# Serie research memoranda

## How To Reduce Vacancy Durations

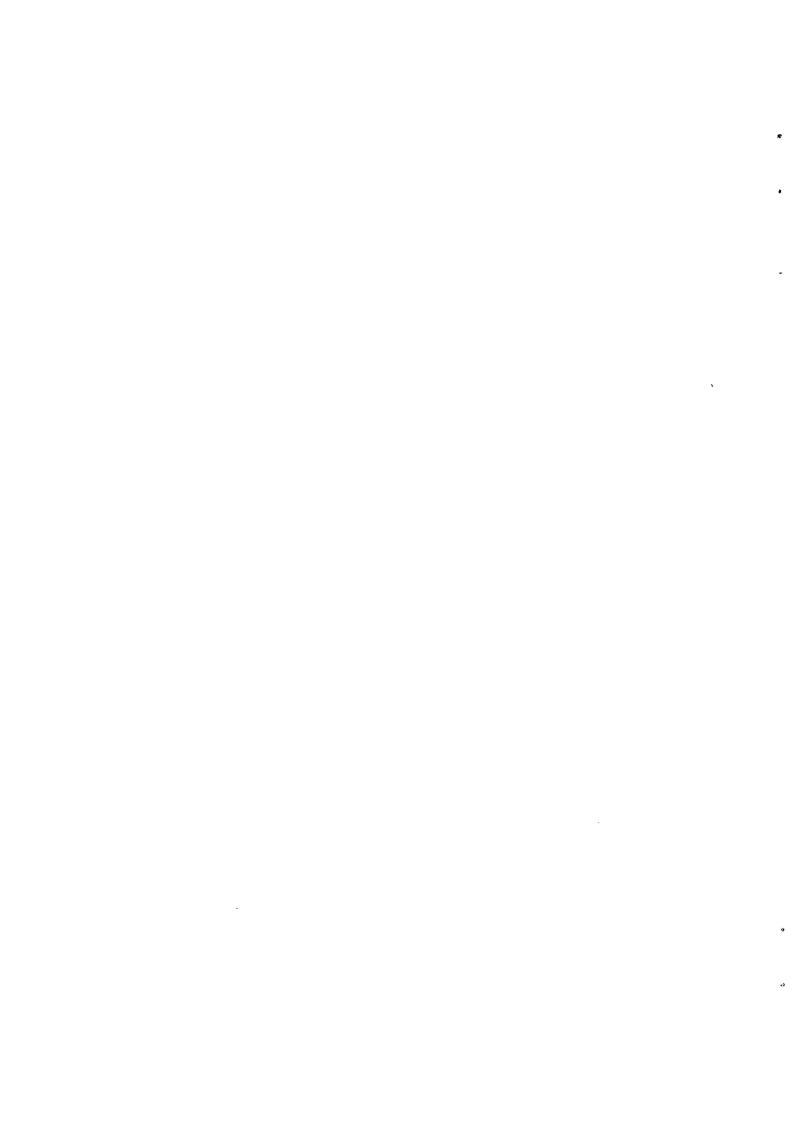**J.H. Abbring**
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# How To Reduce Vacancy Durations

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## Abstract

Public employment offices can use different methods of mediation to get notified vacancies filled. This paper presents an empirical analysis of the relationship between mediation method and vacancy duration. From a theoretical point of view a vacancy duration consists of two periods: an application period and a selection period. Using vacancy data from public employment offices we are able to make an empirical distinction between the two periods. The estimation results suggest that if the public employment office screens possibly suitable job seekers with respect to for example ability, working experience, education and motivation the selection period is shorter. Furthermore it appears that in local labour markets with a high unemployment-vacancy ratio application periods are substantially shorter.

# 1 Introduction

Employers can search for new employees in different ways. They can use personnel advertisements, use informal search channels or notify the public employment office. The choice of a recruitment channel depends on a comparison of expected benefits and costs. An advertisement usually attracts many applicants which may not all be suitable for the job. An advertisement is not only expensive in direct advertising costs but also in screening costs. Informal recruitment channels are said to be highly effective in terms of the match between worker and job, because both employer and new employee gather important information on each other. Friends and colleagues provide valuable information to the worker on the working conditions in the firm and to the firm on the attitude of the applicant. The use of public employment offices as a search channel is very cheap, but the quality of the applicants arriving through mediation of the public employment offices is low.

