)
1996	-0.02	(-0.8)	-0.04	(-1.8)
1997	0.15	(4.6)	0.12	(4.9)
1998	0.17	(5.3)	0.06	(2.3)
1999	0.20	(7.1)	0.05	(2.0)
2000	0.41	(13.4)	0.138	(6.0)
Duration (except for the previous employed in a temporary job)				
1-6 months	-0.026	(-4.4)	-0.020	(-3.4)
7-12 months	-0.009	(-1.8)	-0.006	(-1.1)
13-24 months	-0.012	(-3.9)	-0.010	(-3.0)
25-36 months	0.003	(0.6)	0.017	(4.3)
Duration (for the previous employed in a temporary job)				
1-6 months	-0.044	(-7.3)	-0.040	(-7.4)
7-12 months	-0.025	(-4.3)	-0.017	(-3.2)
13-24 months	-0.008	(-1.8)	-0.005	(-1.3)
25-36 months	-0.002	(-0.4)	0.011	(2.4)

Standard error σ_u	0.22	(51.0)	0.21	(54.1)
Job offers equation				
Constant	-1.18	(-5.0)	-1.15	(-4.9)
Age	-0.0010	(-0.1)	-0.0018	(-0.2)
Age^2	-0.00054	(-2.1)	-0.00063	(-2.4)
Women	-0.23	(-4.4)	-0.25	(-4.8)
Born out of France	-0.23	(-2.6)	-0.251	(-2.8)
Living in Ile-de-France	-0.02	(-0.2)	-0.02	(-0.2)
Educational level				
No diploma or elementary school	-0.13	(-1.7)	-0.14	(-1.7)
Vocational diploma	0.05	(0.6)	0.07	(0.9)
Technical school graduate	0.07	(0.8)	0.10	(1.1)
High school graduate	0.03	(0.2)	0.05	(0.5)
College graduate	0.11	(1.4)	0.15	(1.9)
Local labor market				
Unemployment rate	-0.03	(-2.6)	-0.03	(-2.4)
Long-term unemployment rate	0.00	(0.2)	0.00	(0.0)
Past labor market state				
Permanent part-time job	-0.19	(-1.4)	-0.20	(-1.5)
Temporary full-time job	0.46	(3.5)	0.49	(3.7)
Temporary part-time job	-0.09	(-0.6)	-0.08	(-0.6)
Military service	0.47	(3.8)	0.51	(4.0)
Occasionnal activities	0.10	(0.8)	0.08	(0.6)
Inactivity	-0.39	(-2.5)	-0.47	(-3.2)
Temporal dummy				
1994	0.07	(0.8)	0.10	(1.2)
1996	0.19	(2.2)	0.16	(1.9)
1997	-0.01	(-0.1)	-0.13	(-1.3)
1998	0.11	(1.1)	0.04	(0.4)
1999	0.28	(2.9)	0.17	(1.8)
2000	0.24	(2.1)	0.27	(2.5)
Duration (except for the previous employed in a temporary job)				
1-6 months	0.07	(2.5)	0.06	(2.3)
7-12 months	-0.06	(-2.6)	-0.06	(-2.5)
13-24 months	0.01	(0.6)	0.01	(0.7)
25-36 months	-0.06	(-2.4)	-0.07	(-3.4)
Duration (for the previous employed in a temporary job)				
1-6 months	0.02	(0.7)	0.02	(0.9)
7-12 months	-0.05	(-1.9)	-0.05	(-2.0)
13-24 months	-0.01	(-0.6)	-0.01	(-0.6)
25-36 months	-0.04	(-1.3)	-0.04	(-1.4)
Standard deviation of measurement error of reservation wage σ_w			0.24	(68.5)

Discount rate ρ	0.0039	(7.7)	0.0079	(11.8)

