Imperfect Monitoring of Job Search and Non-Stationarity: 
Structural Estimation and Policy Design*

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Abstract
This paper sets up and estimates a non-stationary structural job search model that incorporates the main stylized features of job search monitoring in Belgian Unemployment Insurance. It finds weak behavioral effects of the reform, essentially because (i) the monitoring technology was not sufficiently precise, (ii) many unemployed were found to have so high search costs that they could not be induced to actively search for jobs, and (iii) the job search assessments were scheduled much too late in the unemployment spell. Too early scheduling should, however, also be avoided, as to leave time to react to the sanction threat.

Keywords: Monitoring, sanctions, non-stationary job search, unemployment benefits, structural estimation.

JEL Classification: J64, J68, C41.

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1 Introduction

The provision of Unemployment Insurance (UI) involves a trade-off between insurance and work incentives. By now it is well-studied how limiting the coverage of UI and the duration of benefit entitlement can restore work incentives. At the same time, apart from limiting the entitlement and coverage, most of the UI schemes also provide incentives by imposing job search requirements on benefit claimants, monitoring the resulting search activity, and issuing sanctions in case of non-compliance. Recently, there has been a growing interest of researchers in the evaluation of such job search monitoring (see below). However, the behavioral channels through which these policies work remain largely unknown, in particular when the unemployed are informed about the timing of the monitoring interviews and sanctions. By integrating a monitoring scheme and the announced timing of associated interviews and sanctions within a structural job search model, we throw light on the dynamic behavioral adjustments induced by such a scheme. We furthermore provide a unified theoretical and empirical framework for investigating the effectiveness and welfare consequences of a typical job search monitoring program.

In many OECD countries monitoring of job search effort is organized along fairly standardized lines (OECD, 2007). It starts off with a notification (often at initial registration) by which the unemployed worker is informed about the search requirements and the proofs thereof to deliver. Simultaneously the worker is informed about the timing of the evaluations of search effort and about the associated sanctions in the case of noncompliance. At the prescribed dates, past job search effort is evaluated on the basis of transmitted paper proofs of job applications or in face-to-face interviews. If the outcome of the evaluation is negative, a sanction in the form of a temporary and partial reduction of unemployment benefits (UB) usually follows. In addition, a subsequent monitoring interview is planned shortly afterwards. In the case of a second negative evaluation, the penalty is reinforced and can even lead to a permanent withdrawal of UB. If the outcome of the evaluation is positive, no sanction is imposed and a subsequent monitoring interview is scheduled, but usually not so quickly as in the case of a negative evaluation.

In this paper we develop and estimate a non-stationary structural job search model which integrates some key ingredients of the job search monitoring scheme that has been introduced in Belgian UI in 2004: an indefinite entitlement to UB subject to job search requirements, an announced timing (with potential delays) of a sequence of meetings in which job search is assessed and (possibly temporary) benefit sanctions are imposed in case of non-compliance, an imperfect monitoring technology that acknowledges that job search effort and requirements are not perfectly measurable. The latter ingredient is crucial, as a model that does not capture this imperfection will result in a too favorable evaluation of the monitoring scheme (Cockx et al., 2014). Even if in Belgium the frequency of meetings is extremely low, while sanctions are very high relative to monitoring schemes in other OECD countries, the structure of the monitoring scheme is very comparable. Our model can therefore provide insights on the optimal design of monitoring schemes and form a basis for the evaluation of schemes operative in other countries.

Overall, we find that job search monitoring hardly enhanced the job finding rate, because (i) the monitoring technology was not sufficiently accurate, (ii) many unemployed were found to have so high search costs that they could not be induced to actively search for jobs, and (iii) the job search assessments were scheduled much too late in the unemployment spell. Simulations show, however, that in the presence of search frictions too early scheduling, as in many OECD countries, should also be avoided, as to leave time to react to the sanction threat.

Mortensen (1977) was the first to integrate the effect of a finite UI entitlement within a non-stationary job search model. It was not before the seminal papers of Wolpin (1987) and van den Berg (1990) that such non-stationary job search models were also estimated. More recently, Garcia-Perez
(2006), Frijters and van der Klaauw (2006), and Lollivier and Rioux (2010) have further developed the estimation of non-stationary job search models, all maintaining the assumption of exogenous job search intensity. Bloemen (2005), Fougerè et al. (2009) and van der Klaauw and van Vuuren (2010) among others have estimated job search models with endogenous job search intensity, though assuming a stationary environment. DellaVigna and Paserman (2005), Paserman (2008) is, to our knowledge, the first to allow for endogenous search in a non-stationary setting, where non-stationarity stems from the finite entitlement to UI\textsuperscript{2}. The model of Paserman (2008) does not consider monitoring of job search effort, but simulations based on this model investigate the implications of a simplified monitoring scheme in which UB is withdrawn if search effort falls below a particular threshold. We add to this literature by combining in a unified empirical framework, that explicitly takes unobserved heterogeneity into account, non-stationarity, endogeneity of search effort, and sanctions.

To our knowledge, only van den Berg and van der Klaauw (2013) have developed and estimated a stationary structural job search model which integrates job search monitoring. Their approach of modeling the monitoring imperfection is different from ours. We capture it by modeling the outcome of the evaluation of search effort as a random decreasing function of average past job search effort (Boone et al., 2007). Following van den Berg and van der Klaauw (2006), they assume that the unemployed search through two imperfectly substitutable channels: a formal and informal one. Search effort is perfectly observed and, hence, monitored in the formal channel, while it cannot be verified at all and, hence, is not monitored in the informal channel. They consider an intensive monitoring policy targeted at short-term relatively skilled unemployed individuals in the Netherlands. Their model reveals that job search channel substitution does not only reduce the effectiveness of monitoring, but that, together with on-the-job search, it also mitigates the adverse effects of monitoring on job quality, as measured by accepted wages and job duration.

Other researchers have developed partial and equilibrium job search models that comprise job search monitoring, but they did not estimate these models. Usually, these models assume that job search effort can be perfectly monitored (Pavoni and Violante, 2007; Manning, 2009; Petrongolo, 2009; Wunsch, 2013), that the probability of negative evaluation is independent of search effort (Abbring et al., 2005), or that it depends on the acceptance of suitable job offers (Ljungqvist and Sargent, 1995; Boone et al., 2009), or on voluntary quits (van den Berg et al., 2015). An imperfect monitoring technology in which the probability of negative evaluation depends on search effort would, however, square better with the existing schemes (OECD, 2007, p.218). To our knowledge, only two studies have considered such imperfect monitoring technology. Setty (2015) builds a dynamic principal-agent model with two levels of search effort to address a question of optimal UI with a probabilistic monitoring technology in which the probability of negative evaluation decreases with the effort level. Boone et al. (2007) consider a stationary equilibrium search model with sanctions. They assume, as we do, that effort is imperfectly observable to the planner, but, in contrast to us, that the unemployed are perfectly informed about the search requirements (see their Appendix C). Here we do not develop an equilibrium job search model. The assumption that the wage offer distribution and the supply of vacancies are unaffected is reasonable for the Belgian monitoring scheme, since this targets only long-term unemployed representing a small fraction of the potential recruits. However, when considering policy reforms in which monitoring would target short-term unemployed our partial equilibrium framework should be treated as an approximation.

There exists a more abundant empirical literature evaluating the effectiveness of monitoring schemes within reduced form models. Early studies\textsuperscript{3} found positive effects of monitoring on the job finding rate. However, since programs themselves often combined counseling with monitoring, they could not disentangle which of these components was responsible for such findings. A number of later contri-

\textsuperscript{2}Launov and Wälde (2013) formulate and estimate a non-stationary matching model with endogenous effort and time-dependent benefits, but focus rather on equilibrium effects of UB reduction in a Mortensen-Pissarides setting.

butions have succeeded in isolating the pure effects of monitoring. Klepinger et al. (1997) in the US, Lalive et al. (2005) in Switzerland and McVicar (2008) in Northern Ireland demonstrate that monitoring significantly increases transitions to employment. In contrast to this evidence, Ashenfelter et al. (2005) find that tighter search requirements in the US have insignificant effects on transitions to employment and Klepinger et al. (2002) report even slightly decreasing job finding rates. This is in line with the insignificant effect of job search monitoring reported by van den Berg and van der Klaauw (2006) for the Netherlands. They argue that this result is caused by substitution of formal by informal search, a phenomenon that would be especially relevant for well qualified short-term unemployed on whom they focus in their study. Finally, Manning (2009) finds that too strict search requirements may lead UB recipients to stop claiming and withdraw from the labor force. Petrongolo (2009) confirms this, demonstrating moreover that monitoring substantially decreases employment stability and annual earnings in the long term. Arni et al. (2013) find the same for post-unemployment earnings.

Using the same data as in this paper, in an application of a regression discontinuity design (RDD) at the age threshold of 30 years, Cockx and Dejemeppe (2012) found that job search monitoring did not have any impact on transition to inactivity. However, it did increase the transition rate to employment by nearly nine percentage points eight months after monitoring started, but before the first evaluation of job search effort took place. Given that at this first evaluation the unemployed do not risk a benefit sanction (only in the case of recidivism four months later), this high treatment effect is puzzling. One explanation is that, despite being robust, the treatment effect was, due to a relatively small sample size, imprecisely estimated. By imposing restrictions implied by our structural model we indeed obtain a much smaller treatment effect.

Our paper is organized as follows. Section 2 provides information on the institutional setting. Section 3 describes the sample selection and the data. In Section 4 we present the job search model that incorporates the main features of the Belgian monitoring scheme and that we estimate subsequently. Section 5 develops the econometric model (specification and likelihood contributions) and discusses identification. Section 6 reports the estimation results: the estimated parameters, an internal validation analysis in which we check the goodness-of-fit of our model, and an external validation of the model. Since parameter estimates are not very informative of the model’s implied behavioral responses to the monitoring of job search, we also simulate the model to graphically display in this section these implied responses. In Section 7 we conduct a welfare analysis in which we evaluate on the basis of simulations the existing scheme as well as investigate whether and in which direction the design of the scheme in place (in terms of timing of assessments, strength of the sanction and precision of the monitoring technology) could be improved. Section 8 summarizes our key results and sets avenues for future research. The (Internet) Appendix contains further technical details of the theoretical and econometric model and its solution.

2 The Belgian Job Search Monitoring Scheme

2.1 The Institutional Setting

In Belgium, UI, monitoring and sanctions are organized at the federal level. The Public Employment Services (PES) are organized at the regional level. They are in charge of counseling, job search assistance, intermediation services and training. In Belgium a worker is entitled to UI in two instances: (i) after graduation from school conditional on a waiting period of 9 months; (ii) after involuntary dismissal from a sufficiently long-lasting job. In contrast to many other countries there is
in principle no time limit to UI. However, sanctions can imply a loss of entitlement to UI, in particular in the context of the policy evaluated in this paper (see below). School-leavers are entitled to flat rate benefits while dismissed workers earn a gross replacement rate ranging between 40% and 60% of past earnings, which is bracketed by a floor and a cap. The benefit level depends on household type (head of household, cohabitant or single) and on unemployment duration for dismissed singles and cohabitants (for whom benefits can drop after one year, and subsequently a second time three or, depending on past work experience, more than three months later). These principles are valid for the period covered by our empirical analysis.

Before 2004, no job search requirements were imposed on the unemployed. In 2004, an important reform introduced such requirements together with a monitoring scheme in which the benefits can be withdrawn if search effort is insufficient. In some regions the reform was accompanied by the provision of more counseling and training. This was not the case in Flanders. Since we aim at evaluating the effects of the monitoring scheme only, the analysis below is restricted to just the Flemish region.

The monitoring scheme was gradually phased in by age group. Between July 2004 and June 2005 only unemployed workers younger than 30 (on July 1) were concerned. In the following year those younger than 40 were included and between July 2006 and June 2007 those younger than 50. Individuals aged between 50 and 54 years must comply to the job requirements since 2014. There were no other labor market reforms affecting the target group during the period of analysis between 2004 and 2006.

Figure 1: Timing of the Monitoring Procedure in Case of Negative Evaluation

The monitoring procedure consists of a notification and a sequence of face-to-face interviews. Figure 1 summarizes the timing of the notification, the first interview and the subsequent interviews in case of negative evaluation. If the outcome of the evaluation is positive at any of the interviews, a new sequence of interviews is scheduled: 16 months later after the first interview and 12 months later otherwise.

First, the administration selects at \( t_s = t_0 - 2 \) individuals who have been entitled to UI for more than 12, but less than 13 months. In the second month after selection, i.e. at \( t_0 = 14 \), a notification letter is sent by mail. It states that entitlement to UB requires to actively search for a job and to participate in any action proposed by the regional PES. Some examples of search methods are provided and it is clearly stated that one should collect written proofs of the undertaken search actions. The letter announces that one will be invited at the UI office to evaluate the undertaken actions and that these evaluations start taking place 8 months after dispatch of the notification (\( t_1 = t_0 + 8 = 22 \)).

These monitoring interviews last approximately half an hour. If search effort at the first interview is deemed insufficient an action plan is drawn up, but the worker is not yet sanctioned. An action plan is an administrative form containing a list of job search activity types (renewing contact with the regional public employment service, sending application letters, registering with a temporary work agency, and the like) imposed by the caseworker together with an indication of a number of times each activity type should be chosen as to comply to the search requirements at the next meeting. An action plan is therefore an individually tailored guideline for the job seeker. However, these guidelines
were not very strictly followed and considerable discretion remained. Interviews with caseworkers in charge revealed that trade-offs between activity types were possible. Moreover, depending on the caseworker, action plans that were not completely satisfied would not automatically imply a sanction, while, conversely, action plans that were followed were not always exempted from negative evaluations. The content of action plans is not available in our data. Consequently, these action plans are taken into account in the model by allowing the sanction probabilities to vary between meetings (see Section 4.1). If at the next interview, 4 months later \( t_2 = t_1 + 4 = 26 \), it is established that the worker does not fulfill the plan, a second, stricter action plan is imposed and benefits are temporarily withdrawn during 4 months. If again, 4 months later \( t_3 = t_2 + 4 = 30 \) at the third interview, the worker does not comply, benefits are completely withdrawn and the worker can regain entitlement only after being uninterruptedly full-time employed during at least one year. If an UB recipient is sanctioned, she can apply to means-tested social assistance benefits (more information about these in Table 3 below).

The aforementioned timing of interviews is purely theoretical. In reality, meetings are delayed for various reasons and, hence, take place at random instants after the announced moments \( t_k \) for \( k \in \{1, 2, 3\} \). Since these delays last 5.75 months on average, they are not innocuous and will, hence, be taken into account in our modeling.

The low frequency of monitoring contrasts quite starkly with that in many other countries: half of OECD countries require reports of job search (in most cases) every two weeks or at least monthly (OECD, 2007). On the other hand, sanctions in case of non-compliance of the action plan seem generally tougher in Belgium than in other OECD countries. For instance, in the Netherlands, a typical punishment for insufficient job search is a 10% reduction of unemployment benefits for a period of 2 months (van den Berg and van der Klaauw, 2006).

Job-search effort is evaluated on the basis of proofs delivered by the unemployed worker (copies of application letters, registration in temporary help agencies, proofs of participation in a recruitment selection process, etc.). Regulations do not specify a minimum number of employer contacts to submit. Consequently, caseworkers have quite some discretion in the evaluation process.

Table 1: The Population Probability of Negative Evaluation Conditional on Being Interviewed\(^a\)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>First interview</td>
<td>33.5%</td>
</tr>
<tr>
<td>Second interview</td>
<td>45.8%</td>
</tr>
<tr>
<td>Third interview</td>
<td>57.8%</td>
</tr>
</tbody>
</table>

\(^a\) Measured in Flanders in the period of our empirical analysis.

Table 1 presents the population probability of negative evaluation conditional on being interviewed in the period of our empirical analysis. These probabilities are relatively high. This important non-compliance reflects the uncertainty regarding the effective search requirements induced by the aforementioned caseworkers’ discretion and regarding the measurement of their fulfillment (see Section 4).

Finally, observe also that nothing guarantees that the unemployed will face the same caseworker at the different interviews. Only in some districts unemployed individuals were in principle assigned to the same caseworker, but even in these districts this rule was often not followed-up for practical reasons. There is therefore little scope for learning about the evaluation standards across interviews.

\(^7\) However, as this is a prerogative of the regional PES, caseworkers are neither allowed to offer job vacancies nor may they propose participation in training programs. Furthermore, sanctioning refusals of suitable offers is a responsibility of another service within the federal UI agency.
Anyway, we cannot identify caseworkers in our data.

3 Data

3.1 Sample Selection Criteria

The data originate from several administrative sources registered between the beginning of 2001 and the end of 2006: (i) the federal UI agency for monthly information on UB claims, the timing and outcomes of the new monitoring scheme; (ii) various Social Security institutions for information about employment spells (including self-employment) and earnings (for salaried workers). Information about the reported job search actions at the evaluation meetings is not available. Since our model does not explain the choice of working hours, we just retain full-time occupations.

As of July 2004, the notification in the new monitoring procedure was sent only to individuals who were younger than 30 years old. Our sample is drawn from the very first notified cohorts. We ignore individuals who were at that moment younger than 25 years old because the policy was implemented differently for them. In order to determine the population to whom notifications are sent in a particular month (e.g. in July), the administration actually selects individuals who have been unemployed between 12 and 13 months according to the information available at the end of the second month prior to the month of dispatch of the notification (on May 31 in the example). Our sample retains these administratively selected individuals at the end of each month between May and August 2004 and to whom therefore a notification was sent between July and October 2004 if they were still UI claimants at that moment. To avoid modeling non-stationary behavior induced by a declining benefit level beyond selection, we discarded from this group cohabitants with sufficient past work experience to be at risk of such a decline (see Section 2.1). These criteria result in a sample of 903 individuals.

Since the sampling occurs two months before notification, we can check whether claimants anticipate the notification by leaving the unemployment register beforehand. Based on the same data Cockx and Dejemeppe (2012) could not find any evidence of such anticipation (see their Section 6.1.2). This means that we can safely assume that the moment of notification came as a surprise. This can be rationalized by the complexity of the duration counter used by the UI agency.

3.2 Descriptive Statistics

Table 2 reports summary statistics for the sample selected in 2004. Time-varying variables are evaluated at the sampling date. Monthly earnings are measured at the start of a salaried employment spell. All monetary variables are measured in 2004 euros. The table retains the individual characteristics conditioned upon in the empirical analysis (gender, the level of education, the household type determining the benefit level) and the type of entitlement (school-leaver or work experience). The monthly benefit level $b_h$ varies between 325€ and 1005€ and is on average 646€. Those who find a job earn net 1,200€ on average.

Table 3 describes the benefit levels in case of a sanction. These are means-tested social assistance benefits. Recall that no sanction is imposed after the first negative evaluation. After subsequent negative evaluations the same benefit amount is withdrawn, but the sanction is temporary after the second, while it is permanent after the third. The benefit loss $b_h - b_l$ ranges between 0 and 385 €/month. Table 3 reports the minimum and maximum sanction by category. School-leavers living alone (i.e. singles) cannot be imposed a benefit sanction, since they remain entitled to equivalent social assistance benefits. This concerns about 7% of the sample.