The Dutch public employment offices provide employers with applicants without any direct costs. Yet, this recruitment channel is not very popular. From a vacancy survey of the Dutch Central Bureau of Statistics (CBS) held in March 1990 it appeared that some 30% of all existing vacancies was notified at the public employment office. From a survey of the Dutch ministry of Social Affairs and Employment it appeared that about 10% of the flow of filled job vacancies originated from the public employment offices. There are several reasons for this low market share. Almost all workers which register at the public employment office as job seekers are unemployed. They are obliged to register at the public employment office if they want to receive unemployment benefits. Unemployed may not all be equally motivated in accepting a job, if one is offered. Employers frequently complain about the service of the public employment offices: the applicants are often not very suitable for the job in either ability or motivation. Employers seeking for new employees therefore often only use the public employment office as an additional recruitment channel.

This article is about the relationship between the duration of notified vacancies and the way those vacancies are handled at public employment offices in the Netherlands. In our theoretical model we split up the vacancy duration in two periods: an application period and a selection period. During the application period employers attract applicants to form a pool of potential new employees. During the selection period the best worker is picked from the pool of applicants.

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In the empirical analysis we use vacancy information from 5 regional Dutch public employment offices. The database contains information about vacancies notified in the first quarter of 1988. The offices have registered the completed duration of the job vacancy. Furthermore they have registered whether or not they themselves were responsible for the filling of the vacancies and they have registered which mediation methods they used.

In 1988 the ratio of unemployed to vacancies was very high. Therefore, the flows of applicants towards vacancies were large, and application periods short. In theory, the mediation method used by the public employment office may influence both the application period and the selection period. The application period may be shortened because applicants find their potential new employer more rapidly. The selection period may be shortened because the public employment office has some pre-selection before sending the job seekers to their potential new employer. In the Dutch labour market of 1988 the main effect of the mediation methods was on the selection period.

The article is set up as follows. In section 2 we describe the process of employers search and we describe the various methods public employment offices use to handle notified job vacancies. In section 3 we present our empirical model. In section 4 we present the data we use in the analysis and we discuss the potential determinants of both application and selection periods. Section 5 contains the estimation results. Section 6 concludes.

## 2  Searching for new employees

### 2.1  Employers search

Employers usually search for new employees by creating job vacancies. The first step of the recruiting process consists of collecting applications from interested candidates who possess the general skills and attributes required for the job. To obtain an initial pool of applicants the employer will actively solicit applications. For that he can use formal recruitment channels like the public employment office or an advertisement in a newspaper, but he may also use an informal recruitment channel like employee referral. Then, through a selection process the employer narrows this general applicant pool to the person with the best job-specific skills. Finally the applicant accepts the job offer (or not). Employers' search is the demand side equivalent of job search. Whereas job search has been investigated frequently, both theoretically and empirically (Devine and Kiefer [3]), employers search has not been analysed frequently.

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Van Ours and Ridder [7] conclude that employers search non-sequential: almost all vacancies are filled from a pool of applicants that is formed shortly after the posting of the vacancy, so vacancy durations should be interpreted as selection periods and not as search periods for applicants. The hazard rate of vacancies being filled is low in the first few weeks and increases afterwards to remain quite stable. Van Ours and Ridder [8] explicitly decompose a vacancy duration into an application period and a selection period and analyze the determinants of both periods. In their theoretical model Van Ours and Ridder assume that employers choose the length of the application period which maximizes the expected discounted profit flow from employing a new worker. They find that the size of the flow of applicants has a negative influence on the length of the application period. In their empirical analysis they find that the application period is rather short: most of the applicants arrive in the first few weeks. This confirms their earlier conclusion that vacancy durations are mainly selection periods. Abbring en Van Ours [1] study employers' search by analyzing the duration of vacancies notified at public employment offices. Again, it appears the employers use a nonsequential search strategy to find new employees. The application period is short and is inversely related to the local unemployment-vacancy ratio.

## 2.2 Public employment offices

The use of public employment offices is costless but there are frequent complaints about sluggishness and poor screening. The public employment office is not very popular with employers. Employers are especially dissatisfied with the quality of the applicants sent by the public employment office and dissatisfied with the slowness in which this happens. With relation to the quality the employers are dissatisfied with both the gap between abilities and vacancy requirements as well as with the motivation of the applicants. Barron and Mellow [2] argue that few employers use the free service of the public employment office because applicants sent by the public employment office have a lower likelihood than other applicants of accepting employment. Therefore using public employment office services has higher screening costs per vacancy.