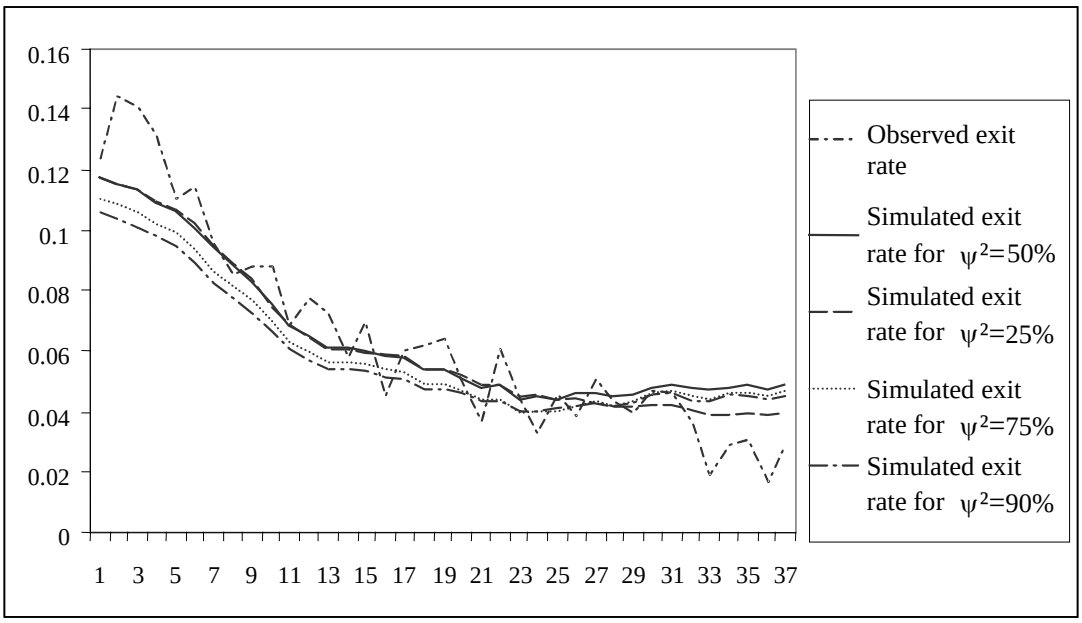
Source: French sample of the ECHP, Insee, 1994-2000.
Sample: unemployement spells beginning after December 1993.
Note: t-ratio are in parentheses. Estimation by maximum likelihood. Reference: a man, born in France, junior high school graduate, unemployed in 1995, previously employed in a permanent full-time job.

Figure 3 – **Simulated job offers arrival rate, and observed and simulated exit rates (ψ^2=50%)**



Source: French sample of the ECHP, Insee, 1994-2000.
Sample: unemployment spells beginning after December 1993.
Note: the arrival rate of job offers and the exit rate are simulated on the sample using the estimated parameters of the job search model with ψ^2=50%.

Figure 4 – **Observed and simulated exit rates (ψ^2=50%, 25%, 70%, 90%)**



Source: French sample of the ECHP, Insee, 1994-2000.
Sample: unemployment spells beginning after December 1993.
Expected unemployment duration: 14.01 months for ψ^2=50%; 14.46 months for ψ^2=25%; 14.35 months for ψ^2=75%; 15.04 months for ψ^2=90%.

Table 5 – **Exit rates simulated in the situation of reference; with a 14% increase in UI benefits (A); the remplacement of the declining time sequence of benefits by a constant sequence (B); the reform B combined with the imposition of punitive sanctions if two job offers are refused (C); a 3 months increase in the maximum duration of UI entitlement (D)**