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8We assume that someone hired for two-third or more of a full-time is classified as a “full-time worker”. This represents nearly 80% of the exits to employment. The actual post-tax remuneration of the retained part-time workers has been scaled to a full-time job.
Table 2: Descriptive Statistics of the Individual Characteristics in the Retained Sample

<table>
<thead>
<tr>
<th><strong>Number of individuals</strong></th>
<th>903</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>45.2%</td>
</tr>
<tr>
<td><strong>Schooling level</strong></td>
<td></td>
</tr>
<tr>
<td>Primary or lower secondary (low)</td>
<td>34.8%</td>
</tr>
<tr>
<td>Upper-secondary (middle)</td>
<td>40.0%</td>
</tr>
<tr>
<td>Higher education (high)</td>
<td>25.2%</td>
</tr>
<tr>
<td><strong>Type of entitlement</strong></td>
<td></td>
</tr>
<tr>
<td>(monthly UB level in 2004 €)</td>
<td></td>
</tr>
<tr>
<td>Entitled by work experience</td>
<td>69.2%</td>
</tr>
<tr>
<td>Head of household (€865-1005)</td>
<td>22.1%</td>
</tr>
<tr>
<td>Single (€725-835)</td>
<td>32.7%</td>
</tr>
<tr>
<td>Cohabitant (€385)</td>
<td>14.4%</td>
</tr>
<tr>
<td>Entitled by schooling</td>
<td>30.8%</td>
</tr>
<tr>
<td>Head of household (€835)</td>
<td>1.8%</td>
</tr>
<tr>
<td>Single (€595)</td>
<td>7.2%</td>
</tr>
<tr>
<td>Cohabitant (€325)</td>
<td>21.8%</td>
</tr>
<tr>
<td><strong>Unemployment benefits</strong></td>
<td></td>
</tr>
<tr>
<td>Mean (2004 €)</td>
<td>646</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>(242)</td>
</tr>
<tr>
<td>25%</td>
<td>385</td>
</tr>
<tr>
<td>Median</td>
<td>725</td>
</tr>
<tr>
<td>75%</td>
<td>835</td>
</tr>
<tr>
<td><strong>Observed net monthly earnings (1st spell)</strong></td>
<td></td>
</tr>
<tr>
<td>Number of individuals</td>
<td>427</td>
</tr>
<tr>
<td>Mean (2004 €)</td>
<td>1,199</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>(279)</td>
</tr>
<tr>
<td>25%</td>
<td>1,066</td>
</tr>
<tr>
<td>Median</td>
<td>1,214</td>
</tr>
<tr>
<td>75%</td>
<td>1,358</td>
</tr>
</tbody>
</table>

a At the sample selection date.
Table 3: Assistance Benefit Levels in Case of a Sanction and Size of Sanction (Monthly Level in 2004€)

<table>
<thead>
<tr>
<th>Type of entitlement</th>
<th>2nd and 3rd interview</th>
<th>Min. sanction</th>
<th>Max. sanction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Entitled by work experience</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head of household ([865€-1005€])</td>
<td>802 €</td>
<td>63€</td>
<td>203€</td>
</tr>
<tr>
<td>Single ([725€-835€])</td>
<td>601 €</td>
<td>124€</td>
<td>234€</td>
</tr>
<tr>
<td>Cohabitant (385€)</td>
<td>0</td>
<td>385€</td>
<td>385€</td>
</tr>
<tr>
<td><strong>Entitled by schooling</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head of household (835€)</td>
<td>802 €</td>
<td>33€</td>
<td>33€</td>
</tr>
<tr>
<td>Single (595€)</td>
<td>595 €</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cohabitant (325€)</td>
<td>0</td>
<td>325€</td>
<td>325€</td>
</tr>
</tbody>
</table>

*a* At the sample selection date.

Table 4: Sampled Population at Each Step of the Monitoring Procedure

<table>
<thead>
<tr>
<th>Number of individuals</th>
<th>903</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Steps of the monitoring procedure</strong></td>
<td></td>
</tr>
<tr>
<td>Notification letter</td>
<td>723 (80.1%)</td>
</tr>
<tr>
<td>First interview</td>
<td>162 (17.9%)</td>
</tr>
<tr>
<td>Positive evaluation</td>
<td>112 (69.1%)</td>
</tr>
<tr>
<td>Negative evaluation</td>
<td>50 (30.9%)</td>
</tr>
<tr>
<td>Second interview</td>
<td>18 (36.0%)</td>
</tr>
<tr>
<td>Positive evaluation</td>
<td>16</td>
</tr>
<tr>
<td>Negative evaluation</td>
<td>2</td>
</tr>
<tr>
<td>Third interview</td>
<td>1 (50.0%)</td>
</tr>
<tr>
<td>Positive evaluation</td>
<td>1</td>
</tr>
<tr>
<td>Negative evaluation</td>
<td>0</td>
</tr>
</tbody>
</table>

*a* % in the population at risk.

Table 4 displays the number of sampled benefit claimants at the various steps of the procedure and the outcomes of each evaluation. Since these individuals may have found a job between the selection and the notification, only 723 out of the 903 are notified. Among those notified, 162 attend the first
4 Job Search in the Presence of Monitoring

In this section we derive in a continuous-time setting the job search behavior of infinitely-lived unemployed workers in case job search is monitored as in the Belgian scheme. Reverting to Figure 1 the unemployment spell, and, hence, job search behavior, can be divided up into five sub-periods: 

- Sub-periods: 
  - $[0, t_0)$
  - $[t_0, t_1)$
  - $[t_1, t_2)$
  - $[t_2, t_3)$
  - $[t_3, \infty)$

Calendar time starts at entry in unemployment so that (calendar) time and unemployment duration are synonyms. Since the unemployed in the retained sample are until notification (at $t_0$) unaware that they will be monitored, the scheme does not affect job search within the first sub-period $[0, t_0)$. Since before the reform the unemployed were entitled to a constant unemployment benefit $b_h$ without any time limit, their behavior within this first sub-period can be described by a standard stationary job search model and not explicitly formulated here.$^{19}$

Notice that once the new scheme is instituted and everyone knows about it, the monitoring will in principle be anticipated as from the start of the unemployment spell and, hence, behavior will be non-stationary as from this moment. When we will simulate some policy reforms in Sections 7.2 and 7.3 we will allow for this anticipatory behavior, instead of assuming that the policy arrives, as for the sampled individuals, by surprise at notification.

In the sequel we consider the behavior of a sampled individual, so that at $t_0$ the unemployed is notified by surprise that at time $t_1 > t_0$ her past job search effort (from $t_0$ onwards) will be evaluated at $t_1 = t_0 + 8$, and at $t_2 = t_1 + 4$ and $t_3 = t_2 + 4$ in case job search is deemed insufficient. Simultaneously, she is informed which sanction she risks in case of non-compliance: (i) at the first interview ($t_1$) an action plan is imposed, but the UB level remains at $b_h$; (ii) at the second interview ($t_2$) benefits are temporarily reduced to $b_f < b_h$; (iii) the benefits are permanently reduced to $b_f$ after a third negative evaluation ($t_3$).

The job search behavior depends on the outcome of the evaluation in each considered sub-period. Since in case of compliance the next evaluation will not take place within the next year, we assume that a standard stationary job search model in which the benefit level is set to $b_h$ without any time limit can approximate the resulting behavior. Similarly, we ignore that, after a third negative evaluation, individuals can be re-entitled to UI if they remain full-time employed for at least a year, so that the standard job search model with the UB set to $b_f$ can describe the behavior after $t_3$. We focus our discussion on how we model behavior within the three remaining sub-periods $[t_{k-1}, t_k)$, i.e. from notification to the first meeting ($k = 1$) and after negative assessment of search effort at the start of the two subsequent sub-periods ($k = 2$ or $k = 3$). In this discussion we focus on a generic sub-period $k$. Hence, the endogenous (control) variables for such a generic problem depend on $k$. However, to avoid clutter, we do not explicitly denote this dependence on $k$.

A feature that complicates the analysis is that evaluations do not take place at the scheduled moments $t_1$, $t_2$ and $t_3$, but are delayed for various reasons. As mentioned in Section 2.1 these delays are important and, hence, cannot be ignored in the empirical analysis. However, since accounting for these delays complicates the analysis substantially without affecting the main insights, we will first ignore them. A last subsection discusses how these delays are taken into account and how it affects the solution.

---

$^{19}$van den Berg and van der Klaauw (2013) report that in the Netherlands less than 3% were negatively evaluated and, in this institutional setting, also sanctioned.

$^{10}$For dismissed cohabitants and singles the benefit level could be step-wise decreasing in this first period, but since the abatement is not very large, we ignore it. In Section 6.3 we demonstrate that this approximation does not invalidate our analysis.
4.1 Monitoring Technology

Since job search requirements need not be satisfied at every instant of the evaluation period, a caseworker bases the evaluation on the average job search effort \( \bar{S}(t_k, t_{k-1}) \) exerted between \( t_{k-1} \) and \( t_k \)\(^{11}\)

\[
\bar{S}(t_k, t_{k-1}) = \frac{\int_{t_{k-1}}^{t_k} s(\tau) d\tau}{t_k - t_{k-1}},
\]

where \( s(\tau) \) denotes the instantaneous job search effort at time \( \tau \in [t_{k-1}, t_k) \), and here and in all subsequent equations \( k \in \{1, 2, 3\} \). We choose to measure job search effort in effective units. This means that \( s(\tau) \) directly measures the job arrival rate, i.e. the number of job offers per time unit. This is not an innocuous normalization, but with the available data and the estimated responses of job seekers to the monitoring scheme we cannot separately identify search intensity and the marginal impact of search effort on the job arrival rate. We return to this point when we discuss the identification of the econometric model in Section 5.2.

It is widely acknowledged, that it is very difficult for caseworkers to directly measure the search intensity of unemployed (see e.g. Boone et al., 2007). So, both instantaneous and average search effort are perfectly known to the unemployed, but not to the caseworker. The caseworker, instead, evaluates on the basis of the average observed search effort, \( \bar{S}^o(t_k, t_{k-1}) \), which may differ from the true average effort \( \bar{S}(t_k, t_{k-1}) \). The caseworker would typically use the observed number of job applications, which can be lower or higher than the number of job offers as measured by \( \bar{S}(t_k, t_{k-1}) \). If the observed average search effort is lower than the imposed search requirement \( R_k \), i.e. if \( \bar{S}^o(t_k, t_{k-1}) < R_k \), a sanction is imposed by (i) imposing an action plan with new search requirements \( R_2 \), but without affecting the level of UB \( (k = 1) \); (ii) imposing search requirements \( R_3 \) and temporarily reducing the benefit level to \( b_2 \) \( (k = 2) \); (iii) permanently reducing the benefit level to \( b_1 \) \( (k = 3) \). Otherwise the outcome of the evaluation is positive and the worker remains entitled to \( b_0 \) without any time limit.

We assume that the observed and the true search efforts are proportional to each other, such that:

\[
\bar{S}^o(t_k, t_{k-1}) = \xi \bar{S}(t_k, t_{k-1}).
\]

To capture that the the caseworker is imperfectly informed about the exact relationship, we assume that the factor of proportionality \( \xi \) is random, with \( \text{supp}(\xi) = (\underline{\xi}, \overline{\xi}) \subset [0, \infty) \) and \( \underline{\xi} < \overline{\xi} \). In addition, we assume that caseworkers have some discretion in determining whether search effort is sufficient. Therefore, the unemployed worker treats the search requirements \( R_k \) likewise as random, with \( \text{supp}(R_k) = [R_{k}, \overline{R}_k] \subset [0, \infty] \) and \( R_k \leq \overline{R}_k \). On the one hand, these assumptions fit well to the institutional environment of a typical monitoring scheme. On the other hand, this is a more general formulation, since a deterministic search requirement is just a special case.

For any given average search effort \( \bar{S}(t_k, t_{k-1}) \), denoting \( \Psi_k \equiv R_k / \xi \), the probability of being sanctioned at \( t_k \) is therefore:

\[
\text{Prob} \left[ \bar{S}^o(t_k, t_{k-1}) < R_k \right] = \text{Prob} \left[ \Psi_k > \bar{S}(t_k, t_{k-1}) \right] = 1 - \text{Prob} \left[ \Psi_k \leq \bar{S}(t_k, t_{k-1}) \right] \equiv \pi_k \left[ \bar{S}(t_k, t_{k-1}) \right].
\]

We assume that \( \Psi_k \) is a continuous random variable with \( \text{supp}(\Psi_k) = [\underline{\Psi}_k, \overline{\Psi}_k] \subset [0, \infty] \) and \( \Psi_k < \overline{\Psi}_k \), so that \( \forall \bar{S}(t_k, t_{k-1}) \in (\underline{\Psi}_k, \overline{\Psi}_k) : \pi_k \left[ \bar{S}(t_k, t_{k-1}) \right] \leq 0 \). In other words, the unemployed cannot increase the probability of negative evaluation by raising job search effort. We also assume that \( \overline{\Psi}_k > s^+ \), where \( s^+ (s^-) \) denotes the stationary search effort after a positive (third negative) evaluation, i.e. once the unemployed is entitled to \( b_2 \) \( (b_1) \) without any time limit and search effort is no longer monitored. Without this assumption the unemployed worker would always be positively evaluated without changing her behavior.

The aforementioned description of the monitoring technology applies to workers who have been continuously unemployed. Workers interrupting their unemployment spell by a job spell that lasts up

\(^{11}\)Alternatively, the caseworker might place higher weight on more recent job search effort. Introducing such weighting into eq. (1) is easy, but will not qualitatively affect the results.
to one year remain subject to the timing of the next evaluations that applied prior to this interruption. However, the interruption does affect the outcome of the evaluation. The guidelines for the assessment instruct caseworkers to take job acceptance as sufficient evidence for compliance to the search requirements. In the empirical analysis we demonstrate that work experience increases significantly the probability of positive evaluation, but it does not guarantee such an outcome, suggesting again caseworker’s discretion in the assessment. In the model we take this feature into account, but, for purposes of tractability, we simplify by assuming that in case of an interruption the probability of negative evaluation no longer depends on past job search effort. Let superscript $e$ denote whether a worker has interrupted unemployment ($e = 1$) or not ($e = 0$) between two interviews. Then, $\pi_k^e[\bar{S}'(t_k, t_{k-1})]$ denotes the probability of negative evaluation for $e \in \{0, 1\}$, and $\pi_k^e[\bar{S}'(t_k, t_{k-1})] = \pi_k^e$, where $\pi_k^e$ is a fixed number. Notice that by allowing this dependence on $e \in \{0, 1\}$, the (optimal) behavior of individuals depends on $e$. Hence, in the sequel all endogenous variables will be denoted by a superscript “$e$”.

4.2 Workers’ Problem

We assume that workers are identical and risk-neutral. They discount the future at rate $\rho > 0$ and consume their current income entirely. By risk-neutrality, non-labor income other than UB does not affect behavior and can thus be normalized to zero. Workers can be either full-time employed and consume their current income entirely. By risk-neutrality, non-labor income other than UB does not affect behavior and can thus be normalized to zero. Workers can be either full-time employed or unemployed. If employed, the worker earns a constant net wage $w > 0$. There are no job-to-job transitions, and jobs dissolve at an exogenous constant Poisson rate $\delta > 0$. As mentioned in Section 4.1 if a temporary job interrupts unemployment the worker remains entitled to UB and the counter $\tau \in [t_{k-1}, t_k)$ determining the timing of the next evaluation remains fixed to its value before the interruption.

With these assumptions the expected lifetime utility of a worker transiting to employment is:

$$W_k(w; \tau) = \frac{w + \delta U_k^1(\tau)}{\rho + \delta}, \quad (3)$$

where $U_k^1(\tau)$ denotes the expected lifetime utility at reentry in unemployment after a spell of temporary employment that started after $\tau$ periods of entitlement to UB, i.e. in case $e = 1$. This is to be distinguished from $U_k^0(\tau)$ which denotes the expected lifetime utility of a worker who has been $\tau$ periods continuously unemployed, i.e. in case $e = 0$.

An unemployed worker who has not been notified or who has satisfied the job search requirements at the previous evaluation at $t_{k-1}$ is entitled to a flat rate benefit $b_h$. After a third negative evaluation the individual is permanently sanctioned and is, hence, entitled to $b_r < b_h$. In case the worker has been notified ($k = 1$) or negatively evaluated at $t_{k-1}$ ($k \in \{2, 3\}$), then the UB is equal to $b_j(k)$, where $j(k) \equiv h$ if $k \in \{1, 2\}$ and $j(k) \equiv \ell$ if $k = 3$. Apart from the UB the unemployed enjoys a value of leisure (net of stigma costs) equal to $\nu$. Job offers arrive according to a time-inhomogeneous Poisson process with rate equal to the job search effort $s^e(\tau)$ at any instant of time $\tau \in [t_{k-1}, t_k)$. Search effort is costly. We denote the cost of search function by $c[s^e(\tau)]$ and assume it to possess standard properties, namely $c(0) = 0$, $c'[s^e(\tau)] > 0$ and $c''[s^e(\tau)] > 0$. In sum, the net instantaneous utility of an unemployed worker is

$$y_j^e(k)(\tau) \equiv b_j(k) + \nu - c[s^e(\tau)]. \quad (4)$$

Workers’ optimal search strategy implies accepting job offers paying a wage $w$ such that $W_k(w; \tau) > U_k^e(\tau)$ at any moment $\tau$. Since $W_k(w; \tau)$ is strictly increasing in $w$, this strategy is equivalent to accepting any offer that exceeds a reservation wage $w^e(\tau)$. Therefore, if $F(\cdot)$ denotes the wage offer distribution and $F(\tau) \equiv 1 - F(\cdot)$, the transition rate from unemployment to employment at time $\tau$ is

$$p^e(\tau) \equiv p^e[s^e(\tau), w^e(\tau)] = s^e(\tau) F(w^e(\tau)) \geq 0, \quad (5)$$

\footnote{We ignore that the counter $\tau$ is reset to zero if the employment spell lasts more than one year.}
and the survivor function at \( \tau \), conditional on being unemployed at \( t_{k-1} \leq \tau \), is

\[
P^e(\tau, t_{k-1}) = \exp \left\{ - \int_{t_{k-1}}^{\tau} p^e(x) \, dx \right\}.
\]

With these assumptions the expected lifetime utility of an unemployed worker at \( t_{k-1} \), \( U^e(t_{k-1}) \), is the discounted sum of three terms: (i) the “sum” from \( t_{k-1} \) to \( t_k \) of the instantaneous utility in unemployment \( (y^e_{j(k)}(\tau)) \) weighted by the probability \( P^e(\tau, t_{k-1}) \) of still being unemployed at each moment \( \tau \in [t_{k-1}, t_k] \); (ii) the “sum” from \( t_{k-1} \) to \( t_k \) of the expected utility of employment conditional on acceptance \( \bar{W}^e_k(\tau) \equiv E[W_k(w; \tau)|w > w^e(\tau)] \) weighted by the density of unemployment duration at \( \tau \), \( p^e(\tau) P^e(\tau, t_{k-1}) \); (iii) the expected lifetime utility right before the monitoring interview (the so-called “Salvage value” \( U^e_k(t_1) \)) weighted by the probability \( P^e(t_k, t_{k-1}) \) of surviving in unemployment up to \( t_k \):

\[
U^e_k(t_{k-1}) = \int_{t_{k-1}}^{t_k} \left[ y^e_{j(k)}(\tau) + p^e(\tau) \bar{W}^e_k(\tau) \right] P^e(\tau, t_{k-1}) e^{-\rho(\tau-t_{k-1})} d\tau
\]

\[
+ U^e_k(t_k) P^e(t_k, t_{k-1}) e^{-\rho(t_{k-1}-t_{k-1})}
\]

\[
= \pi^e_k \left[ \bar{S}^e(t_k, t_{k-1}) \right] U^e_{k+1}(t_k) + \left( 1 - \pi^e_k \left[ \bar{S}^e(t_k, t_{k-1}) \right] \right) U^+
\]

where \( U_1^r(t_3) \equiv U^- \) and \( U^- \) (resp., \( U^+ \)) denotes the stationary expected lifetime utility after a sanction (resp., positive evaluation). Since \( b_1 < b_3 \), \( U^+ > U^- \). In Appendix A it is shown how \( U^e_k(t_{k-1}) \) can be derived from the limit of its recursive definition in discrete time.