Public employment offices use different methods of mediation to get the notified vacancies filled. The Dutch public employment offices use a classification of three groups: selfselection, administrative matching and selective matching.

In the case of selfselection the public employment office is rather passive

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in its mediation. With selfselection information on both job seekers and vacancies is recorded in files, to which both employers and job seekers have access. Unemployed workers registered at the public employment office are not obliged to apply for the vacancies. Job seekers can gather information by telephone on a few vacancies recorded on tape. If they are interested they can inform the public employment office and in some cases they will be invited to the office for an initial screening. If a job seeker is expected to be suitable for the job he or she gets the name and address of the employer. The (unemployed) job seeker is not obliged to apply.

Administrative matching means that the vacancy information is matched with information about registered job seekers. If there are possibly suitable job seekers registered, these job seekers are notified about the job vacancy. There is therefore some obligation for the job seeker to apply for the vacancy. The employer may get the names of the possibly suitable job seekers and may contact these himself.

Selective matching means that additional to administrative matching the public employment office screens the possibly suitable job seekers with respect to ability, working experience, education, motivation, etcetera.

The costs of the mediation methods differ substantially. Selfselection requires the least time for the public employment office. The office provides information on vacancies to the job seekers and spends no or just some time on the selection of candidates. We consider selfselection to be an extensive mediation method. Administrative matching takes more time. The employment office has to find suitable job seekers matching the vacancy. Selective matching takes most time. Apart from the matching the employment office has to spend time in screening suitable candidates. We consider both administrative matching and selective matching to be intensive mediation methods.

Van Ours [6] analyses the influence of mediation methods on durations of notified vacancies. From this analysis it appears that intensive matching leads to a significant reduction of the duration of vacancies filled by the public employment office. Administrative mediation has a positive, though not significant effect. Van Ours concludes that it may be necessary to stimulate (unemployed) job seekers to apply. Furthermore, it is effective if the public employment office does some initial screening of candidates on for example motivation. An initial screening on motivation and other aspects seems to be very useful.

In this paper we combine the studies by Abbring and Van Ours [1] and

Van Ours [6] by introducing in a competing risk model application and selection periods, both of which may be influenced by mediation methods.

# 3   Empirical model

As in Van Ours [6] we assume that the process of filling job vacancies can be described by a competing risk model, in which vacancies can either be filled by the public employment office or by another channel. We assume these to be the competing risks. In order to get probability distributions of the latent durations we will make the following assumptions. [1] Applicants only arrive during the application period. After that, the pool of applicants stays the same and the selection process is started. The length of the application period at the public employment office (other channels) is, conditional on a heterogeneity component, exponentially distributed with parameter $\lambda_e$ ($\lambda_o$). The same holds for the length of the selection period, with parameter $\theta_e$ ($\theta_o$). We will specify these parameters exponentially: $\lambda_e = e^{\beta_e' X + \mu_e}$, $\theta_e = e^{\gamma_e' X + \nu_e}$, $\lambda_o = e^{\beta_o' X + \mu_o}$ and $\theta_o = e^{\gamma_o' X + \nu_o}$. $X$ is a vector of explanatory variables. $\beta_e$, $\gamma_e$, $\beta_o$ en $\gamma_o$ are vectors of parameters. $\mu_e$, $\nu_e$, $\mu_o$ en $\nu_o$ are unmeasured heterogeneity terms that are simultaneously distributed with probability density $h(\mu_e, \nu_e, \mu_o, \nu_o)$. For the sake of simplicity we will assume independence of the latent durations. Furthermore we will assume that the lengths of the application and selection periods are independent.[2] In that case we can rewrite $h$ as the product of four marginal distributions, that is $h(\mu_e, \nu_e, \mu_o, \nu_o) = g_e(\mu_e) h_e(\nu_e) g_o(\mu_o) h_o(\nu_o)$. In this paper we will further restrict ourselves to two point heterogeneity, such that

$$
\begin{aligned}
g_e(x) &= 1/\left(1 + e^{\psi_e}\right) && \text{if } x = \mu_e^1 \\
&= e^{\psi_e}/\left(1 + e^{\psi_e}\right) && \text{if } x = \mu_e^2 \\
&= 0 && \text{otherwise, and} \\
h_e(x) &= 1/\left(1 + e^{\zeta_e}\right) && \text{if } x = \nu_e^1 \\
&= e^{\zeta_e}/\left(1 + e^{\zeta_e}\right) && \text{if } x = \nu_e^2 \\
&= 0 && \text{otherwise,}
\end{aligned}
$$

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[1] See Van Ours and Ridder [8].