Elapsed duration	Simulated hazard *Reference*	Simulated hazard *(A)*	Simulated hazard *(B)*	Simulated hazard *(C)*	Simulated hazard *(D)*
1	0.114	0.112	0.111	0.119	0.114
2	0.112	0.110	0.109	0.118	0.112
3	0.110	0.107	0.106	0.116	0.109
4	0.105	0.103	0.101	0.113	0.105
5	0.102	0.100	0.098	0.111	0.102
6	0.097	0.095	0.092	0.106	0.097
7	0.090	0.088	0.085	0.099	0.090
8	0.085	0.083	0.079	0.093	0.084
9	0.079	0.078	0.074	0.087	0.079
10	0.072	0.070	0.066	0.078	0.072
11	0.065	0.064	0.060	0.071	0.065
12	0.061	0.060	0.056	0.067	0.061
13	0.058	0.057	0.052	0.063	0.057
14	0.058	0.056	0.052	0.063	0.058
15	0.056	0.055	0.051	0.061	0.056
16	0.055	0.054	0.049	0.059	0.055
17	0.054	0.053	0.048	0.058	0.054
18	0.050	0.050	0.045	0.054	0.050
19	0.050	0.049	0.044	0.053	0.050
20	0.048	0.047	0.042	0.050	0.048
21	0.045	0.044	0.039	0.047	0.045
22	0.045	0.044	0.038	0.047	0.045
23	0.040	0.039	0.035	0.041	0.040
24	0.041	0.040	0.035	0.042	0.041
25	0.040	0.040	0.035	0.040	0.040
26	0.042	0.042	0.037	0.042	0.042
27	0.042	0.042	0.038	0.041	0.042
28	0.041	0.041	0.037	0.040	0.040
29	0.042	0.042	0.038	0.042	0.042
30	0.045	0.045	0.041	0.043	0.044
31	0.045	0.045	0.041	0.043	0.045
32	0.044	0.044	0.040	0.042	0.044
33	0.044	0.043	0.040	0.041	0.044
34	0.044	0.045	0.041	0.043	0.045
35	0.045	0.045	0.040	0.044	0.045
36	0.043	0.043	0.040	0.043	0.044
37	0.045	0.045	0.042	0.043	0.045
Expected duration	14.01	14.35	15.4	13.15	14.07

Sample: all the unemployed.

Note: the completed duration is computed using the simulated hazard (with ψ^2=50%).

Tableau 6 – **Exit rates simulated in the situation of reference; with a 14% increase in UI benefits (A); the remplacement of the declining time sequence of benefits by a constant sequence (B); the reform B combined with the imposition of punitive sanctions if two job offers are refused (C); a 3 months increase in the maximum duration of UI entitlement (D)**

Elapsed duration	Simulated hazard *reference*	Simulated hazard *(A)*	Simulated hazard *(B)*	Simulated hazard *(C)*	Simulated hazard *(D)*
1	0.103	0.099	0.097	0.114	0.102
2	0.101	0.097	0.093	0.115	0.100
3	0.098	0.094	0.089	0.113	0.097
4	0.093	0.089	0.084	0.110	0.092
5	0.089	0.084	0.079	0.107	0.088
6	0.083	0.080	0.073	0.103	0.082
7	0.075	0.072	0.064	0.092	0.074
8	0.071	0.068	0.060	0.087	0.071
9	0.072	0.069	0.060	0.087	0.072
10	0.064	0.061	0.052	0.076	0.063
11	0.057	0.054	0.045	0.067	0.057
12	0.051	0.049	0.041	0.062	0.051
13	0.050	0.048	0.039	0.061	0.050
14	0.051	0.049	0.039	0.059	0.050
15	0.050	0.047	0.037	0.058	0.049
16	0.046	0.044	0.036	0.053	0.046
17	0.050	0.048	0.038	0.056	0.050
18	0.048	0.046	0.035	0.055	0.048
19	0.044	0.042	0.033	0.049	0.044
20	0.043	0.041	0.031	0.048	0.043
21	0.040	0.039	0.030	0.043	0.040
22	0.041	0.040	0.030	0.044	0.041
23	0.039	0.038	0.028	0.041	0.038
24	0.037	0.037	0.028	0.038	0.037
25	0.038	0.037	0.027	0.036	0.038
26	0.041	0.041	0.030	0.043	0.041
27	0.042	0.041	0.032	0.042	0.042
28	0.043	0.042	0.033	0.041	0.042
29	0.042	0.041	0.033	0.040	0.041
30	0.043	0.043	0.037	0.042	0.043
31	0.047	0.046	0.039	0.044	0.046
32	0.047	0.046	0.040	0.041	0.046
33	0.044	0.045	0.037	0.041	0.043
34	0.046	0.046	0.038	0.041	0.046
35	0.042	0.041	0.034	0.040	0.041
36	0.043	0.043	0.035	0.038	0.043
37	0.043	0.043	0.037	0.043	0.043
Expected Duration	16.01	16.7	19.93	13.78	16.17

Sample: the top quartile of the UI benefits distribution (at full rate).

Note: the completed duration is computed using the simulated hazard (with ψ^2=50%).