How can we solve this optimization problem? Since the objective of stage \( k \) depends on the objective in the following stage \( k+1 \), it can be solved by backward induction, starting with the stationary problems in case of a positive evaluation and a third negative evaluation, and then for \( k = 3 \) and \( e = 1 \), for \( k = 3 \) and \( e = 0 \), for \( k = 2 \) and \( e = 1 \), and so on. The dependence of the probability of negative evaluation on the effort accumulated up to the evaluation moment makes a solution to the optimization problem by standard stochastic dynamic programming intractable. We therefore opt for optimal control as a solution technique. By writing the density of unemployment duration as \( p^e(\tau) P^e(\tau, t_{k-1}) \) and treating \( P^e(\tau, t_{k-1}) \) as a state variable the optimal control problem is drastically simplified, since it is then autonomous in the sense that time enters only directly through the generalized discount term. The generalized discount term is \( \exp \left\{ - \int_{t_{k-1}}^{\tau} (p^e(x) + \rho) \, dx \right\} \). The discount term is generalized in that the discount rate \( \rho \) is augmented by \( p^e(\tau) \) and the current value \( \dot{x} \) of any variable \( x \) is generalized to condition on survival in unemployment: \( \dot{x} \equiv x \cdot \exp \left\{ \int_{t_{k-1}}^{\tau} (p^e(x) + \rho) \, dx \right\} = x \cdot \exp \{ \rho(\tau-t_{k-1}) \} / P^e(\tau, t_{k-1}) \). In Appendix B.1 we show how to write the optimality conditions in terms of derivatives of the generalized current value Hamiltonian which no longer directly depends on time.

Equation (8) explicitly shows how the evaluation probability \( \pi^e_k \left[ \bar{S}^e(t_k, t_{k-1}) \right] \) enters the problem of the unemployed worker. Optimal behavior over the interval \([t_{k-1}, t_k]\) can be derived by maximizing \( U^e_k(t_{k-1}) \) with respect to (‘wrt’) the controls \( \{s^e(\tau), w^e(\tau)\}_{\tau \in [t_{k-1}, t_k]} \) subject to the laws of motions for the two state variables: the survival probability \( P^e(\tau, t_{k-1}) \) and the average search effort \( \bar{S}^e(\tau, t_{k-1}) \). Differentiating \( (6) \) wrt \( \tau \) yields the first law of motion

\[
\dot{P}^e(\tau, t_{k-1}) = -p^e(\tau) P^e(\tau, t_{k-1}).
\]

Similarly, from \( (1) \) one obtains the second law of motion

\[
\dot{\bar{S}}^e(\tau, t_{k-1}) = \frac{s^e(\tau) - \bar{S}^e(\tau, t_{k-1})}{\tau-t_{k-1}}.
\]

\[\text{Note that, using expression } (6) \text{ for the survivor function, } P^e(\tau, t_{k-1}) e^{\rho(\tau-t_{k-1})} \text{ can be rewritten as } \exp \left\{ - \int_{t_{k-1}}^{\tau} (p^e(x) + \rho) \, dx \right\}. \text{ See Spinnewyn (1990) for another example of this approach.}\]
4.3 Optimality Conditions

The pair of optimal paths \( \{ w^x_j(\tau), s^x(\tau) \} \) are derived in Appendix B.1. These should obey two first order conditions (FOC). The first one is:

\[
U^x_k(\tau) = W^x_k(w^x_j(\tau); \tau) = \frac{w^x_j(\tau) + \delta U^x_k(\tau)}{\rho + \delta} \iff w^x_j(\tau) = \rho U^x_k(\tau) - \delta \left[ U^x_k(\tau) - U^x_k(\tau) \right] \tag{11}
\]

This states that the reservation wage is chosen such that the expected lifetime utility in unemployment and in employment at the reservation wage should be equal at every instant of time \( \tau \). If we use the facts that \( U^x_k(\tau) = \rho U^x_k(\tau) - w^x_j(\tau) \), \( W^x_k(\tau) = U^x_k(\tau) \) and, by (11), that \( p^x(\tau) [W^x_k(\tau) - U^x_k(\tau)] = p^x(\tau) E[W^x_k(w; \tau) - U^x_k(\tau) | w > w^x_j(\tau)] = p^x(\tau) \frac{E[w - w^x_j(\tau)|w > w^x_j(\tau)]}{\rho + \delta} \int_{w^x_j(\tau)}^{\infty} (w - w^x_j(\tau)) dF(w) \), we obtain a generalization of the condition reported by van den Berg (1990, Eq. (3), p.259) and which leads to an alternative interesting intuitive interpretation:

\[
w^x_j(\tau) + c[s^x(\tau)] + \delta \left[ U^x_k(\tau) - U^x_k(\tau) \right] = b_j(k) + \nu + p^x(\tau) \frac{E[w - w^x_j(\tau)|w > w^x_j(\tau)]}{\rho + \delta} + U^x_k(\tau). \tag{12}
\]

The interpretation is as follows. The right-hand side represents the benefits of continuing search if one is offered a job that pays the reservation wage. It consists of three components: (i) the flow of income \( b_j(k) \) to which one remains entitled by not accepting the job offer augmented with the net value of leisure; (ii) the probability of finding a job times the expected lifetime discounted wage gains relative to the reservation wage, given that no job paying below the reservation wage is accepted; (iii) the rate of appreciation of the asset value of unemployment. In the optimum these marginal benefits should be equal to the marginal cost of continuing search, as expressed on the left-hand side of Equation (12) also consisting of three components: (i) the opportunity cost of not accepting the job; (ii) the cost of search effort; (iii) the opportunity cost induced by foregoing the entitlement effect if the job offer is rejected: In case \( \pi^v_k < \pi^v_k[\hat{S}^0(t_{k-1}, t_k)] \) the expected lifetime utility in case of redundancy from the offered job is larger than before job acceptance, i.e. \( U^v_k(\tau) > U^v_k(\tau) \).

The second FOC is:

\[
c^t[s^x(\tau)] = \int_{w^x_j(\tau)}^{\infty} \frac{(w - w^x_j(\tau)) dF(w)}{\rho + \delta} + \frac{\pi^v_k[\hat{S}^v(t_{k-1}, t_k)]}{t_{k-1}} \left[ U^v_{k+1}(t_k) - U^v \right] P^e(t_k, \tau) e^{-\rho(t_k-\tau)}. \tag{13}
\]

This generalizes the familiar condition that the marginal cost of search should equal its marginal return (Mortensen, 1986, p.871). The monitoring of job search increases the marginal return by the second term on the right-hand side of (13). Increasing job search marginally at \( \tau \) decreases the probability of negative evaluation by \( -\pi^v_k[\hat{S}^v(t_{k-1}, t_k-1)] (t_k - t_{k-1}) \). The division by \( (t_k - t_{k-1}) \) reflects that the evaluation occurs on the basis of average rather than instantaneous search effort. The value of avoiding a sanction is \( [U^v - U^v_{k+1}] \). Since this return realizes only to the extent that the worker is unemployed at \( t_k \), we need to weigh it by the survivor probability between \( \tau \) and \( t_k \). In addition since the evaluation occurs in the future \( (t_k \geq \tau) \), the return is discounted by \( e^{-\rho(t_k-\tau)} \).

---

14 In Appendix B.1, the optimal paths are actually derived for the scheduled interval in the more general case considered in Section 4.4 which allows for the fact that the assessment of job search does not take place at the scheduled moment, but is delayed. However, the solution of the simpler problem considered in this section corresponds to the one of the scheduled interval if we allow for the following changes: (i) Notationally, replace \( t_{k-1}, t_k \) and subscript “\( k \)” by \( t_{k-1}, t_k \) and “\( k \)”; (ii) \( \frac{\partial U^v(t_k)}{\partial t_{k-1}} \) by \( \frac{\partial U^v(t_k)}{\partial t_{k-1}} \) = \( \pi^v_k[\hat{S}^v(t_{k, t_{k-1}})] U^v_{k+1}(t_k) - U^v \), where the last equality follows from (4).

15 van den Berg assumes an exogenous job arrival rate \( (s^v(\tau) = \lambda(\tau)) \), \( c[s^v(\tau)] = 0 \) and no job destruction \( (\delta = 0) \). In addition on the left-hand side of (12) we write \( w^x_j(\tau) \) instead of \( \rho U^x_k(\tau) \). The equivalence of the latter follows immediately from (11) for \( \delta = 0 \).
4.4 Accounting for Delays in the Scheduled Timing of the Job Search Assessments

We now introduce the complication that the evaluations do not take place at the scheduled moments \( t_1, t_2 \) and \( t_3 \), but are for various reasons delayed, on average by 6.3 months. A delay implies that each period \([t_{k-1}, t_k]\) is split up in two sub-periods of which the second ends at a random instant and the first may start with delay. We denote these sub-periods by \([t_{k-1}^*, t_k^*]\) and \([t_k^*, T_k^*]\), where \( t_0^* = t_0 \). The first sub-periods are the so-called “scheduled intervals”, lasting for \( k = 1 \) and \( k \in \{2, 3\} \) respectively 8 and 4 months. According to the regulations no evaluation can take place within a scheduled interval. We assume that an assessment of job search effort occurs at some random instant \( T_k^* \) within the second sub-period, i.e. the “delay interval”. If \( t_k^* \) denotes the realization of \( T_k^* \), the realized delay, \((t_k^* - t_k)\), is assumed to be the minimum of a random draw from an exponential distribution with mean \( 1/\bar{q} \) and some fixed maximum delay \( \bar{t}_k^* \), which is equal to the maximum observed delay in the data.

This additional feature modifies the optimization problem in the following ways. Let us denote the expected lifetime utility at time \( \tau \) in the first and second sub-period by \( U_{k,1}^e(\tau) \) and \( U_{k,2}^e(\tau) \). For the first sub-period \([t_{k-1}^*, t_k^*]\), the objective is \( \mathbb{E}(t_{k-1}^*, t_k^*; U_{k,1}^e(\tau), U_{k,2}^e(\tau)) \) replace, respectively, \( t_{k-1}, t_k, U_{k,1}^e(t_{k-1}) \) and \( U_{k,2}^e(t_k) \).

\[
U_{k,1}^e(t_{k-1}^*) = \int_{t_{k-1}^*}^{t_k^*} \left[ y_j(t_k)(\tau) + p^e(\tau)\bar{W}_k(\tau) \right] P^e(\tau, t_{k-1}^*) e^{-\rho(\tau-t_{k-1}^*)} d\tau + U_{k,2}^e(t_k^*) e^{-\rho(t_k^*-t_{k-1}^*)} \tag{14}
\]

Note that the Salvage value is now just equal to the objective function of the second sub-period. By a similar replacement the latter can be written as

\[
U_{k,2}^e(t_k^*) = \int_{t_k^*}^{T_k^*} \left[ y_j(t_k)(\tau) + p^e(\tau)\bar{W}_k(\tau) + q\mathbb{E}(\tau, t_k^*) \right] P^e(\tau, t_k^*) e^{-\rho(\tau-t_k^*)} d\tau
+ U_{k,2}^e(t_k^*) e^{-\rho(t_k^*-t_{k-1}^*)} \tag{15}
\]

\[
U_{k,2}^e(\tau) = \bar{S}^e(\tau, t_{k-1}^*) U_{k,1,1}^e(t_{k-1}^*) + \left(1 - \bar{S}^e(\tau, t_{k-1}^*)\right) U^+. \tag{16}
\]

During the delay interval, the unemployed’s job search effort is assessed at a rate \( q \). This assessment occurs not later than \( t_k^* \), as expressed on the second line of (15). In (15), the discount rate is augmented by the arrival rate of the meeting and, hence, is equal to \( \rho + q \).

In Appendix [B.1 and B.2] we derive the FOC of these optimization problems. This reveals that the FOC’s of the reservation wage, \( x \) and \( t_k^* \), are not affected when we replace the expected lifetime utility of the unemployed by the corresponding ones in the scheduled and delay periods. By contrast the FOC’s of search effort are affected. In the scheduled period we obtain:

\[
c' [S^e(\tau)] = \frac{1}{\rho + \delta} \int_{w^e(\tau)}^{\infty} [w - w^e(\tau)] dF(w) + \frac{1}{\bar{t}_k^* - t_{k-1}^*} \frac{\partial U_{k,2}^e(t_k^*)}{\partial S^e(t_k^*)} P^e(t_k^*, \tau) e^{-\rho(t_k^* - \tau)} \tag{17}
\]

where

\[
\frac{1}{\bar{t}_k^* - t_{k-1}^*} \frac{\partial U_{k,2}^e(t_k^*)}{\partial S^e(t_k^*, t_{k-1}^*)} = \int_{t_k^*}^{T_k^*} \left[ \bar{S}^e(\tau, t_{k-1}^*) \right] \left[ U_{k,1,1}^e(t_{k-1}^*) - U^+ \right] P^e(\tau, t_k^*) e^{-\rho(\tau-t_k^*)} d\tau + \left[ \bar{S}^e(\tau, t_{k-1}^*) \right] U^+ \right] P^e(\tau, t_k^*) e^{-\rho(\tau-t_k^*)} \tag{18}
\]


If we compare this condition to (13) the only difference is the second term on the right-hand side of the FOC. This represents the effect of search effort on lifetime utility through its impact on the probability of negative evaluation. Eq. (18) shows that this impact is no longer evaluated at the end of the considered sub-period \( t_k \), but rather at some random instant on the delay interval. The integral on the right-hand side of (18) takes the expectation of this impact over the random timing of the assessment over the delay interval \([t_k^*, t_k^*] \). While the last term is the expected impact at the maximum delay. This clearly demonstrates that the delay reduces the incentives of the monitoring scheme.

On the delay interval the FOC of search corresponds to (17) apart from the last term which is replaced by 

\[
\frac{1}{\tau - t_k^*} \frac{\partial U_{\beta}^{\pi_e}(\tau)}{\partial S^0(\tau, t_k^*)},
\]

defined by (18) if \( \tau \in [t_k^*, t_k^*] \) substitutes \( t_k^* \). The interpretation is similar.

5 The Econometric Model

5.1 Specification

Estimation of the structural model requires specification of the unknown functions \( c(.) \), \( F(.) \), \( \pi_k^e(.) \) (for \( \epsilon = 0, 1 \) and \( k = 1, 2, 3 \)) and a choice of the way in which these functions and unknown parameters of the model \( (\rho, \nu, \delta \text{ and } q) \) depend on individual characteristics. We allow the cost of search, the separation rate, the value of leisure, and the mean of the wage distribution to depend on gender and three levels of education (low, medium and high), which we denote by \( y_1 \). Furthermore, the cost of search and the value of leisure are function of the household type \( y_2 \) (head of household, cohabitant or single), since this affects the preferences for work and is informative of other income in the household: An unemployed is regarded head of household if she lives together with partner or relatives (children or other) of whom labor earnings or allowances do not exceed a threshold as defined by regulations; otherwise she is a cohabitant, or single, if living alone. Following the traditional labor supply literature (e.g. Mroz, 1987), we exclude the household type as determinant of the wage distribution and the job separation rate. Let \( \mathbf{x} \equiv (\mathbf{x}_1 \mathbf{x}_2) \). Finally, in view of the limited set of observable individual characteristics, the cost of search is also allowed to depend on unobservables \( u \), independently distributed of \( x \). Because of computational limitations, we exclude this dependence from the other functions and impose that \( u \) follows a discrete distribution with two points of support: \( u \in \{v_1, v_2\} \), where \( Q_1 \) and \( Q_2 = (1 - Q_1) \) respectively denote the probability that \( u = v_1 \) and \( u = v_2 \) at entry in unemployment.

More specifically, the value of leisure and the job separation rate are specified respectively as

\[
\nu(x) = x' \zeta_u \quad \text{and} \quad \delta(x_1) = \exp \{x_1' \zeta_d\}.
\]

The functional form for cost of effort is:

\[
c(s; x; u) = e^{x' \zeta_u + u [e^{\epsilon s} - 1]}, \quad \text{with } \epsilon > 0, \; u \in \{v_1, v_2\}, \tag{19}
\]

where \( v_1 = 0 \), by normalization, since \( x \) includes a constant term to represent the reference category, i.e. male, high educated, head of household and \( u = v_1 \).

The heterogeneity \( u \) is unobserved by the econometrician, but not necessarily by the caseworker. Therefore, the realization of \( u \) can affect not only search effort, but also the probability of negative evaluation. At the \( k^{th} \) interview \( (k \in \{1, 2, 3\}) \) and for someone who did not leave unemployment since notification \( (\epsilon = 0) \) (respectively, someone who returned to unemployment after a temporary job \( (\epsilon = 1) \)), we assume that this probability takes the following functional form:

\[
\begin{align*}
\pi_{k,u}^0 \left[ S^0 (\tau, t_{k-1}; x, u) \right] &= \exp \{-(\alpha_{k,u} + \beta_k S^0(\tau, t_{k-1}; x, u))\}, \; \alpha_{k,u}, \beta_k \geq 0, \; u \in \{v_1, v_2\} \tag{20} \\
\pi_{k}^1 &= \exp \{-\gamma_k\}, \; \gamma_k \geq 0. \tag{21}
\end{align*}
\]

\(^{16}\)Respectively, (i) primary or lower secondary, (ii) upper-secondary education and (iii) higher education.

\(^{17}\)Observed characteristics could also affect those parameters. However, given the size of vector \( x \) and the very limited number of observations at meetings, we have opted for a more parsimonious specification. Hence, \( x \) plays a role only as a determinant of average search effort.
The net wage offer density $f(w)$ needs to be recoverable and is assumed to be log-normal: $w \sim \mathcal{LN}(\mu, \sigma)$, with $\mu (x_1) = e^{x_1^\prime \omega}$. Observed net wages $w^o$ are measured with a multiplicative error $m$: $w^o = w \cdot m$, and the density function of the measurement error $h(m)$ is a unit-mean log-normal: $m \sim \mathcal{LN}(-\omega^2/2, \omega)$. Following Christensen and Kiefer (1994), it can be shown that the density function of observed accepted wages $f_o(w^o; \tau)$ if unemployment is left at $\tau$ is given by

$$f_o(w^o; \tau) = \int_0^{w^o/w^o(\tau)} \frac{f(w^o/m) 1}{F[w^o(\tau)]} h(m) dm. \quad (22)$$

5.2 Identification

The data contain information on the observed individual characteristics ($x$), on the UB level that is paid out to each individual and on the duration of the unemployment spell ($d_u$). For any observed unemployment spell of length $d_u$, the data are informative about the timing of monitoring within this spell: The unemployment duration at the moment of notification ($t^u_0$) and the unemployment duration at the moment of the $k$th interview ($\{t^u_k\}_{k=1}^3$), where $t^u_k = \emptyset$ if the $k$th interview did not yet take place. Furthermore, for each observed $k$th interview the data provide the outcome ($O_k$) of the evaluation of job search effort, where $O_k = 0$ if the outcome is positive, $O_k = 1$ if the outcome is negative and $O_k = \emptyset$ if the interview did not yet take place.

Whenever the unemployed individual leaves to a destination other than full-time employment we right-censor the unemployment duration. Once the destination state is full-time employment, we record the net wage earned at the start of the employment spell ($w^e$) and the duration of the employment spell ($d_e$, $e \in \{0, 1\}$). Similar to the duration of unemployment, the observed employment spell is right-censored if one leaves for destinations other than unemployment.