[2] The first assumption enables us to estimate the coefficients for the public employment office and the other channels separatily (see section 5). Besides, restrictions on the functional form of $h$ are required to accomplish identification.

for some $\mu_e^1$, $\mu_e^2$, $\nu_e^1$, $\nu_e^2$, $\psi_e$ and $\zeta_e$. $g_o$ and $h_o$ are specified like $g_e$ and $h_e$ with parameters $\mu_o^1$, $\mu_o^2$, $\nu_o^1$, $\nu_o^2$, $\psi_o$ and $\zeta_o$. Note that the expectation of the heterogeneity term does not necessarily equal zero, which makes a constant term in $X$ redundant.

For the time being we will omit channel subscripts, and denote the length of the application period by $A$ and the length of the selection period by $S$. We will now find expressions for the mixing probability density function, $\overline{f}$, the mixing cumulative distribution function, $\overline{F}$, and the mixing hazard rate, $\overline{\alpha} = \overline{f} / (1 - \overline{F})$ for the total (latent) duration $T = A + S$. In order to do so we will first derive the distribution functions conditional on the realisation of the unobserved heterogeneity, that is, conditional on $\lambda$ en $\theta$.

It holds that $f_{A|\lambda,\theta}(a) = \lambda e^{-\lambda a}$ if $a \geq 0$ and 0 otherwise. Furthermore, $f_{T|A,\lambda,\theta}(t|a) = \theta e^{-\theta(t-a)}$ when $t \geq a$ and 0 otherwise. This implies for the simultaneous distribution of $A$ and $T$

$$f_{A,T|\lambda,\theta}(a,t) = f_{T|A,\lambda,\theta}(t|a) f_{A|\lambda,\theta}(a) = \lambda\theta e^{-\theta t} e^{-(\lambda-\theta)a}, \qquad (1)$$

if $t \geq a$ and 0 otherwise.

When $\lambda \neq \theta$, the marginal distribution of $T|\lambda,\theta$ is given by

$$\begin{aligned}
f_{T|\lambda,\theta}(t) &= \int_0^t f_{A,T|\lambda,\theta}(a,t)\, \mathrm{d}a \\
&= \left[ \frac{\lambda\theta}{\theta-\lambda} e^{-\theta t} e^{-(\lambda-\theta)a} \right]_0^t \\
&= \frac{\lambda\theta}{\theta-\lambda}\left( e^{-\lambda t} - e^{-\theta t} \right),
\end{aligned} \qquad (2)$$

if $t \geq 0$ and 0 otherwise, thus implying for the cumulative distribution

$$\begin{aligned}
F_{T|\lambda,\theta}(t) &= \int_0^t f_{T|\lambda,\theta}(u)\, \mathrm{d}u \\
&= \frac{\lambda\theta}{\theta-\lambda}\left[ \frac{1}{\theta}e^{-\theta u} - \frac{1}{\lambda}e^{-\lambda u} \right]_0^t \\
&= 1 - \frac{\theta e^{-\lambda t} - \lambda e^{-\theta t}}{\theta - \lambda},
\end{aligned} \qquad (3)$$

if $t \geq 0$ and 0 otherwise. Therefore, the conditional hazard rate $\alpha_{T|\lambda,\theta}(t)$ is given by

$$\alpha_{T|\lambda,\theta}(t) = \frac{f_{T|\lambda,\theta}(t)}{1 - F_{T|\lambda,\theta}(t)} = \lambda\theta\frac{e^{-\lambda t} - e^{-\theta t}}{\theta e^{-\lambda t} - \lambda e^{-\theta t}}, \qquad (4)$$

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if $t \geq 0$ and 0 otherwise.