Identification of most parameters is quite standard (Flinn and Heckman, 1982; Eckstein and van den Berg, 2007; Keane et al., 2011). We briefly discuss identification for homogeneous individuals, i.e. with a given set of characteristics ($x, u$) and a particular level of UB. Since the log-normal is recoverable from a truncated distribution, the observed wages and the parametric assumption on the measurement error of wages are sufficient to identify the reservation wage, the complete wage offer distribution ($\mu$ and $\sigma$) and the variance of the measurement error ($\omega^2$). Given that the reservation wage and the wage offer distribution are identified, one can recover the job arrival rate and hence, given the normalization mentioned in Section 4.1 and further discussed at the end of this section, the effective search intensity from data on the duration at which jobs are found. The job separation rate $\delta$ is identified from the observed employment durations, while the arrival rate of job search assessments $q$ from the observed delays in the evaluations.

If the parameters of the probability of negative evaluation are known (more on this below), this leaves us with four unknowns: the discount rate $\rho$, the value of leisure $\nu$, and the two parameters in the cost of search function ($\varepsilon$ and the multiplier in front of (19)). In a stationary environment, we would only have two FOCs to solve for these unknowns, so that the model would be underidentified. However, we consider an environment that changes at notification and at each of the three aforementioned assessments of job search effort differently according to whether the evaluation is positive or negative. This means that the observed variables mentioned in the previous paragraph, such as job finding rates and wages, are different across these environments and, hence, affect the form of the FOCs across these environments. Consequently, this increases the number of equations (i.e. FOCs), while maintaining the number of unknowns, resulting in overidentification instead. Moreover, since agents anticipate the moments of these assessments, this induces non-stationary behavior and, hence, different FOCs at each instant of time within each of these environments (after notification or a negative evaluation), which therefore provides further identifying information (Paserman, 2008; Keane et al., 2011, p. 419). Nevertheless, since only relatively few individuals are observed in more than one environment and since trial estimates of the discount rate converged to unreasonably high values, we decided to fix, as van den Berg and van der Klaauw (2013), the discount rate to 5% on an annual basis.
The above discussion can be replicated for any value of the vector of observed characteristics \( \mathbf{x} \) and, hence, identification holds for any such subgroup, while the functional form restrictions further enhance identification. Unobserved heterogeneity \( u \) induces a dynamic sorting such that for each combination of observed characteristics the fraction of individuals with high unobserved search costs increases with unemployment duration. Hence, this introduces another source of variation, aside of the one induced by the anticipation of the job search evaluations, in the observed time path of the job finding rate and accepted wages (Paserman, 2008). By scaling the cost of search function \( a_{19} \), the level of the realization of the unobserved type \( u = v_j \) together with the share \( Q_j \) of this type at entry are two degrees of freedom to match the duration dependence of exit rates for a given set of observables \( x \).

The parameters \( \alpha_{1,u}, \beta_1,\gamma_1 \) that determine the probability of negative evaluation at the first interview are identified from the observed outcome \( (O_1) \) at the first evaluation of job search effort, from the average search effort \( \bar{s}^{e=0}(t_1^*, t_2^*) \), and from the observation of an employment experience since notification \( (e = 1) \). \( \alpha_{1,v_1} \) can be separately identified from \( \alpha_{1,v_2} \) by explicitly allowing the average probability of negative evaluation to evolve in accordance with the dynamic selection process, steadily increasing the share of individuals with high unobserved search costs over the unemployment spell (see the specification of the corresponding likelihood in \( 27 \) below). Since the second and third evaluation interviews are observed for very few individuals (see Table 4 in Section 3.2), we elaborate a refined statistical procedure which allows identifying \( \alpha_{k,u}, \beta_k,\gamma_k \) for \( k \in \{2, 3\} \) from aggregate observations on the outcomes of these evaluations and thus avoids reliance on \( O_2 \) and \( O_3 \). How this is done is explained in the next paragraphs\(^{18} \).

Essentially, the idea is to use the information on the population sanction probabilities \( (\pi_k) \) at the different meetings \( (k \in \{1, 2, 3\}) \) presented in Table 1 and the estimated parameters of the probability of negative evaluation at the first meeting to infer the parameters of the individual sanction probabilities at the subsequent meetings. This involves three major steps. First, we assume that the relative differences between average sanction probabilities in the sample \( \bar{\pi}_k \) and the aforementioned probabilities population remain constant across meetings: \( \forall k \in \{2, 3\} : \bar{\pi}_k/\bar{\pi}_1 = \pi_1/\pi_k. \) Hence, we can estimate the average sample probability of negative evaluation as follows: \( \forall k \in \{2, 3\} : \bar{\pi}_k = (\pi_k/\pi_1) \cdot \bar{\pi}_1. \)

In a second step, we relate the average sanction probabilities in the sample \( \bar{\pi}_k \) to the individual sanction probabilities \( \pi_{k,i,u}(\cdot) \) for each individual \( i \) in the sample. These probabilities are conditional on being evaluated (i.e. not being positively evaluated in a prior meeting) and not uniform across individuals, since they depend on average search effort, on temporary employment prior to the meeting \( (e = 0 \text{ or } e = 1) \), and on unobservables \( (u) \). We must therefore take these determinants of the individual probabilities into account when calculating the average probability of negative evaluation in the sample. In Appendix B \( ^{19} \), we show how we can derive these probabilities based on the assumption that individuals behave as predicted by our theoretical model.

In a third step we solve for the unknown parameters in the individual probability of negative evaluation at each meeting \( (k \in \{2, 3\}) \) such that the derived relationship between the latter and \( \bar{\pi}_1 \) is satisfied. Since we have only one equality for each meeting, we assume that all parameters at the \( k^{th} \) meeting \( (k \in \{2, 3\}) \) are tied to the estimated parameters of the first meeting by the same factor of proportionality \( \kappa_k: \forall k \in \{2, 3\}, u \in \{v_1, v_2\}, e \in \{0, 1\} : \hat{\alpha}_{k,u} = \kappa_k \hat{\alpha}_{1,u}, \hat{\beta}_k = \kappa_k \hat{\beta}_1, \text{ and } \hat{\gamma}_k = \kappa_k \hat{\gamma}_1. \)

Finally, in Section 4.1 we made the assumption that \( s^e(\tau) \) directly measures the job arrival rate. Here we explain why we made this assumption. Suppose that the job arrival rate was specified as \( \lambda[s^e(\tau)] \) with \( \lambda(\cdot) > 0 \) and \( \lambda''(\cdot) \leq 0. \) Then in the FOC of job search effort, as described by e.g. \( 13 \), the first term on the right-hand side of the equality would have been multiplied by \( \lambda[s^e(\tau)]. \) Assume first that the second term on the right-hand side is zero, such as would be the case in a standard job search model. Then it is clear that we can only identify the ratio \( c'[s^e(\tau)]/\lambda[s^e(\tau)] \) from

\(^{18}\) See Ridder and van den Berg (2003) for another example in which parameters of interest can be identified from aggregate data if individual micro data are unavailable.
this FOC\footnote{See e.g. van den Berg and van der Klaauw (2006) for a discussion.} Alternatively, one may assume, as we do here, that $X[s^e(\tau)] = 1$ and identify $c'[s^e(\tau)]$. Consider now the case that the second term on the right-hand side of (13) is different from zero. A consequence is that $c'[s^e(\tau)]$ and $X[s^e(\tau)]$ are no longer proportional. So, if individuals are observed in two different environments (e.g. between notification and the first interview and between the first and second interview), then we obtain two independent FOCs of search effort which we can solve for $c'[s^e(\tau)]$ and $X[s^e(\tau)]$. However, a necessary condition for the second term on the right-hand side to be different from zero is that the probability of negative evaluation depends on average search effort, i.e. $\beta_k > 0$. Unfortunately, in the empirical analysis the estimate of $\beta_1$ converges to zero. We therefore must maintain the assumption that $X[s^e(\tau)] = 1$.

5.3 Likelihood Contributions

To write down the likelihood contribution of an unemployed individual consider first the probability of surviving in unemployment until some given moment $t$. For that, let $p^0(\tau; \mathbf{x}, u)$ be given by (5) with superscript $e = 0$ denoting that the worker with type $(\mathbf{x}, u)$ did not leave unemployment since $t_0$, and let $p^+(\mathbf{x}, u) \equiv s^+(\mathbf{x}, u)F(w^+(\mathbf{x}, u))$. Furthermore define $t_k' \equiv \min\{t, t_k^*\}$; $t_k^* \equiv \min\{t, t_k^*\}$ and $t_k^* \equiv t_k^* \equiv \infty$. With these definitions, the probability of surviving in unemployment until $t$, being notified at $t_0^*$ and being evaluated at $\{t_k^*\}_{k=1}^3$, conditional on the type $(\mathbf{x}, u)$ and on the outcome of the notification ($O_0 \equiv 1$) and of the evaluations ($\{O_k\}_{k=1}^3$) is

$$
\mathcal{P} \left\{ t, \{t_k^*\}_{k=0}^3, \mathbf{x}, u, \{O_k\}_{k=1}^3 \right\} = \exp \left\{ -p^+(\mathbf{x}, u) \left[ \sum_{k=1}^{4} O_{k-1} \left[ \int_{t_k^*}^{t_k'} p^0(\tau; \mathbf{x}, u) d\tau + 1 \left[ t \geq t_k' \right] \int_{t_k'}^{t_k^*} \left[ p^0(\tau; \mathbf{x}, u) + q \right] d\tau \right] \right] \right\} \times \prod_{k=1}^{3} q^{1[t \geq t_k^*]} \exp \left\{ -\sum_{k=1}^{3} (1 - O_k) p^+(\mathbf{x}, u) (t - t_k^*) \right\},
$$

Note that if $O_3 = 1, \forall \tau > t_k^*; e \in \{0,1\}$: $p^e(\tau; \mathbf{x}, u) = p^-(\mathbf{x}, u) \equiv s^-(\mathbf{x}, u)F(w^-(\mathbf{x}, u))$ since the entitlement to pre-program UB has been lost. The first term on the right-hand side in (23) is the survivor rate in unemployment between entry into unemployment and $t$ or the notification $t_0^*$, depending on which of the two comes first. The term following on the next line gives for each $k$ the survivor rates in the scheduled interval $[t_k^*-1, t_k']$ and in the delay interval $[t_k', t_k^*]$. In the latter interval re-employment and the occurrence of an evaluation are competing risks, which explains the presence of $q$ in the expression. However, if an evaluation takes place, the worker still remains unemployed. Consequently, the probability of surviving in unemployment after $t_k^*$ is the density of being evaluated at $t_k^*$ times the probability of surviving in unemployment beyond $t_k^*$. Since this density at $t_k^*$ is the product of the arrival rate of evaluation $q$ and the corresponding survivor function, this explains the presence of $q$ in the last term on the third line on the right-hand side of (23). The last term also contains the survivor rate in unemployment after a positive evaluation at any interview $k$.

The density of the duration $t$ spent in unemployment before exiting to a job, conditional on $(\mathbf{x}, u)$ reads

$$
g^0(t|\mathbf{x}, u) \equiv p^0(t; \mathbf{x}, u) \mathcal{P} \left\{ t, \{t_k^*\}_{k=0}^3 | \mathbf{x}, u, \{O_k\}_{k=1}^3 \right\}
$$

where we neglect for notational convenience the dependence on $\{t_k^*\}_{k=0}^3$ and $\{O_k\}_{k=0}^3$. The duration data are grouped into monthly intervals. We account for this grouping by integrating over the corresponding time intervals and by assuming that at most one transition occurs within an interval. Conditional on $\mathbf{x}$ and the elapsed unemployment duration at selection $t_0$, but marginal on the unobserved factor $u$ affecting the cost of search, an individual contribution of an unemployment spell
last month followed by an employment spell of length \( d_e \) paying the observed wage \( w^o \), writes for uncensored unemployment durations:

\[
\ell(d_u, d_e, w^o; t_s) = \frac{\sum_{j=1}^{2} Q_j \int_0^{d_u-1} \left\{ g^0(t|x; v_j) \left[ f_0(w^o; t, x_1, v_j) \right]^{c_w} dt \right\} e^{-\delta(x_1)d_e - c_ee^{-\delta(x_1)(d_e+1)}}}{\sum_{j=1}^{2} Q_j \exp \left\{ -p^+(x; v_j)t_s \right\}} (25)
\]

where the density \( f_o \) has been defined in (22), \( c_e = 0 \) if the employment spell that follows the transition from unemployment is right censored (\( c_e = 1 \) otherwise), and \( c_w = 0 \) if the wage upon this transition is unobserved (\( c_w = 1 \) otherwise). For unemployment durations censored between durations \( d_{u-1} \) and \( d_u \), the contribution to the likelihood becomes:

\[
\ell(d_u, d_e, w^o; t_s) = \frac{\sum_{j=1}^{2} Q_j \left( 1 - \int_0^{d_u-1} g^0(t|x, v_j) dt \right)}{\sum_{j=1}^{2} Q_j \exp \left\{ -p^+(x; v_j)t_s \right\}} (26)
\]

Finally, the likelihood function for the realized evaluation outcomes at the first interview conditional on it taking place at time \( t_1^* \) is

\[
\ell(O_1, e; t_1^*) = \frac{\sum_{j=1}^{2} Q_j P \left\{ t_1^*, \{ t_k^* \}_{k=0}^{3} | x, v_j, \{ O_k \}_{k=0}^{3} \right\} \left[ \exp \left\{ -\left( \alpha_1, v_j + \beta_1 S^0(t_1^*, t_0^*; x, v_j) \right) \right\} \right]^{O_1} \times \left( 1 - \exp \left\{ -\left( \alpha_1, v_j + \beta_1 S^0(t_1^*, t_0^*; x, v_j) \right) \right\} \right)^{1-O_1} \right]^{1-e} \left[ \exp \left\{ -\gamma_1 \right\} \right]^{O_1} \left( 1 - \exp \left\{ -\gamma_1 \right\} \right)^{1-O_1} e (27)
\]

for \( e \in \{0, 1\} \). Appendix D describes in detail how the model is solved and estimated.

6 Results

6.1 Estimated Parameters

Table 5 presents the parameter estimates. During the maximization of the likelihood function, the mass point \( v_2 \) systematically converges to very high values, meaning that the cost of search of type \( v_2 \) individuals becomes huge and hence their normalized search effort (i.e. their exit probability) converges to zero. For these people, the estimated probability of negative evaluation is not one, but \( \exp[-0.85] = 0.43 \) at the first meeting (0.49 and 0.57 at the next evaluations).

The share of unemployed who do not search for a job is at entry equal to 20% (see the estimated value of \( Q \) in Table 5). Both, that we evaluate the monitoring scheme at the moment of its introduction.

Figure 2: The Share of Unemployed Searching for a Job.
and that benefits do not expire in Belgian UI, may explain that many inactive individuals, i.e. not searching for a job, are entitled to UB. This has important consequences for the effectiveness of the scheme. For, dynamic sorting implies that this share increases over time. Given the spread out timing of the monitoring procedure, Figure 2 shows that the share of unemployed searching for a job becomes negligible at the second and third meeting. Consequently, if the monitoring scheme has any significant impact on search behavior, then this impact can only be quantitatively important up to the first meeting.

Furthermore, for the unemployed with finite job search costs \( u = v_1 \) and no temporary job before the first meeting \( (e = 0) \), average search effort \( \bar{S}_0 \) has no effect on the probability of being negatively evaluated: \( \hat{\beta}_1 \) in (20) robustly converges to zero \(^{20}\). The probability of negative evaluation is estimated to be equal to \( \exp[-1.56] = 0.21 \) at the first meeting, i.e. half of the probability in the absence of search (0.27 and 0.36 at the two next evaluations). Finally, finding a temporary job has a clear favorable effect on the probability of negative evaluation, lowering it at the subsequent meetings to respectively 0.18, 0.24 and 0.33. These findings suggest that the monitoring technology of the new program was capable to discriminate between the unemployed who searched for a job and those who did not \( \exp(-\hat{\alpha}_{k,v_1}) < \exp(-\hat{\alpha}_{k,\infty}) \) and generally rewarded those who accepted a temporary job, but not to differentiate between the unemployed searching at different intensities \( \hat{\beta}_k = 0 \). Apparently, the measurement of search effort involves so much uncertainty or the caseworkers had too much discretion to overrule any objective measurement that the new scheme resulted in a quite blunt arbitration mechanism.

According to our estimates, the marginal costs of search are the lowest for women and low educated. These findings are not expected, since these two groups are usually found to be disadvantaged on the labor market. A possible explanation is that employers recognize that these groups have more difficulties on the labor market, so that being unemployed does not convey as negative a signal for them as for more advantaged groups. These are expected to directly transit to employment when they enter into the labor market and to transit to other jobs through on-the-job search. Hence, employers may be less likely to offer jobs \(^{21}\) to these advantaged groups when they are unemployed (Eriksson and Gottfries, 2005; Eriksson and Lagerström, 2006; Longhi, 2015). By contrast, heads of households may experience lower costs, because their family responsibility may push them to search much harder than cohabitants or singles.

In line with expectations, the value of leisure is higher for women, the low educated, cohabitants, and to a lesser extent for singles. The high estimated value of leisure for cohabitants (443€/month) suggests that household activities within this group are highly valued. By contrast, the reference individual (high-educated male head of household) seems to perceive stigma costs to being unemployed of about 80€/month.

Disadvantaged workers on the labor market, such as women and the low educated, are more likely to separate from jobs. Women enter in lower paying jobs than men, but the educational level does not seem to play a significant role in the determination of the entry wages. The latter finding is in line with the aforementioned interpretation that the high educated are less likely to be offered jobs, because of the negative signal their unemployment conveys. Hence, if they are offered a job, it does not pay more than for low educated. Note that the standard deviation of the log wage distribution is estimated to be about 6.7% of the mean offered log wages. It accounts for just 13% \( = \hat{\omega}^2 / (\hat{\omega}^2 + \hat{\sigma}^2) \) of the variance of the observed accepted log wages. This relatively small measurement error suggests that the Log-Normal wage offer distribution fits the observed wages quite well.

Finally, \( q \) is estimated to be equal to 0.159. Since the delay is capped by the maximum observed one \( \bar{t}_k \) (see Section 4.4), the average delay is 5.75 months, which is somewhat shorter than the average

\(^{20}\)We also experimented with specifications in which we allowed the probability of negative evaluation to depend on observed covariates, but this did not affect the conclusion.

\(^{21}\)Recall that our model could not discriminate between the marginal effect of search on costs for the unemployed and on the job arrival rate (see Section 5.2).
Table 5: Estimated Parameters

<table>
<thead>
<tr>
<th>Coeff. (S.E.)</th>
<th>Coeff. (S.E.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \zeta ) constant</td>
<td>1.092 (1.225)</td>
</tr>
<tr>
<td>female</td>
<td>-5.418 (3.175)</td>
</tr>
<tr>
<td>skill-low</td>
<td>-1.722 (0.882)</td>
</tr>
<tr>
<td>skill-med</td>
<td>-1.568 (0.803)</td>
</tr>
<tr>
<td>single</td>
<td>4.268 (1.033)</td>
</tr>
<tr>
<td>( \zeta ) constant</td>
<td>-0.795 (0.203)</td>
</tr>
<tr>
<td>female</td>
<td>0.615 (0.389)</td>
</tr>
<tr>
<td>skill-low</td>
<td>1.931 (0.614)</td>
</tr>
<tr>
<td>skill-med</td>
<td>1.018 (0.599)</td>
</tr>
<tr>
<td>single</td>
<td>1.375 (0.498)</td>
</tr>
<tr>
<td>( \ln(\epsilon) )</td>
<td>1.735 (0.539)</td>
</tr>
<tr>
<td>( \sigma )</td>
<td>0.175 (0.030)</td>
</tr>
<tr>
<td>( \omega )</td>
<td>0.067 (0.008)</td>
</tr>
<tr>
<td>( q )</td>
<td>0.159 (0.032)</td>
</tr>
<tr>
<td>( Q )</td>
<td>0.204 (0.018)</td>
</tr>
</tbody>
</table>

Log-likelihood: -3969.86

<table>
<thead>
<tr>
<th>Probability ( \pi ) of negative evaluation</th>
<th>1st meeting</th>
<th>2nd meeting (^b)</th>
<th>3rd meeting (^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inactive job seekers</td>
<td>0.43</td>
<td>0.49</td>
<td>0.57</td>
</tr>
<tr>
<td>Active job seekers</td>
<td>0.21</td>
<td>0.27</td>
<td>0.36</td>
</tr>
<tr>
<td>Job seekers with job interruption</td>
<td>0.18</td>
<td>0.24</td>
<td>0.32</td>
</tr>
</tbody>
</table>

\(^a\) Symbols:  
- \( \zeta \): Coefficient vector of covariates in the cost of search function;  
- \( \zeta \): Coefficient vector of covariates in the value of leisure, i.e. \( \nu(x) \) measured in hundreds of \( \mathcal{E} \);  
- \( \ln(\epsilon) \): \( \ln \) of the multiplier of search in the cost of effort;  
- \( \sigma \): Standard deviation of the log-wage offer distribution;  
- \( \omega \): Standard deviation of the log-measurement error distribution;  
- \( q \): Arrival rate of the actual assessment in the delay period;  
- \( Q \): Share at entry in unemployment of people with infinite cost of search;  
- \( \zeta \): Coefficient vectors of covariates in the separation rate;  
- \( \zeta \): Coefficient vector of covariates in the mean of the wage distribution;  
- \( \alpha_{1,\infty} \): Constant term in the probability of negative evaluation at the first assessment when the cost of search is infinite and \( \epsilon = 0 \);  
- \( \alpha_{1,\nu} \): Same parameter as in previous line, but in case of finite search cost;  
- \( \gamma_1 \): Same parameter for \( \epsilon = 1 \);  
- \( \beta_1 \): Coefficient of \( \bar{S}(t^*_1, t^*_0) \) in the probability of negative evaluation at the first assessment

\(^b\) The probability of negative evaluation at the 2nd and 3rd meeting is obtained by multiplying the parameters determining this probability at the first meeting by \( \kappa_2 = 0.829 \) and \( \kappa_3 = 0.653 \), respectively. The latter are solved such that the sample averages of the individual probabilities at the second and third interviews are compatible with the aggregate observed frequencies (see Section 5.2 and Appendix C).
of the corresponding untruncated Exponential distribution, i.e. $1/0.159 = 6.3$, but still remains substantial.

6.2 Internal Validation: Goodness-of-Fit

This subsection reports the within-sample fit of the model. First, in the left panel of Figure 3 the solid line depicts the hazard function of job finding since notification as predicted by the structural model and the dashed line the smoothed non-parametric counterpart (Tanner and Wong, 1983). The optimal bandwidth for this estimator is chosen by cross-validation, as suggested by Tanner and Wong (1984). The 99% confidence interval around the smoothed nonparametric hazard function (dotted lines) is based on the bootstrap with 1000 replications. The right panel of Figure 3 displays the density function of observed net monthly earnings predicted by the structural model (solid line) on the same plot with kernel density of observed wages from the data (dashed line). The Kernel function is Epanechnikov and the optimal bandwidth is Silverman. The 99% confidence interval around the kernel density estimate (dotted lines) is likewise based on the bootstrap with 1000 replications.

From Figure 3 we see that fitted hazard of job finding and density of observed wages are everywhere within the confidence bounds of the corresponding nonparametric estimates. This underlines a very good fit of our structural model to the data.

6.3 External Validation

We propose an out-of-sample validation that is somewhat different from the standard approach (see e.g. Todd and Wolpin, 2006). In the standard approach researchers would typically use pre-reform data to check whether the model’s predictions about program impacts track the (non-)experimental post-reform impact estimates. However, we could not follow such a strategy since it turns out that economic conditions were notably worse in the pre-program period than during the time the program was in place: GDP real growth attained only 0.8% in 2003 against 2.7% on average between 2004 and 2006. This adversely affected the pre-reform exit rates to employment. This would therefore require

\footnote{Notice that this strategy would in any case be partial, since the parameters of the probability of negative evaluation can only be identified on the basis of post-reform data.}
of our structural model not only to predict the program impacts, but also the impact of the improved economic conditions, which is clearly too ambitious.\footnote{An alternative would have been to estimate the model on a slightly older age group that was not yet affected by the reform. However, employment exit behavior of this older group differs (Cockx and Dejemeppe, 2012, p.733, Figure 2) and since the program was already in place for the younger group, this group could anticipate that it was going to be treated in the subsequent year.}

We therefore propose a less ambitious validation exercise, which aims at checking whether our stationary structural model in the absence of the policy reform, mixed with an unobserved heterogeneity distribution with two points of support, is capable of reproducing the dynamic sorting between entry in unemployment and the date of sample selection, i.e. 13 months later. If this appears to be the case, we can be more confident in performing counterfactual policy experiments (see Section 7): The model can then not only predict the impact of job search monitoring on long-term individuals notified after 13 months, but also on individuals who would enter unemployment when the monitoring scheme would be well established and well known already at the start of the unemployment spell.

In order to implement this validation exercise we obtained from the UI agency a random sample of individuals born and starting their unemployment spell in the same time period as those retained for the estimation. On this sample we then simulate our model until the counterfactual sample selection date, i.e. at an elapsed unemployment duration of 13 months. We then check whether the distribution of observed personal characteristics in this simulated external sample is statistically indistinguishable from the corresponding distribution of the sample that was selected for estimation. This is not obvious, since the unobserved heterogeneity induces sorting over time which changes the composition of observables over the course of the unemployment spell (See e.g. Ridder, 1984).\footnote{Furthermore, this is not obvious since we ignore in this exercise that for dismissed cohabitants and singles the benefits decrease with unemployment duration and, hence, that their behavior should be non-stationary (see footnote 10).}

The simulation is repeated 1000 times to account for the classification error of an individual being an active job seeker ($u < \infty$), as well as to account for sampling error in both the inflow sample and the sample retained for estimation. The first column of Table 6 reports sample fractions, $\hat{r}$, of the mutually exclusive and exhaustive partition of individual characteristics in the sample that we use for estimation of our structural model. The second column of this table reports sample fractions, $\hat{r}_{sim}$, in the very same partition of individual characteristics at the counterfactual date of selection simulated using the aforementioned inflow sample into unemployment. Last two columns show the $t$ statistic and the p-value of the test of $H_0: r = r_{sim}$, variable by variable, respectively.

We see that, on the variable-by-variable basis, we do not reject that relative sizes of all cells in the partition of individual characteristics, except for the “female” × “skill-low” × “cohabitant” one, are equal at any standard level of significance. Test statistic of joint equality of the actual distribution of covariates and the distribution of covariates generated by the model, $H_0 : r = r_{sim}$, is given by

$$
(\hat{r} - \hat{r}_{sim}) \hat{\Sigma}^{-} (\hat{r} - \hat{r}_{sim})' \sim \chi^2_{rk|\Sigma} 
$$

where $\hat{\Sigma}^{-}$ is the Moore-Penrose generalized inverse of the estimated covariance matrix of the difference between actual and model-based cell frequencies\footnote{By independence between these samples, the covariance matrix of the difference is equal to the sum of the estimated covariance matrices} and $rk|\Sigma$ denotes its rank (see Andrews (1988a, b) for a general theory and applications). Since these 18 cell frequencies add up to one, we have that $rk|\Sigma = 17$ and the value of this test statistic is 18.95 with a p-value of 0.33. Hence, we cannot reject that the actual and model-based distribution of covariates at the moment of selection are equal.

6.4 Implied Behavioral Responses

Since the parameter estimates are not informative about the behavioral responses in terms of search effort and reservation wages to the monitoring scheme over time, we simulated the model for each individual in the sample under the assumption that she searches actively for a job ($u = v_1 < \infty$)
and does not leave unemployment before the third meeting, that the outcome of the evaluations are always negative and that there are no delays in the timing of the meetings. By these assumptions the composition of the sample is unchanged over the course of the unemployment spell and the timing of assessments identical across individuals, so that the simulation reflects the behavioral adjustment over time throughout the different stages of the monitoring process.

Figure 4 displays the time paths of these simulated behavioral responses for an unemployed job seeker with average observed characteristics who did not experience any temporary employment after notification. After the third negative evaluation, the unemployed is permanently sanctioned and entitled to the lower welfare benefits. This raises the job arrival rate to about 0.77 and the job acceptance and does not leave unemployment before the third meeting, that the outcome of the evaluations are always negative and that there are no delays in the timing of the meetings. By these assumptions the composition of the sample is unchanged over the course of the unemployment spell and the timing of assessments identical across individuals, so that the simulation reflects the behavioral adjustment over time throughout the different stages of the monitoring process.

Table 6: Distribution of Personal Characteristics at the (Counterfactual) Selection

<table>
<thead>
<tr>
<th>Variable</th>
<th>( \hat{r} ) (s.e.)</th>
<th>( \hat{r}_{sim} ) (s.e.)</th>
<th>( t )-stat.</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>“female” × “skill-low” × “single”</td>
<td>0.0208 (0.0048)</td>
<td>0.0199 (0.0060)</td>
<td>0.1156</td>
<td>0.9080</td>
</tr>
<tr>
<td>“female” × “skill-low” × “cohabitant”</td>
<td>0.0302 (0.0058)</td>
<td>0.0646 (0.0106)</td>
<td>-2.8503</td>
<td>0.0044</td>
</tr>
<tr>
<td>“female” × “skill-med” × “single”</td>
<td>0.0805 (0.0092)</td>
<td>0.0591 (0.0102)</td>
<td>1.5599</td>
<td>0.1188</td>
</tr>
<tr>
<td>“female” × “skill-med” × “cohabitant”</td>
<td>0.0619 (0.0082)</td>
<td>0.0631 (0.0105)</td>
<td>-0.0847</td>
<td>0.9325</td>
</tr>
<tr>
<td>“female” × “skill-high” × “single”</td>
<td>0.0860 (0.0095)</td>
<td>0.0955 (0.0127)</td>
<td>-0.6006</td>
<td>0.5481</td>
</tr>
<tr>
<td>“female” × “skill-high” × “cohabitant”</td>
<td>0.0538 (0.0077)</td>
<td>0.0614 (0.0104)</td>
<td>-0.5092</td>
<td>0.5557</td>
</tr>
<tr>
<td>“female” × “skill-high” × “single”</td>
<td>0.0642 (0.0071)</td>
<td>0.0590 (0.0102)</td>
<td>-1.0324</td>
<td>0.3019</td>
</tr>
<tr>
<td>“female” × “skill-high” × “cohabitant”</td>
<td>0.0585 (0.0080)</td>
<td>0.0634 (0.0105)</td>
<td>-0.3687</td>
<td>0.7124</td>
</tr>
<tr>
<td>“female” × “skill-high” × “hh-head”</td>
<td>0.0129 (0.0038)</td>
<td>0.0105 (0.0044)</td>
<td>0.4049</td>
<td>0.6855</td>
</tr>
<tr>
<td>“male” × “skill-low” × “single”</td>
<td>0.1116 (0.0107)</td>
<td>0.1187 (0.0140)</td>
<td>-0.3995</td>
<td>0.6895</td>
</tr>
<tr>
<td>“male” × “skill-low” × “cohabitant”</td>
<td>0.0439 (0.0069)</td>
<td>0.0361 (0.0081)</td>
<td>0.7295</td>
<td>0.4657</td>
</tr>
<tr>
<td>“male” × “skill-low” × “hh-head”</td>
<td>0.0618 (0.0082)</td>
<td>0.0512 (0.0095)</td>
<td>0.8413</td>
<td>0.4002</td>
</tr>
<tr>
<td>“male” × “skill-med” × “single”</td>
<td>0.1053 (0.0104)</td>
<td>0.0949 (0.0127)</td>
<td>0.6366</td>
<td>0.5244</td>
</tr>
<tr>
<td>“male” × “skill-med” × “cohabitant”</td>
<td>0.0630 (0.0082)</td>
<td>0.0476 (0.0092)</td>
<td>1.2488</td>
<td>0.2118</td>
</tr>
<tr>
<td>“male” × “skill-med” × “hh-head”</td>
<td>0.0253 (0.0053)</td>
<td>0.0327 (0.0077)</td>
<td>-0.7883</td>
<td>0.4305</td>
</tr>
<tr>
<td>“male” × “skill-high” × “single”</td>
<td>0.0552 (0.0077)</td>
<td>0.0445 (0.0089)</td>
<td>0.9098</td>
<td>0.3629</td>
</tr>
<tr>
<td>“male” × “skill-high” × “cohabitant”</td>
<td>0.0785 (0.0091)</td>
<td>0.0668 (0.0108)</td>
<td>0.8261</td>
<td>0.4087</td>
</tr>
<tr>
<td>“male” × “skill-high” × “hh-head”</td>
<td>0.0045 (0.0023)</td>
<td>0.0110 (0.0045)</td>
<td>-1.2761</td>
<td>0.2019</td>
</tr>
</tbody>
</table>

Positive evaluation at any of the meetings is a special case of the considered simulation. If evaluation is positive, the program terminates at that very meeting and the dynamics thereafter becomes identical to the dynamics before the notification.

Note that these values also apply after a positive evaluation at any of the three interviews.
probability to about 27%, resulting in an exit rate to employment of about 21% and an average residual unemployment duration of slightly less than 5 months. The search effort, acceptance probability and job finding rate of active job seekers rises, gradually, as a consequence of anticipatory behavior between meetings, and abruptly just after each negative assessment, from the levels before notification to those after the third negative evaluation. The job finding rate eventually is raised by about 50%, which is substantial. However, notice that the rate of increase in all three variables is only very slight between notification and the first interview. This is because the first negative evaluation does not involve an immediate sanction, but only the threat of a temporary withdrawal of benefits in case the signed action plan is not complied to at the second assessment. The transition rate to employment is actually not substantially affected before the second meeting, and particularly jumps up after the third negative evaluation.

\* The solid lines display for the parameter estimates reported in Table 5 and a job seeker with average characteristics the time profile of the behavioral responses to the monitoring scheme in the absence of delays (setting \( q = 0 \)), and conditional on remaining unemployed and being negatively evaluated at each meeting. The dashed lines display these profiles for a monitoring technology that generates “front-loading”, i.e. for \( \alpha_{1,v_1} = \tilde{\alpha}_{1,\infty} = 0.8515 \) and \( \beta_1 = 0.8160 \) (See Section 7.4). Without delays the 1\textsuperscript{st}, 2\textsuperscript{nd} and 3\textsuperscript{rd} meeting take place respectively 8, 12 and 16 months after notification.
evaluation when the unemployment benefits are permanently withdrawn. The spread-out timing of the monitoring interviews substantially reduces the effectiveness of the monitoring scheme in raising the exit rate of the notified unemployed to employment. This is further reinforced by the delays in the scheduled timing of the meetings, which are ignored in Figure 2 for illustrative purposes: Beyond the second interview, point from which the impact of monitoring starts to matter, about 90% of notified individuals (95% of those who enter unemployment) are actually not seeking any job (cf. Figure 2) and, hence, are not influenced at all by the job search assessments. This means that the monitoring scheme did not achieve raising the average job finding rate of notified individuals in any significant way. In the next section we investigate whether a change in the design of the scheme can affect this conclusion.

7 Policy Evaluation

A major advantage of structural over reduced form estimation is that it fully characterizes preferences of agents and the economic environment, here in particular as described by the wage offer distribution and the form of the search cost technology. Hence, in this section we conduct a welfare analysis of both, the policy that has been implemented as well as alternatives. The reader should, however, bear in mind the limitations of this welfare analysis in that it is conducted in a partial equilibrium supply side framework and it ignores that the unemployed are risk averse.

We follow Paserman (2008) and van den Berg and van der Klaauw (2013) and define “welfare” (a measure of “efficiency” in the absence of risk aversion) as the difference between the sample average of the expected discounted lifetime utility of the unemployed \( U_{0}^{k}(t_{0}) \) and the present value of the expected expenditures of the public authorities on unemployment and, in case of a sanction, on assistance benefits, and on implementing the job search assessments \( Y_{0}^{k}(t_{0}) \). Based on accounting information of the UI agency, each assessment costs 100€ on average. This welfare measure is partial in that it ignores the tax revenues generated by the job creation resulting from job search monitoring. However, taking this into account is not possible without a general equilibrium framework determining to which extent these newly created jobs are additions to the economy as a whole. Apart from the aforementioned welfare indicator and its constituents, we will also report the impacts on the expected unemployment duration, on the monthly starting wage, and on the expected discounted stream of labor earnings \( X_{0}^{k}(t_{0}) \). Formal definitions of these indicators can be found in Section B of the Internet Appendix.

The welfare analysis is conducted in the following steps. First, we simulate the average treatment effects on the treated (ATT) of the introduction in 2004 of the monitoring scheme on the population of 25- to 30-years-olds who were by surprise notified after an elapsed unemployment duration of 14 months \((t_{0} = 14)\) that their search effort would be monitored for a first time eight months later \((t_{1} = 14 + 8 = 22)\). The discounted welfare measures are in this case evaluated at the moment of notification \((t_{0} = 14)\). However, once the monitoring scheme is fully instituted, the notification no longer comes as a surprise after 14 months, but individuals are informed about the timing of the scheme at entry in unemployment. Therefore we repeat the welfare analysis on the sample of entrants that we used in the external validation reported in Section 6.3, assume that in this case the notification arrives as of entry and the first interview is scheduled after 22 months. In all subsequent steps we maintain the assumption that the monitoring scheme is fully instituted and evaluate policy reforms on the entry sample \((t_{0} = 0)\).

We consider two major sets of policy reforms. In the first set the monitoring technology is unaffected, but both the scheduled timing of the monitoring interviews and the delays in this timing are modified. In addition, we study the effect of introducing a temporary sanction in case of a negative evaluation at the first job search assessment. In the second major set we consider the same policy reforms as in the first, but we increase the precision of the monitoring technology by allowing the probability of negative evaluation \( \pi_{0,k,u}[.\] at the \( k^{th} \) meeting to depend on the average search effort
since the previous meeting \( (S^0(t_k^*, t_k^{*-1})) \), i.e. we allow \( \beta_k > 0 \). From the FOC of search effort \( \{13\} \) it is easy to see (there is an additional positive term on the right-hand side) that this raises the returns to search and, hence, should increase the effectiveness of monitoring. In a final subsection we show that a monitoring technology in which the probability of negative evaluation is sufficiently sensitive to search effort exhibits an interesting property, which we label “front-loading” of search effort, because in this case search effort may even exceed the post permanent sanction level.

7.1 The Effect of the 2004 Reform

In Panel A of Table 7 we report the effects of introducing the monitoring scheme on the long-term unemployed workers who in 2004 were notified by surprise that their job search effort would be evaluated for a first time eight months later. We disentangle the total effects into those for inactive \( (u = +\infty) \) and active job seekers \( (u = v_1) \).

Obviously, for inactive job seekers the monitoring did not affect the unemployment duration and the effect on the expected starting wage is meaningless. Depending on the order of the interview, between 43% and 57% of this group is each time evaluated negatively (see Table 5). The loss in UB payments in case of a sanction reduces the expected discounted lifetime utility on average by 6,019.87€. This loss in UB payments is a direct transfer to the UI agency, which must, however, also finance the operating costs of possibly multiple job search assessments. The welfare costs of monitoring amount for this group of inactive job seekers precisely to the discounted value of these operating costs, i.e. to 151.47€. Clearly, because monitoring cannot affect the behavior of these individuals, it can never be welfare enhancing. It could be questioned whether the welfare criterion is appropriate in this case, since it could be argued that these inactive job seekers do not “deserve” to be paid out an UB. However, considering another welfare criterion is beyond the scope of this research.