When $\lambda = \theta$, however, $T|\lambda, \theta$ is $gamma\,(\lambda, 2) = gamma\,(\theta, 2)$ distributed and

$$f_{T|\lambda,\theta}\,(t) = \theta^2 e^{-\theta t} t, \tag{5}$$

if $t \geq 0$ and 0 otherwise. Therefore

$$F_{T|\lambda,\theta}\,(t) = \int_0^t f_T\,(u)\,du = 1 - (1 + \theta t)\,e^{-\theta t}, \tag{6}$$

if $t \geq 0$ and 0 otherwise and

$$\alpha_{T|\lambda,\theta}\,(t) = \frac{f_{T|\lambda,\theta}\,(t)}{1 - F_{T|\lambda,\theta}\,(t)} = \frac{\theta^2 t}{1 + \theta t}, \tag{7}$$

if $t \geq 0$ and 0 otherwise.[3]

The mixture distributions follow by taking the expectation with respect to the unmeasured heterogeneity of $f$ en $F$. As we have chosen simple two point heterogeneity this gives us simple expressions like $\overline{f}\,(t) = \sum_{\mu,\nu} f_{T,\lambda,\theta}\,(t) = \sum_{\mu,\nu} f_{T|\lambda,\theta}\,(t)\,g\,(\mu)\,h\,(\nu)$. [4] We will not elaborate on this.

# 4 Data and variables

## 4.1 Data

Our data are from an experimental registration system of vacancies called ARVA (Automatic Registration of Vacancies), in which a few employment offices participated. We use a sample from 5 public employment offices of 501 vacancies that were notified in the first quarter of 1988 and refer to single— one person wanted— vacancies. For each vacancy we know the duration as measured by the time between the date of notification of the vacancy and the date it was filled. Furthermore we know what mediation method was applied, whether it was filled by the public employment office or otherwise, etcetera (appendix A and B provide more information on the data).

As described in section 2 vacancies notified at the public employment office may be filled by the office itself or by another recruitment channel like

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[3]The gamma distribution also emerges as a limiting case $(\lambda - \theta) \to 0$ of expressions (2)–(4).

[4]See for example Lancaster [4], section 3.1.

an advertisement. The latter possibility occurs if the employer uses more recruitment channels than just the public employment office. The vacancy may end because it is filled, either by an applicant send by the public employment office or by an applicant who contacted the employer by another recruitment channel. After the vacancy is filled, the employment office establishes whether or not this was due to the mediation of that employment office.

## 4.2 Variables

Like in Van Ours [6], we have grouped the possible determinants of application and selection period as follows:

- **Labour market conditions:** The ratio of unemployment (U) to vacancies (V) is specified by occupation and region of the public employment office.

- **Required skills:** We distinguish three categories of vacancies with respect to required skills: vacancies for metal or construction workers, vacancies for service occupations at a secondary or higher educational level, and other vacancies.

- **Characteristics of the employer:** Large firms are expected to have lower interview costs due to specialization in the hiring process and will therefore be more likely users of the public employment office services (Barron and Mellow [2]). We distinguish four size classes: 0-10, 10-50, 50-100, >100 employees. We use a dummy variable that equals 1 if the use of other recruitment channels is indicated, and 0 otherwise. We assume that if there is an effect on vacancy duration of the reported use of other recruitment channels, this is a signal of employers' dissatisfaction about the public employment office. Such an effect is an indication of employers not using the employment office intensively, because of the expected low effectiveness.

- **Characteristics of the vacant job:** Characteristics like temporary or parttime job may be less attractive to job seekers and may thus lead to longer vacancy durations.

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- **Local conditions:** Apart from local labour market conditions the functioning of the public employment offices themselves may be important. To investigate the latter we again use dummy variables. We only expect an effect of these variables on the latent duration at the public employment office. If, however, the employment offices are in different regions, and not all regional effects are summarized by the local labour market situation, there may be some effect on both latent durations.

- **Mediation method:** To investigate whether or not intensive mediation is worthwhile we use dummy variables for administrative matching and for selective matching. If intensive mediation is effective, it will at least reduce selection durations, because it increases the quality of the pool of applicants. There may also be an effect on application durations: a negative effect because applicants are better informed and thus react more rapidly, and a positive effect because more intensive mediation may demand more administrative capacity from the employment office. Any effect of the dummy variables on the vacancy duration, however, can also be explained by sample selectivity. If the employment office selects vacancies that are not hard to fill for intensive mediation, a positive effect on both latent hazard rates will be found. Thus, such a correlation is not very informative on the effectiveness of mediation methods. A positive correlation between the intensity of mediation and employment office hazard rates only, however, can only be explained by effective mediation, unless the employment offices select vacancies that they can fill relatively easily compared to other channels because of other reasons than the already included employers' dissatisfaction, etcetera.