For notified active job seekers monitoring reduces unemployment duration by about 6 days (0.18 months) and the average monthly starting wage by about 2€/month. Despite the lower starting wage the discounted value of labor earnings increases by 325.03€. This means that negative effect on the wage is more than compensated by the additional working time. Monitoring imposes much lower costs on the active than on the inactive job seekers: 183.98€. As already mentioned in Section 6.4, this is essentially because monitoring occurs very late in the unemployment spell and most of them have, even without modifying search behavior, already left unemployment before the second interview takes place and the first sanction is potentially imposed (see Figure 2). Obviously, because the behavioral impact is so small, the UI agency cannot be expected to recover the monitoring costs, so also for this group the policy reform reduced welfare on average by 117.27€ per notified individual, and, hence, the total welfare loss is 134.90€.

7.2 Policy Reforms without Affecting the Monitoring Technology

In the previous section we concluded that the current monitoring scheme has a negligible impact on welfare and unemployment duration essentially because (i) it cannot have a behavioral impact on about half of the notified individuals who do not seek for a job, and (ii) the timing of the monitoring is too much spread out over time and sanctions are imposed too late. In this section we investigate whether by changing the design of the monitoring scheme more positive conclusions can be obtained. We focus on the impact of the active job seekers, since, in the absence of any behavioral impact, a different design only has a “mechanical” welfare decreasing effect on the inactive group and is, hence, not very interesting.

As mentioned, we compare these reforms to the fully operational monitoring scheme in which the individuals know already from the start of the unemployment spell (nearly 80% are then actively seeking for a job) that the first assessment of job search effort is scheduled only after 22 months. Because of discounting and because many active job seekers find a job between entry in unemployment and notification 14 months later, the ATT’s of the fully operational benchmark monitoring scheme
### Table 7: ATT of the Implemented (Benchmark) Monitoring Scheme and of Policy Reforms on Active Job Seekers Only

<table>
<thead>
<tr>
<th>Panel A</th>
<th>Implemented Monitoring Scheme: Notification at $t_0 = 14$</th>
<th>Policy Reforms: ATT on Active Job Seekers Only</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>B.1 Benchmark Mon. Tech.: $\alpha_{1,\infty}, \alpha_{1,v_1}, \beta_1$ as in Tab. 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Benchmark Scheme: Notification at $t_0 = 0$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Optimal Design:*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(a) Delay = 1 month</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Scheduled Timing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(b) $k = 1$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(c) $k = 2, 3$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(d) Sanction at Meeting 1‡: 0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(e) Combining (a) to (d)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f) “Strict”£ Monitoring</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B.2 Preciser Mon. Tech.: $\alpha_{1,\infty} = \alpha_{1,v_1} = 0.85, \beta_1 = 0.82$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Benchmark</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Optimal Design:*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(a) Delay = 1 month</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Scheduled Timing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(b) $k = 1$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(c) $k = 2, 3$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(d) Sanction at meeting 1‡: no sanction (0%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(e) Combining (a) to (d)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f) “Strict”£ Monitoring</td>
</tr>
<tr>
<td></td>
<td><strong>Exp. Un. Dur.</strong> Months, <strong>Entry Wage</strong> €/month, <strong>Lifetime Earnings</strong> €, <strong>Lifetime Utility</strong> €, <strong>Gov’t Disc. Expendit.</strong> €, <strong>Welfare</strong> €</td>
<td><strong>Maximizing welfare by varying each dimension (a)-(d) separately within the ranges displayed in Figures 5 and 6, while keeping other dimensions fixed to benchmark; † After notification (at entry in unemployment) if $k = 1$; ‡ optimal choice may range between 0%-100% of the (temporary) sanction at the second meeting; £ Monitoring with an expected delay of 1 month, 1 month between any two scheduled meetings, including notification, and a temporary sanction already at the first meeting; Benchmark policy for active job seekers in <em>italics</em> and the combined optimal (a)-(d) policy in <strong>bold</strong>.</strong></td>
</tr>
<tr>
<td>Inactive Job Seekers</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Active Job Seekers</td>
<td>-0.18</td>
<td>-2.04</td>
</tr>
<tr>
<td>All UI Recipients</td>
<td>-0.10</td>
<td>-</td>
</tr>
</tbody>
</table>

**Notes:**
- *Maximizing welfare by varying each dimension (a)-(d) separately within the ranges displayed in Figures 5 and 6, while keeping other dimensions fixed to benchmark; † After notification (at entry in unemployment) if $k = 1$; ‡ optimal choice may range between 0%-100% of the (temporary) sanction at the second meeting; £ Monitoring with an expected delay of 1 month, 1 month between any two scheduled meetings, including notification, and a temporary sanction already at the first meeting; Benchmark policy for active job seekers in *italics* and the combined optimal (a)-(d) policy in **bold**.
are even smaller than those reported in the previous section for by surprise notified individuals. This can be deduced by comparing the first line of Panel B of Table 7 to the second line of Panel A.

Next, we study the impact of gradually (i) reducing the average delay in the timing of interviews from 5.75 months in the benchmark to one month; (ii) reducing the scheduled duration from entry in unemployment to the first interview from 22 months (= $t_1 = 14 + 8$) to 1 month; (iii) reducing the scheduled timing of the second and third assessment from 4 months to 1 month; (iv) increasing the sanction intensity at the first interview from 0% to 100% of the temporary sanction imposed in the benchmark scheme at the second interview. To this purpose, we first evaluate the partial effects of each of these four design features separately and compare the effects of these on the retained indicators in Table 7 except for lifetime earnings. These effects are graphically displayed in Figure 5. Subsequently, we choose for each design feature the value that maximizes welfare over the range of values that are considered. Under the heading “Optimal Design” in lines (a) to (d) in panel B.1 of Table 7 we then report for the optimal choice of each design feature the corresponding effects on the retained indicators. In a third step we combine the optimal design features (a)-(d) and impose them simultaneously. This is written in line (e). Finally, since the “optimal” policy is still rather lenient, line (f) considers the impact of a “strict” monitoring scheme. In such a scheme job search assessments start much earlier in the unemployment spell (one month between any two scheduled meetings, including notification, with an average delay of one month only) and sanctions are imposed.

\[28\] It is clear that this choice does not guarantee global optimality in any sense. Finding a global optimum is, however, beyond the scope of the present research.
earlier (a temporary sanction already at the first meeting). This provides an indication of the size of the expected effects in case the Belgian authorities would decide to implement a scheme of which the timing is in line with that in other OECD countries, while the size of the sanction is stronger than in most countries.

Figure 5 illustrates that “stricter” monitoring always reduces unemployment duration and the average entry wage monotonically. By combining the strict design features, the ATT on these outcomes more than doubles, but remains very moderate: unemployment durations fall from about 3 days (0.11 months) in the benchmark to 7 days (0.24 months) and the average entry wage from 1.29€/month to 2.69€/month. However, a strict policy does not maximize welfare. Even if reducing delays and the time between the scheduled meetings is welfare enhancing, speeding up the moment of the first assessment and introducing a sanction at the first meeting has opposite effects. The “optimal policy” maintains the first interview at 22 months and imposes no sanction after a first negative evaluation of search effort. Hence, welfare is only reduced by 83.81€ rather than by 247.10€ in the case of strict monitoring.

An explanation that stricter monitoring is not uniformly more efficient is that the monitoring technology is too blunt to provide significant incentives to search for jobs. Indeed, our estimates (Table 5) reveal that the probability of negative evaluation for active searchers is insensitive to the amount of search effort. The finding that monitoring hardly affects unemployment duration is in line with this explanation. Similarly, it can also explain the U-pattern that Figure 5 displays for the relation between government expenditures and duration until the first meeting. If the behavioral impact of monitoring is small, the operating cost of the job search assessments has more weight in these expenditures. By advancing the timing of the first assessment prior to the 22nd month, expenditures initially fall, because the savings generated by the enhanced exits from unemployment dominate the growing operating costs induced by the increasing number of individuals who are still unemployed and, hence, must be evaluated. At a certain point the latter force starts to dominate the former, so that expenditures start to increase again if the first interview is scheduled too early. As shown in the next section, the latter force become much less important as soon as the precision of the monitoring technology is enhanced, so that the savings induced by the behavioral response dominate.

7.3 Policy Reforms in Case of Enhanced Monitoring Precision

The precision of the monitoring technology crucially depends on the sensitivity of the probability of negative evaluation to average search effort. Researchers have generally assumed that this precision is perfect in that job seekers are evaluated negatively if job search effort falls short of some predetermined target and positively if effort exceeds this threshold (Paserman, 2008; van den Berg and van der Klaauw, 2013, e.g.). At this threshold the first derivative of the probability of negative evaluation is infinite and the probability of negative evaluation drops discretely from one to zero as the threshold is crossed. We find by contrast that the probability of negative evaluation is over a wide region insensitive to search effort. For instance, at the first interview it falls discontinuously from 43% to 21% as search effort shift from zero (inactive job seekers) to a strictly positive (active job seekers) level (cf. Table 5), but once it is strictly positive, it is completely insensitive to the level of search effort, i.e. $\beta_1 = 0$. In this section we study what happens if we increase the precision of this monitoring technology, without making it perfect, however. As to focus on the effect of enhancing the precision and not on increasing the level, we therefore first set the probability of negative evaluation of active job seekers at the first meeting to that of the inactive ones in the counterfactual that they would not search, i.e. $\alpha_{1,v1} = \alpha_{1,\infty} = 0.8517$ and the probability of negative evaluation is, hence, 43%. Second, we raise $\beta_1$ to a strictly positive level such that the probability of negative evaluation gradually falls to 21% (the estimated constant level for active job seekers) in case average search effort $S(t_1, 0)$ is equal
Figure 6: Effects of Alternative Policy Design Features: Case of Enhanced Monitoring Precision

We assume throughout that enhancing the precision of the monitoring technology is costless. This might not be so unrealistic in the Belgian context though, since presumably a lot of precision could simply be gained by decreasing the discretionary power of the counselors in charge of the assessments, replacing it by some strict uniform guidelines. However, this can obviously not be ascertained without further research.

In Panel B.2 of Table 7 and in Figure 6 we report how this enhanced precision in the monitoring technology affects the ATT’s and the “optimal design” by proceeding in the same way as in the previous section. First, observe that for the benchmark monitoring scheme this enhanced precision not only decreases unemployment duration by more than 45% (from -0.11 to -0.16 months); At the same time lifetime utility falls by less than 5% (about 3% of the loss in case of the benchmark monitoring technology), while more than 35% are saved on public outlays (nearly 80% of the savings in the benchmark case). This points to considerable efficiency gains. The “welfare” loss is reduced by more than 30% or 31% of the loss with the benchmark technology.

A second important observation is that enhancing the precision makes it worthwhile to intervene earlier. In Figure 6 we now observe that the welfare loss of monitoring is minimized by scheduling the first assessment after 10 months instead of after 22 months. Notice that it is not because, as with the benchmark monitoring technology, the savings in public outlays are maximized at this scheduled

Notice that with our assumptions, in contrast to a perfectly precise monitoring technology, the threshold beyond which the probability of negative evaluation drops to zero is never attained.

32
duration. This occurs rather at the 2nd month of unemployment. Welfare increases as one delays the scheduled time of the first interview (without changing any other design feature of the monitoring technology) from entry in unemployment up to 10 months later, because the rate at which the savings in public expenditures falls is lower than the rate at which lifetime utility of the unemployed decreases. This is presumably induced by the stronger behavioral responses (higher search effort and lower reservation wages) that linking negative evaluations more tightly to job search intensity generates. Evaluating job search effort too early is not efficient, because it does not provide enough time for job seekers to respond to the threat of a sanction in case of a negative assessment and to possibly escape it by leaving unemployment earlier. In the next section we indeed provide evidence that a more accurate monitoring technology induces job seekers to intensify their job search effort (and reduce their reservation wages) prior to the assessments.

From Figure 6 we further deduce that, once the monitoring precision is high enough, welfare increases by setting the delay and the time that elapses between any two interviews at the minimum. By contrast, welfare decreases significantly by sanctioning the job seeker already at the first negative evaluation. Combining these optimal design features induces a significantly smaller loss in welfare than imposing a “strict” monitoring scheme. In comparison to the counterfactual of no monitoring, welfare falls by only 25.72€ in the “optimal” scheme, while by as much as 173.63€ in case of “strict” monitoring. A striking difference with the benchmark monitoring technology is that the “optimal” scheme is not much less efficient in reducing unemployment duration than the “strict”. Average unemployment duration is reduced by 12 days (0.40 months) in the former and by 17 days (0.56 months) in the latter, while with the benchmark monitoring technology this contrast was much larger: 4 and 7 days, respectively. This suggests that while the Belgian monitoring scheme is clearly too lenient, the stricter schemes in many other OECD countries, may actually start assessing job search too early from an efficiency point of view.

If we compare our findings of the “strict” monitoring scheme for active job seekers\(^{30}\) to those of two other studies that evaluate job search monitoring on the basis of a similar approach, we find smaller impacts on unemployment duration and non-systematic different impacts on welfare. The order of magnitude of these impacts is the same. Paserman (2008) finds that monitoring in the U.S. decreases unemployment duration by 4.7 weeks (6.3 weeks) and increases (decreases) welfare by 70 (261) 1983-$ assuming a (Log-) Normal wage offer distribution\(^{31}\) van den Berg and van der Klaauw (2013) report that compared to the counterfactual of no monitoring unemployment duration decreases by 3.6 weeks and welfare decreases by 540 1999-E \(^{32}\) The fact that monitoring in these studies has about two to three times as large effects on unemployment duration is most likely related to the perfect monitoring precision assumed in these studies. This finding may also be a consequence of our focus on 25- to 30-year-olds, while the aforementioned authors do not target a particular age class.

Finally, in none of our counterfactual evaluations we find that monitoring can enhance welfare relative to the counterfactual of no monitoring. This does not exclude, however, the possibility that if we further enhance the precision of the monitoring technology we might find that monitoring is efficiency enhancing. From the findings of Paserman (2008) we deduce that the form of the wage offer distribution may also play a role, since he finds that monitoring can increase welfare if a Normal instead of a Log-Normal wage distribution is assumed. However, the finding that monitoring does not enhance welfare may also be a consequence of the too simple definition of welfare. In this definition we assign the same weight to a expected discounted euro, irrespectively of whether it is assigned to the unemployed or to the public authorities. As a consequence of moral hazard there is an efficiency

\(^{30}\)We believe that this is the relevant basis of comparison, since the schemes in the countries of comparison are indeed “stricter” than in Belgium and because the presence of inactive job seekers in UI is most likely related to the very lenient UI scheme in Belgium.

\(^{31}\)Paserman (2008) focuses his analysis on unemployed with hyperbolic time preferences, but also considers unemployed with time consistent preferences. We restrict our comparison on the latter case.

\(^{32}\)We deduce this from their Table 5, p. 22.
cost to transferring money from the public authorities to the unemployed and this cost should be taken into account in the relative weight of public expenditures in the welfare measure. Moreover, the welfare measure (and our model) ignores that the unemployed are risk averse. These neglects relate to the trade-off between incentives and insurance which is amply studied in the literature on optimal UI (Shavell and Weiss, 1979; Hopenhayn and Nicolini, 1997; Pavoni and Violante, 2007, e.g.). Ideally, we should set the optimal design of a monitoring scheme in such a framework. This would lead to a notion of welfare (“efficiency”) that incorporates the aforementioned currently neglected trade-off. This is an avenue for further research.

7.4 “Front-Loading” of Search Effort

In the previous section we mentioned that a more precise monitoring technology induces job seekers to intensify their job search effort (and reduce their reservation wages) prior to the assessments. In this section we provide further evidence of this. In particular, we demonstrate that if $\beta_1$ is sufficiently high, this should induce “front-loading” of search effort: If by raising search effort the opportunity to avoid a sanction is enhanced, the monitoring of job search substitutes higher search effort before the evaluation for lower search effort afterwards, in case of a positive evaluation. Remarkably, job search effort prior to the evaluation may even rise above $s^-$, the level that is attained after a permanent sanction is imposed. In Section C of the Internet Appendix we provide a sufficient condition for search effort to increase above the post sanction level $s^-$. The value that is chosen in Section 7.3 satisfies this condition.

In Figure 4 the dashed lines illustrate that front-loading indeed occurs if we set the parameters of the probability of negative evaluation to the values that generate the enhanced monitoring precision discussed in the previous section. Search effort prior to the third meeting, 16 months after notification, is clearly higher than after the permanent sanction is imposed. Moreover, the figure clearly illustrates that more precision leads to raising search effort and reducing the reservation wage well before the actual meetings, which points to the need of not setting the timing of the first meeting too early, so that this anticipated behavioral response can realize.

8 Conclusion

In this paper we set up and estimate a structural job search model that incorporates the main stylized features of Belgian UI and a job search monitoring scheme that was introduced herein in 2004. We innovate relative to the existing literature by explicitly taking into account that the measurement of search effort is imperfect and that the assessments of job effort take place at prescribed moments in time, so that the unemployed can anticipate these and gradually adjust behavior as these evaluation moments are approached, i.e. by allowing for non-stationary behavior.

The estimation results point to very weak behavioral impacts of the new monitoring scheme in Belgian UI. According to these, once the scheme is fully instituted, a population of 25- to 30-year-olds entrants into unemployment is expected to find a job 3 days earlier and earn at the start of this job 1.29€ per month less than in the absence of monitoring. Essentially this is because (i) as much as 20% of the individuals of this age group who start a spell of unemployment are found to have so high search costs that they cannot be induced to search for a job and are, hence, effectively out of the labor force, and (ii) the timing of the monitoring is too much spread out over time: the first assessment of search effort (of maximum three) does not occur earlier than the 22nd month of UI and, as a consequence of administrative delays, even realizes later than that. Consequently, most active job seekers have already left unemployment by the time that the first evaluation takes place. The high share of inactive UI recipients is most likely a consequence of the lenient UI in Belgium, which does not impose a time limit on eligibility and which did not monitor job search behavior before the studied reform in 2004.
The advantage of estimating this structural model is that it allows us to investigate how changing the design could enhance the efficiency of the monitoring scheme. We therefore studied the effects of policy reforms on unemployment duration, the expected entry wage and “welfare”, defined by the (monetary value of) the expected discounted lifetime utility minus the expenditures of public authorities on unemployment and welfare benefits, as well as on the operational costs of the job search assessments. In this analysis we focused on the consequences of the reforms on active job seekers only, since it is only for this group that an alternative design can deliver interesting insights. Our analysis revealed that the precision of the monitoring technology is a crucial determinant of success. From the estimates we could deduce that the Belgian monitoring scheme was very blunt in that the unemployed could not decrease the probability of negative assessment by marginally increasing their job search effort. Introducing the latter feature is shown to dramatically improve the efficiency of monitoring. In this case advancing the scheduled timing of the first job search assessment improves welfare. However, our simulations show that, as a consequence of search frictions, this first meeting should neither be scheduled too early in the unemployment spell (in the simulation the optimum is after 10 months), because otherwise there is not enough time for job seekers to respond to the threat of a sanction in case of a negative evaluation. More generally, it is shown that while monitoring more “strictly” monotonically decreases unemployment duration and starting wages, it does not monotonically increase welfare. Therefore, while the Belgian monitoring scheme is certainly too lenient, we conclude that the scheme in many other OECD countries might be too “strict”. Key is the precision of the monitoring technology. Currently, we know very little about this precision and we therefore invite scholars to include this in their research agenda.

Finally, as any study, this research is not exempt of limitations. Let us list here a couple of these without claiming to be exhaustive. First, the analysis revealed that monitoring job search in any considered design always decreased welfare. We claimed that this may be a consequence of the simplified definition of welfare, which ignores the efficiency costs of transferring public funds to the unemployed and also risk aversion of the unemployed. Hence, we argued that, ideally, we should derive this objective from a well defined optimization problem in the spirit of the literature on the optimal design of UI (Shavell and Weiss, 1979; Hopenhayn and Nicolini, 1997; Pavoni and Violante, 2007, e.g.). A second weakness of this study is that it was not capable to distinguish between the job arrival rate and the job search effort. One way to solve this, and this is the route taken by van den Berg and van der Klaauw (2013), is to collect information on indicators of job search effort (such as indicators of the types of search channels used or the number of application letters sent). Another solution was proposed in Section 5.2 and consists in using the indirect information on job search effort that can be deduced from the probability of negative evaluation and from the optimality conditions. Unfortunately, this strategy could not be implemented in this study, because it was found that a negative evaluation was unrelated to job search effort. Third, welfare issues are clearly better studied in an equilibrium search model, such as the one proposed by Boone et al. (2007). All these exiting topics are left as avenues for further research.

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\[33\] This was also the conclusion of Cockx et al. (2014), who studied the theoretical welfare implications of job search monitoring of unemployed with time inconsistent preferences.

\[34\] Recently, Arni and Schiprowski (2015) find that setting job search requirements above the job seeker’s unconstrained effort choice, can enhance the job finding rate substantially. These authors study the Swiss system in which job search requirements are quite sharply defined. This supports our finding that a sufficiently accurate monitoring scheme can indeed be effective in raising job search effort. However, more research is required to obtain insights into the sensitivity of this effectiveness with respect to measurement precision and the implications of this on the optimal design of job search monitoring.
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Appendix

A Derivation of $U^e_k(t_{k-1})$ from the Limit of its Recursive Definition in Discrete Time

Consider time intervals of length $d\tau$. The lifetime utility of an unemployed worker at time $\tau$ can be written by the following recursive relation:

$$U^e_k(\tau) = \frac{\left\{y^e_{j(k)}(\tau) d\tau + \left[1 - s^e(\tau) d\tau\right] U^e_k(\tau + d\tau) + s^e(\tau) d\tau \left[F^e[w^e(\tau)] U^e_k(\tau + d\tau) + \bar{F}^e[w^e(\tau)] W^e_k(\tau + d\tau)\right]\right\}}{1 + \rho d\tau}$$ (A-1)

where $s^e(\tau) d\tau$ is the probability that a job offer arrives between $\tau$ and $\tau + d\tau$. Rearrangement yields

$$\rho d\tau U^e_k(\tau) = y^e_{j(k)}(\tau) d\tau + s^e(\tau) d\tau \bar{F}^e[w^e(\tau)] \left[W^e_k(\tau + d\tau) - U^e_k(\tau + d\tau)\right] + [U^e_k(\tau + d\tau) - U^e_k(\tau)] .$$ (A-2)

Dividing by $d\tau$, taking the limit for $d\tau \to 0$ and using that $s^e(\tau) \bar{F}^e[w^e(\tau)] \equiv p^e(\tau)$ leads to the following differential equation:

$$\dot{U}^e_k(\tau) - [p^e(\tau) + \rho] U^e_k(\tau) = - \left[y^e_{j(k)}(\tau) + p^e(\tau) W^e_k(\tau)\right]$$ (A-3)

Multiplying by $P^e(\tau, t_{k-1}) e^{-\rho(\tau-t_{k-1})}$ leads to

$$\frac{1}{d\tau} \left(U^e_k(\tau) P^e(\tau, t_{k-1}) e^{-\rho(\tau-t_{k-1})}\right) = - \left[y^e_{j(k)}(\tau) + p^e(\tau) W^e_k(\tau)\right] P^e(\tau, t_{k-1}) e^{-\rho(\tau-t_{k-1})}$$ (A-4)

Finally, integrating from $t_{k-1}$ to $t_k$ results in

$$U^e_k(t_k) P^e(t_k, t_{k-1}) e^{-\rho(t_k-t_{k-1})} - U^e_k(t_{k-1}) = - \int_{t_{k-1}}^{t_k} \left[y^e_{j(k)}(\tau) + p^e(\tau) W^e_k(\tau)\right] P^e(\tau, t_{k-1}) e^{-\rho(\tau-t_{k-1})} d\tau ,$$ (A-5)

which after rearrangement yields equation (7), with $U^e_k(t_k) = U^e_k(t_k)$ given by (5).

B Optimal Paths and Endpoint Conditions

In this section we derive the first-order conditions and consider optimal paths for control variables, along with the corresponding endpoint conditions. The exposition focuses on the time span between two adjacent interviews (interview “$k-1$” and interview “$k$”) and explicitly considers the difference between the scheduled interval and the time of interview delay.
B.1 The Optimization Problem

B.1.1 Scheduled Interval

Consider first the scheduled interval \([t_{k-1}', t_k']\). Before solving the optimization problem, we show how it can be restated in terms of the generalized current value Hamiltonian. We first restate the optimization problem:

\[
\max_{s^e(\tau), w^e(\tau)} U^e_{k,1}(t_{k-1}') = \int_{t_{k-1}'}^{t_k'} \left[ y^e_{j(k)}(\tau) + p^e(\tau) \bar{W}^e_k(\tau) \right] P^e(\tau, t_{k-1}') e^{-\rho(\tau-t_{k-1}')} d\tau \\
+ \mathbb{U}^e_{k,1}(t_k') P^e(t_k', t_{k-1}') e^{-\rho(t_k'-t_{k-1}')} \quad (B-1)
\]

s.t. : \[
\mathbb{U}^e_{k,1}(t_k') = U^e_{k,2}(t_k'), \\
P^e(\tau, t_{k-1}') = -p^e(\tau) P^e(\tau, t_{k-1}'), \\
\dot{S}^e(\tau, t_{k-1}') = \frac{s^e(\tau) - \bar{S}^e(\tau, t_{k-1}')} {\tau - t_{k-1}'},
\]

The Hamiltonian \(H^e_{k,1}(\tau)\) of this problem is

\[
\left[ y^e_{j(k)}(\tau) + p^e(\tau) \bar{W}^e_k(\tau) \right] P^e(\tau, t_{k-1}') e^{-\rho(\tau-t_{k-1}')} - \lambda_P^e(\tau)p^e(\tau)P^e(\tau, t_{k-1}') + \lambda_S^e(\tau) \frac{s^e(\tau) - \bar{S}^e(\tau, t_{k-1}')} {\tau - t_{k-1}'} \quad (B-3)
\]

where \(\lambda_P^e(\tau)\) and \(\lambda_S^e(\tau)\) are the multiplier functions associated to the state variables \(P^e(\tau, t_{k-1}')\) and \(\bar{S}^e(\tau, t_{k-1}')\). To get rid of \(\lambda_P^e(\tau)p^e(\tau)P^e(\tau, t_{k-1}')\) in the last expression, consider the FOC wrt \(P^e(\tau, t_{k-1}')\):

\[
\dot{\lambda}_P^e(\tau) = \frac{\partial}{\partial \tau} (\lambda_P^e(\tau)p^e(\tau, t_{k-1}')) = \lambda_P^e(\tau)p^e(\tau) - \left[ y^e_{j(k)}(\tau) + p^e(\tau) \bar{W}^e_k(\tau) \right] e^{-\rho(\tau-t_{k-1}')} \quad (B-3)
\]

Subtracting \(\lambda_P^e(\tau)p^e(\tau)\) from both sides and multiplying by \(P^e(\tau, t_{k-1}')\) yields

\[
\frac{\partial}{\partial \tau} \left( \lambda_P^e(\tau)p^e(\tau, t_{k-1}') \right) = - \left[ y^e_{j(k)}(\tau) + p^e(\tau) \bar{W}^e_k(\tau) \right] P^e(\tau, t_{k-1}') e^{-\rho(\tau-t_{k-1}')} \quad (B-3)
\]

Integrating this equation from \(\tau\) to \(t_k'\) gives

\[
\lambda_P^e(t_k')P^e(t_k', t_{k-1}') - \lambda_P^e(\tau)P^e(\tau, t_{k-1}') = - \int_{\tau}^{t_k'} \left[ y^e_{j(k)}(x) + p^e(x) \bar{W}^e_k(x) \right] P^e(x, t_{k-1}') e^{-\rho(x-t_{k-1}')} dx. \quad (B-4)
\]

The transversality condition for \(P^e(t_k', t_{k-1}')\) is

\[
\lambda_P^e(t_k') = \frac{\partial \left( \mathbb{U}^e_{k,1}(t_k') P^e(t_k', t_{k-1}') e^{-\rho(t_k'-t_{k-1}')} \right)} {\partial P^e(t_k', t_{k-1}')} = \mathbb{U}^e_{k,1}(t_k') e^{-\rho(t_k'-t_{k-1}')} \quad (B-4)
\]

Inserting this in \((B-4)\), rearranging and using the fact that \(P^e(x, t_{k-1}')(x-t_{k-1}') = P^e(x, \tau)e^{-\rho(x-t_{k-1}')} P^e(\tau, t_{k-1}') e^{-\rho(\tau-t_{k-1}')} \) delivers by \((B-1)\)

\[
\lambda_P^e(\tau)e^{\rho(\tau-t_{k-1}')} = \int_{\tau}^{t_k'} \left[ y^e_{j(k)}(x) + p^e(x) \bar{W}^e_k(x) \right] P^e(x, \tau)e^{-\rho(x-\tau)} dx + \mathbb{U}^e_{k,1}(t_k') P^e(t_k', \tau)e^{-\rho(t_k'-\tau)} \equiv U^e_{k,1}(\tau). \]

37
By multiplying both sides by $e^{-\rho(\tau-t_{k-1}^*)}$ and inserting this in (B-3) one obtains

$$H_{k,1}^c(\tau) = \left[ y_{k(j)}^e(\tau) + p^e(\tau) \left[ \dot{W}_k^c(\tau) - U_{k,1}^c(\tau) \right] \right] P(\tau, t_{k-1}^*) e^{-\rho(\tau-t_{k-1}^*)} + \lambda_s^e(\tau) \frac{s^e(\tau) - \tilde{S}^e(\tau, t_{k-1}^*)}{\tau - t_{k-1}^*}.$$

Defining the generalized current value of any variable $x$ during the scheduled interval as

$$\tilde{x} \equiv x \cdot \exp \left\{ \int_{t_{k-1}^*}^{\tau} (p^e(x) + \rho) \, dx \right\} = x \cdot \exp \left\{ \rho(\tau - t_{k-1}^*) \right\} / P^e(\tau, t_{k-1}^*),$$

and using the definition of $y_{k(j)}^e(\tau)$, we can define the generalized current value Hamiltonian during the scheduled interval as:

$$\dot{H}_{k,1}^e(\tau) = b_{k(j)} + \nu - c [s^e(\tau)] + p^e(\tau) \left[ \dot{W}_k^e(\tau) - U_{k,1}^e(\tau) \right] + \tilde{\lambda}_s^e(\tau) \frac{s^e(\tau) - \tilde{S}^e(\tau, t_{k-1}^*)}{\tau - t_{k-1}^*}.$$

Using the fact that $\dot{W}_k^e(\tau) \equiv E [W_k(w; \tau)|w > w_r^e(\tau)] = \int_{w_r^e(\tau)}^{\infty} \frac{w + \delta U_{k,1}^e(\tau)}{(\rho + \delta) P[w_r^e(\tau)]} \, dw$, we can write $\dot{H}_{k,1}^e(\tau)$ in a slightly more convenient form, namely

$$\dot{H}_{k,1}^e(\tau) = b_{k(j)} + \nu - c [s^e(\tau)]
+ \frac{s^e(\tau)}{\rho + \delta} \int_{w_r^e(\tau)}^{\infty} \left\{ w - \rho U_{k,1}^e(\tau) + \delta \left[ U_{k,1}^e(\tau) - U_{k,1}^e(\tau) \right] \right\} \, dF(w) + \tilde{\lambda}_s^e(\tau) \frac{s^e(\tau) - \tilde{S}^e(\tau, t_{k-1}^*)}{\tau - t_{k-1}^*}. $$

One can easily see that the FOC for the control variables are not affected if one uses $\dot{H}_{k,1}^e(\tau)$ rather than $H_{k,1}^c(\tau)$. The FOC of the state variables need, however, a slight modification. To see this, consider $\dot{S}^e(\tau, t_{k-1}^*)$, written below $\tilde{S}(\tau)$ for short. The FOC for this state variable in $\dot{H}_{k,1}^e(\tau)$ is

$$\frac{\partial \dot{H}_{k,1}^e(\tau)}{\partial S(\tau)} = \frac{\partial H_{k,1}^e(\tau)}{\partial S(\tau)} \exp \left\{ \rho(\tau - t_{k-1}^*) \right\} / P^e(\tau, t_{k-1}^*) = -\tilde{\lambda}_s^e(\tau) \exp \left\{ \rho(\tau - t_{k-1}^*) \right\} / P^e(\tau, t_{k-1}^*)
\quad = \left[ p^e(\tau) + \rho \right] \tilde{\lambda}_s^e(\tau) - \tilde{\lambda}_s^e(\tau) \right)$$

where the second equality follows from the FOC for $S(\tau)(\tau)$ in $H_{k,1}^c(\tau)$ and the third equality from the relationship between $\tilde{\lambda}_s(\tau)(\tau)$ and $\tilde{\lambda}_s^e(\tau)(\tau)$. The transversality condition is modified as follows:

$$\tilde{\lambda}_s^e(t_k^*) \equiv \lambda_s^e(t_k^*) \exp \left\{ \rho(t_k^* - t_{k-1}^*) \right\} / P^e(t_k^*, t_{k-1}^*) = \frac{\partial U_{k,1}(t_k^*)}{\partial S(t_k^*, t_{k-1}^*)}$$

where the second equality follows from the transversality condition for $\lambda_s^e(t_k^*)$.

### B.1.2 First Order Conditions

- **Control variables**

Considering search effort $s(\tau)$:

$$\frac{\partial \dot{H}_{k,1}^e(\tau)}{\partial s^e(\tau)} = -c^e [s^e(\tau)] + \frac{1}{\rho + \delta} \int_{w_r^e(\tau)}^{\infty} \left\{ w - \rho U_{k,1}^e(\tau) + \delta \left[ U_{k,1}^e(\tau) - U_{k,1}^e(\tau) \right] \right\} \, dF(w) + \frac{\dot{\lambda}_s^e(\tau)}{\tau - t_{k-1}^*} = 0$$

$$\Rightarrow c^e [s^e(\tau)] = \frac{1}{\rho + \delta} \int_{w_r^e(\tau)}^{\infty} \left\{ w - \rho U_{k,1}^e(\tau) + \delta \left[ U_{k,1}^e(\tau) - U_{k,1}^e(\tau) \right] \right\} \, dF(w) + \frac{\dot{\lambda}_s^e(\tau)}{\tau - t_{k-1}^*}. \quad (B-9)$$
Considering reservation wage \( w, (\tau) \):

\[
\frac{\partial H_{k,1}^e (\tau)}{\partial w^e (\tau)} = - \frac{s^e (\tau)}{\rho + \delta} \left\{ u^e_k (\tau) - \rho U^e_{k,1} (\tau) + \delta \left[ U^e_{k,1} (\tau) - U^e_{k,1} (\tau) \right] \right\} f \left( w^e (\tau) \right) = 0
\]

which leads to \((11)\).

- **State variables**

  For average search effort \( \bar{S}^e (\tau, t^*_{k-1}) \):

  \[
  \frac{\partial \bar{H}^e_{k,1} (\tau)}{\partial \bar{S}^e (\tau, t^*_{k-1})} = - \frac{\bar{\lambda}^e_S (\tau)}{\tau - t^*_{k-1}} = \left[ p^e (\tau) + \rho \right] \bar{\lambda}^e_S (\tau) - \bar{\lambda}^e_S (\tau)
  \]

  \[\Leftrightarrow \frac{\bar{\lambda}^e_S (\tau)}{\bar{\lambda}^e_S (\tau)} = p^e (\tau) + \rho + \frac{1}{\tau - t^*_{k-1}}.\]

  Acknowledging that \( \frac{\bar{\lambda}^e_S (\tau)}{\bar{\lambda}^e_S (\tau)} \lambda^e_S (\tau) = \frac{\partial}{\partial \tau} \ln \bar{\lambda}^e_S (\tau), \)

  \[\frac{\partial}{\partial \tau} \ln \bar{\lambda}^e_S (\tau) = \frac{\partial}{\partial \tau} \ln P^e (\tau, t^*_{k-1}) + \rho + \frac{\partial}{\partial \tau} \ln (\tau - t^*_{k-1}) \cdot \]

  Integrating from \( \tau \) to \( t^*_{k} \) and rearranging

  \[
  \ln \frac{\bar{\lambda}^e_S (t^*_{k})}{\lambda^e_S (\tau)} = - \ln P^e (t^*_{k}, \tau) + \rho (t^*_{k} - \tau) + \ln \frac{t^*_{k} - t^*_{k-1}}{\tau - t^*_{k-1}}
  \]

  \[\Leftrightarrow \frac{\lambda^e_S (t^*_{k})}{\lambda^e_S (\tau)} = \frac{t^*_{k} - t^*_{k-1}}{\tau - t^*_{k-1}} e^{\rho (t^*_{k} - \tau)} P^e (t^*_{k}, \tau).\]

  Applying the transversality condition

  \[
  \bar{\lambda}^e_S (t^*_{k}) = \frac{\partial U^e_{k,1} (t^*_{k})}{\partial \bar{S}^e (t^*_{k}, t^*_{k-1})} = \frac{\partial U^e_{k,2} (t^*_{k})}{\partial \bar{S}^e (t^*_{k}, t^*_{k-1})}
  \]

  we finally see that

  \[
  \bar{\lambda}^e_S (\tau) = \frac{\tau - t^*_{k-1}}{t^*_{k} - t^*_{k-1}} \frac{\partial U^e_{k,2} (t^*_{k})}{\partial \bar{S}^e (t^*_{k}, t^*_{k-1})} P^e (t^*_{k}, \tau) e^{-\rho (t^*_{k} - \tau)}. \tag{B-10}
  \]

  Inserting this result, together with \((11)\), into \((B-9)\) we obtain first order condition for search effort \((17)\).

  Section A of the Internet Appendix shows that differentiating the FOC and the value of unemployment expressed in \((B-1)\) with respect to time yields a system of differential equations that describes the evolution of the optimal controls and the lifetime utility in the scheduled interval. This system can be solved backwards from the endpoint conditions for all the paths at \( t^*_{k} \). Endpoint conditions for reservation wage and search effort are found by solving the system of FOCs \((11)\) and \((17)\) evaluated at \( t^*_{k} \).
B.2 Delay Interval

B.2.1 The Optimization Problem

Consider first the interval past the scheduled date, but before the arrival of the next interview \([t_k', t_k^*]\). The realized delay \(t_k^*\) is the minimum of the random draw form the distribution of delay time with rate \(q\) and a maximum possible delay \(t_k^\circ\). Lifetime utility at \(t_k'\) is therefore given by \([\ref{15}]\) and \([\ref{16}]\), where \(y_{j(k)}(\tau)\) replaces \(y_h\). The definition of the generalized current value of any variable \(x\) is now:

\[
\tilde{x} \equiv x \cdot \exp \left\{ \int_{t_k'}^T (p^e(x) + \rho + q) \, dx \right\} = x \cdot \exp \left\{ (\rho + q)(\tau - t_k') \right\} / P^e(\tau, t_k'),
\]

(B-11)

Following the same steps as in the scheduled interval, the generalized current value Hamiltonian in the delay period reads

\[
\tilde{H}_{k,2}^e(\tau) = \tilde{c}_j + \nu - c \left[ s^e(\tau) \right] + p^e(\tau) \left[ \tilde{W}_{k}^e(\tau) - U_{k,2}^e(\tau) \right] + q U_{k,2}^e(\tau) + \tilde{\lambda}_S^e(\sigma) \left[ \sigma^e(\tau) - \tilde{S}^e(\tau, t_k^*) \right].
\]

Using the definition of \(\tilde{W}_{k}^e(\tau)\), we can write \(\tilde{H}_{k,2}^e(\tau)\) in a slightly more convenient form, namely

\[
\tilde{H}_{k,2}^e(\tau) = \tilde{c}_j + \nu - c \left[ s^e(\tau) \right] + q U_{k,2}^e(\tau)
\]

+ \(s^e(\tau) / (\rho + \delta) \int_{w_{e}(\tau)}^\infty \left\{ w - \rho U_{k,2}^e(\tau) + \delta \left[ U_{k,2}^1(\tau) - U_{k,2}^e(\tau) \right] \right\} dF(w) + \tilde{\lambda}_S^e(\tau) \left[ \sigma^e(\tau) - \tilde{S}^e(\tau, t_k^*) \right].
\]

B.2.2 First Order Conditions

- **Control Variables**
  
  FOC for control variables repeat the derivations in B.1.1 leading us to \([\ref{11}]\) and to

\[
c' \left[ s^e(\tau) \right] = \frac{1}{\rho + \delta} \int_{w_{e}(\tau)}^\infty \left\{ w - \rho U_{k,2}^e(\tau) + \delta \left[ U_{k,2}^1(\tau) - U_{k,2}^e(\tau) \right] \right\} dF(w) + \frac{\tilde{\lambda}_S^e(\tau)}{\tau - t_k^*}. \quad \text{(B-12)}
\]

- **State variables**

  For average search effort \(\tilde{S}^e(\tau, t_k^*)\):

\[
\frac{\partial \tilde{H}_{k,2}^e(\tau)}{\partial \tilde{S}^e(\tau, t_k^*)} = q \frac{\partial \pi_k^e \left[ \tilde{S}^e(\tau, t_k^*) \right]}{\partial \tilde{S}^e(\tau, t_k^*)} \left[ U_{k+1,1}(t_k^*) - U^+ \right] - \frac{\tilde{\lambda}_S^e(\tau)}{\tau - t_k^*} = \left[ p^e(\tau) + \rho + q \right] \tilde{\lambda}_S^e(\tau) - \tilde{\lambda}_S^e(\tau)
\]

\[
\Leftrightarrow \tilde{\lambda}_S^e(\tau) = \left( p^e(\tau) + \rho + q + \frac{1}{\tau - t_k^*} \right) \tilde{\lambda}_S^e(\tau) = -q \frac{\partial \pi_k^e \left[ \tilde{S}^e(\tau, t_k^*) \right]}{\partial \tilde{S}^e(\tau, t_k^*)} \left[ U_{k+1,1}(t_k^*) - U^+ \right]
\]

Multiplying both sides with \(P^e(\tau, t_k')\exp\left\{ - \int_{t_k'}^{t_k^*} [\rho + q + 1/\left( x - t_k^* \right)] + dx \right\}\) we recognize that

\[
\tilde{\lambda}_S^e(\tau) P^e(\tau, t_k') e^{-\int_{t_k'}^{t_k^*} [\rho + q + 1/\left( x - t_k^* \right)] + dx}
\]

\[
- \left( p^e(\tau) + \rho + q + \frac{1}{\tau - t_k^*} \right) \tilde{\lambda}_S^e(\tau) P^e(\tau, t_k') e^{-\int_{t_k'}^{t_k^*} [\rho + q + 1/\left( x - t_k^* \right)] + dx}
\]

\[
= -q \frac{\partial \pi_k^e \left[ \tilde{S}^e(\tau, t_k^*) \right]}{\partial \tilde{S}^e(\tau, t_k^*)} \left[ U_{k+1,1}(t_k^*) - U^+ \right] P^e(\tau, t_k') e^{-\int_{t_k'}^{t_k^*} [\rho + q + 1/\left( x - t_k^* \right)] + dx}
\]
\[
\Rightarrow \frac{\partial}{\partial \tau} \left( \tilde{\lambda}_S^e (\tau) P^e (\tau, t_k^e) e^{-\int_{t_k^e}^{t_{k-1}^e} [\rho q + 1/(x-t_{k-1}^e)] dx} \right) = -q \frac{\partial \pi_k^e}{\partial S^e (x, t_{k-1}^e)} \left[ U^e_{k+1,1} (t_k^e) - U^+ \right] P^e (\tau, t_k^e) e^{-\int_{t_k^e}^{t_{k-1}^e} [\rho q + 1/(x-t_{k-1}^e)] dx}.
\]

Integrating the last result from \( \tau \) to \( t_k^e \) we see that

\[
\tilde{\lambda}_S^e (t_k^e) P^e (t_k^e, t_k^e) e^{-\int_{t_k^e}^{t_{k-1}^e} [\rho q + 1/(x-t_{k-1}^e)] dx} - \tilde{\lambda}_S^e (\tau) P^e (\tau, t_k^e) e^{-\int_{t_k^e}^{t_{k-1}^e} [\rho q + 1/(x-t_{k-1}^e)] dx} = - \int_{\tau}^{t_k^e} q \frac{\partial \pi_k^e}{\partial S^e (x, t_{k-1}^e)} \left[ U^e_{k+1,1} (t_k^e) - U^+ \right] P^e (x, t_k^e) e^{-\int_{t_k^e}^{t_{k-1}^e} [\rho q + 1/(x-t_{k-1}^e)] dx} dx.
\]

Applying the transversality condition

\[
\tilde{\lambda}_S^e (t_k^e) = \frac{\partial U^e_{k+1,1}}{\partial S^e (t_k^e, t_{k-1}^e)} = \frac{\partial \pi_k^e}{\partial S^e (t_k^e, t_{k-1}^e)} \left[ U^e_{k+1,1} (t_k^e) - U^+ \right]
\]

and rearranging further shows that

\[
\tilde{\lambda}_S^e (\tau) = \int_{\tau}^{t_k^e} q \frac{\partial \pi_k^e}{\partial S^e (t_k^e, t_{k-1}^e)} \left[ U^e_{k+1,1} (t_k^e) - U^+ \right] P^e (x, \tau) e^{-\int_{\tau}^{x} [\rho q + 1/(x-t_{k-1}^e)] dx} dx
\]

\[
+ \frac{\partial \pi_k^e}{\partial S^e (t_k^e, t_{k-1}^e)} \left[ U^e_{k+1,1} (t_k^e) - U^+ \right] P^e (t_k^e, \tau) e^{-\int_{\tau}^{t_k^e} [\rho q + 1/(x-t_{k-1}^e)] dx} dx
\]

\[
\Rightarrow \frac{\tilde{\lambda}_S^e (\tau)}{\tau - t_{k-1}^e} = \int_{\tau}^{t_k^e} q \frac{\partial \pi_k^e}{\partial S^e (x, t_{k-1}^e)} \left[ U^e_{k+1,1} (t_k^e) - U^+ \right] P^e (x, \tau) e^{-\rho q (x-\tau)} dx
\]

\[
+ \frac{\partial \pi_k^e}{\partial S^e (t_k^e, t_{k-1}^e)} \left[ U^e_{k+1,1} (t_k^e) - U^+ \right] P^e (t_k^e, \tau) e^{-\rho q (t_k^e - \tau)}.
\]

Inserting this result, together with (11), into (B-12) leads to (17). In Section A of the Internet Appendix we derive again the system of differential equations that can be solved recursively.

### C Derivation of the Sample Average Probability of Negative Evaluation

In the main text it was explained that the sample average probability of negative evaluation at the \( k^{th} \) interview \( \pi_k \) is estimated by a weighted sum of the expected individual probability of negative evaluation for each notified individual in the sample. Subscript \( i \) refers to a notified individual characterized by a specific UB level, gender and schooling level. \( E\pi_{ki} \) denotes the expected probability of negative evaluation for a notified individual \( i \) conditional on being evaluated for the \( k^{th} \) time \( (k \in \{1, 2, 3\}) \) and irrespective of having experienced an employment spell since the last evaluation \( (\epsilon = 0 \ or \ \epsilon = 1) \). \( PE_{ki} \) denote the probability that the \( k^{th} \) evaluation takes place for individual \( i \).

Then, if \( N \) denotes the number of notified individuals, one can write the sample average probability as a weighted average of expected individual probabilities:

\[
\pi_k = \sum_{i=1}^{N} \frac{PE_{ki}}{\sum_{j=1}^{N} PE_{kj}} E\pi_{ki} \quad (C-1)
\]
where

\[ PE_{ki} = \prod_{l=0}^{k-1} E\pi_{li} \]  

and where \( E\pi_{0i} = 1 \). In the model one cannot escape a first evaluation \( (PE_{1i} = 1) \), since the duration counter that determines whether an evaluation will take place is temporarily halted rather than reset to zero if an individual leaves unemployment for employment. Since employment spells are exponentially distributed and since \( \bar{t}_i \), the maximum duration at which the evaluation takes place, is finite, individuals will always eventually return to unemployment and be evaluated with probability one.\(^{35}\) A second evaluation can only take place if one is negatively evaluated at the first: \( PE_{2i} = E\pi_{1i} \). Finally, a third evaluation takes place only if the evaluation at the previous two was negative: \( PE_{3i} = E\pi_{1i} E\pi_{2i} \).

We now derive \( E\pi_{ki} \). For compactness, we abstract from the vector of observed characteristics \( \mathbf{x} \). The probability of negative evaluation depends on whether the unemployment spell was interrupted by employment \((e = 1)\) or not \((e = 0)\), and if \( e = 0 \) on the timing \( \tau \) of the interview within the delay interval \( (\tau \in [\bar{t}_k, \bar{t}_k^*]) \) and on the average search effort \( S^0_i(\tau, t_{k-1}^*; v_j) \) of individual \( i \) with unobserved mass point \( v_j \):

\[
\frac{\pi^*_0}{\pi^*_k} \left[ S^0_i(\tau, t_{k-1}^*; v_j) \right] = \exp \left\{ -\kappa_k (\alpha_1 + \beta_1 S^0_i(\tau, t_{k-1}^*; v_j)) \right\} \quad (C-3)
\]

\[
\frac{\pi_k}{\pi^*_k} = \exp (-\kappa_k \gamma_1) \quad (C-4)
\]

where \( \kappa_1 = 1 \). The expected probability of negative evaluation \( E\pi_{ki} \) is a weighted average of these probabilities, where the weights depend on the probability of their realization. We first derive these probabilities conditional on the unobserved mass points and denote these by \( E\pi_{ki}(v_j) \). Subsequently, we write the unconditional probability as a function of the conditional probabilities.

\[
E\pi_{ki}(v_j) = \left\{ \begin{array}{l}
1 - e^{\int_{\tau}^{\bar{t}_k} p^0_i(z; v_j) dz} + \int_{\tau}^{\bar{t}_k} p^0_i(\tau; v_j) e^{\int_{v_j}^{\bar{t}_k} \left[ p^0_i(z; v_j) + q \right] dz} d\tau \pi_k^1 \\
+ e^{-\int_{\tau}^{\bar{t}_k} p^0_i(z; v_j) dz} \left\{ \int_{\tau}^{\bar{t}_k} q e^{-\int_{\tau}^{\bar{t}_k} \left[ p^0_i(z; v_j) + q \right] dz} \frac{\pi^*_0}{\pi_k} \left[ S^0_i(\tau, t_{k-1}^*; v_j) \right] d\tau \\
+ e^{-\int_{\tau}^{\bar{t}_k} \left[ p^0_i(z; v_j) + q \right] dz} \frac{\pi^*_0}{\pi_k} \left[ S^0_i(\bar{t}_k, t_{k-1}^*; v_j) \right] \right\} \end{array} \right. \quad (C-5)
\]

for \( k \in \{1, 2, 3\} \). The expression contains four terms. The first two terms weigh the probability of negative evaluation for \( e = 1 \) \((\pi^*_k)\) by the probability of having found employment before the \( k \)th interview. This occurs if employment is found during the scheduled interval \([t_{k-1}^*, t_k^*]\) (first term) or if employment is found during the delay interval \([t_k^*, \bar{t}_k]\) before an interview takes place (second term). The third term weighs for each \( \tau \in [t_k^*, \bar{t}_k] \) the probability of negative evaluation for \( e = 0 \) \((\pi^*_0 [S^0_i(\tau, t_{k-1}^*; v_j)])\) by the probability that an evaluation occurs before employment is found and integrates (“sums”) this over the delay interval. The last term is the probability of negative evaluation for \( e = 0 \) if it takes place at the end of the delay interval \([S^0_i(\bar{t}_k, t_{k-1}^*; v_j)]\) weighted by the probability of neither having the \( k \)th interview nor a transition to employment before \( \bar{t}_k \).

The expected probability of negative evaluation, unconditional on \( v_j \) can then be expressed as follows:

\[
E\pi_{ki} = \frac{\sum_{j=1}^{2} Q_j e^{-\int_{v_j}^{\tau_0} p^0_i(z; v_j) dz} \prod_{l=0}^{k-1} E\pi_{li}(v_j)}{\sum_{j=1}^{2} Q_j e^{-\int_{v_j}^{\tau_0} p^0_i(z; v_j) dz} \prod_{l=0}^{k-1} E\pi_{li}(v_j)} \quad (C-6)
\]

\(^{35}\)This is an approximation, since in reality the duration counter determining the moment of evaluation is reset to zero after an uninterrupted full time employment spell of 12 months.
for \( k \in \{1, 2, 3\} \) and where \( E\pi_k(v_j) \equiv 1 \). Each conditional expected probability of negative evaluation \( E\pi_k(v_j) \) is weighted by the conditional probability that the mass point is equal to \( v_j \), conditional on individual \( i \) of type \( v_j \) being evaluated for the \( k^{th} \) time, and, hence, conditional on \( k-1 \) negative evaluations, i.e. it is weighted by

\[
Q_j e^{-\int_0^{\bar{t}_3} p^0(z;v_j)dz} \prod_{l=0}^{k-1} E\pi_{li}(v_j) / \left[ \sum_{j=1}^2 Q_j e^{-\int_0^{\bar{t}_3} p^0(z;v_j)dz} \prod_{l=0}^{k-1} E\pi_{li}(v_j) \right],
\]

where \( e^{-\int_0^{\bar{t}_3} p^0(z;v_j)dz} \) is the probability that individual \( i \) of type \( v_j \) survives in unemployment until notification.

**D Solving the Optimal Control Problem and Estimation**

Estimation requires that the optimal control problem described in Section 4.4 has to be solved at each iteration of the numerical optimization. Given a vector of all parameters of the model, for each sampled individual the problem is solved, both for \( e = 0 \) and \( e = 1 \), by backward induction in the following steps:

**Step 0:** The stationary problems are solved in case of a positive evaluation and in case of a sanction after a third interview; \( U^+ \) and \( U^- \) are calculated.

**Step 1.1:** Given \( U^+ \) and \( U^- \), the FOC for control variables are solved at \( \bar{t}_3 \) to determine the endpoint conditions for the paths of control variables at \( \bar{t}_3 \). First we solve for endpoint conditions under effort-independent evaluation (\( e = 1 \)), since for \( e = 1 \) FOC depend only on the knowledge of \( U^+ \) and \( U^- \). Then we solve for endpoint conditions under effort-dependent evaluation (\( e = 0 \)), as for \( e = 0 \) FOC require knowledge of \( U_{3,2}(\bar{t}_3) \), available now from the former solution. Moreover, these FOC also require knowledge of \( \pi^0 [S^0(\bar{t}_3, t_3')] \), which itself contains an integral of the yet unknown path of the search effort. An initial guess for this probability is taken.

**Step 1.2:** Given the endpoint conditions of Step 1.1, the system of differential equations that describe the evolution of the optimal paths of control variables is solved in the interval \( [t_3', \bar{t}_3] \). This system is obtained by the differentiation of the FOC for control variables with respect to time. First we solve for optimal paths under effort-independent evaluation (\( e = 1 \)). Then we solve for optimal paths under effort-dependent evaluation (\( e = 0 \)), since the solution of the system of differential equations in this case requires knowledge of the path of \( U_{3,2}(\tau) \), \( \tau \in [t_3', \bar{t}_3] \), available now from the former solution. Moreover, this system also requires knowledge of \( \pi^0 [S^0(\bar{t}_3, \tau)] \), \( \tau \in [t_3', \bar{t}_3] \), for which the initial guess is maintained for the moment. Using both solutions, \( U_{3,2}(t_3') \) and \( U_{3,2}(\bar{t}_3) \) at the scheduled date of the third interview \( t_3' \) are computed.

**Step 1.3:** Given \( U_{3,2}(t_3') \) and \( U_{3,2}(\bar{t}_3) \) from Step 1.2, the FOC for control variables are solved at \( t_3' \) to determine the endpoint conditions for the paths of control variables at \( \bar{t}_3 \). The endpoint conditions are solved first for the effort-independent evaluation, followed by the effort-dependent evaluation (for the same reason as in Step 1.1).

**Step 1.4:** Given the endpoint conditions of Step 1.3 the system of differential equations that describe the evolution of the optimal paths of control variables is solved in the interval \( [t_3', \bar{t}_3] \). First we solve for optimal paths under effort-independent evaluation, followed by effort-dependent evaluation (for the same reason as in Step 1.2). Likewise, the system of differential equations under effort-dependent evaluation requires knowledge of \( \pi^0 [S^0(t_3', \tau)] \), \( \tau \in [t_3', \bar{t}_3] \), for which the initial guess is currently maintained.

**Step 1.5:** The solution of Steps 1.1-1.4 provides us with the optimal path of search effort \( s^0(\tau) \) on \( [t_3', \bar{t}_3] \). This is used to update the initial guess about \( \pi^0 [S^0(\bar{t}_3, \tau)] \), \( \tau \in [t_3', \bar{t}_3] \), and Steps 1.1-1.4 are repeated again until convergence in \( s^0(\tau) \). Upon convergence the value of the lifetime utility \( U_{3,1}(t_3') \) at the actual date of the second interview is evaluated.
Step 2: We go back to Step 1.1, replace $U^-_2$ by $U^0_{2,1}(t^*_2)$, as calculated in Step 1.5, and iterate until convergence. The result is the lifetime utility $U^0_{2,1}(t^*_1)$ at the actual date of the first interview.

Step 3: We continue in this way until arriving at $t^*_0$, the moment of notification.$^{36}$

The above described solution algorithm takes the vector of all parameters of the model as given. Parameters of the model are described by the following likelihood functions: (25)-(26) determine all parameters but $\{\alpha_{1,vj}\beta_1\}_{j=1,2}$, and (27) determines $\{\alpha_{1,vj}\beta_1\}_{j=1,2}$. Consequently the estimation is performed in two stages:

STAGE 1: For the initial values of $\{\alpha_{1,vj}\beta_1\}_{j=1,2}$ and the rest of the parameters, (25)-(26) are maximized conditional on $\{\alpha_{1,vj}\beta_1\}_{j=1,2}$. The resulting estimates are used to compute, based on Steps 0 to 3, the average search effort at the first interview $\bar{S}^0(t^*_1,t^*_0)$ for all individuals who are observed to have the first interview.

STAGE 2: Given $\bar{S}^0(t^*_1,t^*_0)$ from Stage 1, (27) is maximized with respect to $\{\alpha_{1,vj}\beta_1\}_{j=1,2}$, $\{\alpha_{k,vj}\beta_k\}_{j=1,2}$ with $k = 2, 3$ are updated as described in Section 5.2 and in Appendix C. Based on these new parameter estimates Steps 0 to 3 are implemented as input for Stage 1.

Stages 1 and 2 are iteratively repeated until convergence in all parameters of the model.

References


$^{36}$Detailed expressions of the systems of endpoint conditions and optimal paths at each step are provided in the Internet Appendix, Section A.


46