As in Abbring and Van Ours [1] the sets of explanatory variables are different for the application and the selection period. For the hazard rate of the application period we use the UV-ratio, employers' dissatisfaction, dummy variables for the employment offices, and the use of mediation methods as explanatory variables. The hazard rate of the selection period is determined by required skills, size of the firm, employers' dissatisfaction, characteristics of the vacant job, and the use of mediation methods. The UV-ratio can be included to provide a test on the nonsequential search assumption (see Abbring en Van Ours [1]).

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# 5 Estimation results

We define the likelihood as the probability of the 501 (complete) durations and filling channels according to the competing risk model. [5] Thus, the likelihood $\mathcal{L}$ is given by $\mathcal{L} = \mathcal{L}_e \mathcal{L}_o$, where

$$\mathcal{L}_e = \prod_{peo} \bar{f}_e \prod_{oth} \left(1 - \bar{F}_e\right) \tag{8}$$

and

$$\mathcal{L}_o = \prod_{oth} \bar{f}_o \prod_{peo} \left(1 - \bar{F}_o\right), \tag{9}$$

because $T_e$ and $T_o$ are independent. $\prod_{peo}$ denotes the product over all vacancies that are filled by the public employment office; $\prod_{oth}$ denotes the product over the other cases. Estimates of $\beta_e$, $\gamma_e$, $\mu_e^1$, $\mu_e^2$, $\nu_e^1$, $\nu_e^2$, $\psi_e$ and $\zeta_e$ can be obtained by maximizing $\mathcal{L}_e$, and estimates of $\beta_o$, $\gamma_o$, $\mu_o^1$, $\mu_o^2$, $\nu_o^1$, $\nu_o^2$, $\psi_o$ en $\zeta_o$ by maximizing $\mathcal{L}_o$. Therefore, estimation can be done separately for the public employment office and other channels.

Using the software package Gauss we obtained maximum likelihood estimates of the model in section 3. Table 1 gives estimates of a competing risk and a single risk model without unmeasured heterogeneity. Clearly, competing risks are a valuable expansion of the single risk model, so we can restrict ourselves to discussing the competing risk estimates. [6] As expected the employment office dummies have no effect on latent durations at other channels. Furthermore, mediation methods only have a significant effect on the selection period at the public employment office. As this invalidates the argument that employment offices select vacancies that are generally easy to fill for intensive mediation, this is very likely to be explained as the effect of intensive mediation. Omitting some variables with insignificant parameters gives table 2. Adding unobserved heterogeneity gives no insignificant improvement in the determination of the latent durations at the public employment office and other channels (likelihood ratio statistics equal 5.2 and 2.0, respectively). Note that $\lambda$ and $\theta$ can succesfully be identified on the application and selection periods: the first is much shorter than the second, as will be shown later (see Abbring and Van Ours [1]). The remainder of

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[5] See for example Lancaster [4], section 5.5.

[6] The likelihood ratio statistic indicating the significance of the improvement of the model equals $-2\left(440.2 + 259.2 - 576.2 - 501\log(2)\right) = 55.2$, and is distributed $\chi_{20}^2$ (see Narendranathan and Stewart [5]).

this section concerns the results in table 2.

As was to be expected, a high number of unemployed per vacancy considerably reduces the length of the application period at both the public employment office and other channels. The length of the selection period is relatively large for jobs in the metal and construction branches as well as for jobs in the medium and higher services branches. Employers' dissatisfaction with employment offices clearly favours other channels. Understandably, selection periods for temporary jobs are shorter than those for steady jobs. Intensive mediation seems to reduce the duration of selection periods at the employment office. Only administrative matching has a significant effect (on a 10% level).

We will now further investigate the effect of the state of the labour market and the use of mediation methods on the total vacancy duration and the probability that a notified vacancy is filled by the public employment office. As we did not find unmeasured heterogeneity, independence of $T_e$ and $T_o$ implies that the density of the total vacancy duration is given by $f_T = f_{T_e}(1 - F_{T_o}) + f_{T_o}(1 - F_{T_e})$. [7] Thus, total expected vacancy duration, $E[T]$, is given by

$$
\begin{aligned}
E[T] \;=\; & \int_0^\infty t f_T(t)\,\mathrm{d}t = \frac{1}{(\theta_e - \lambda_e)(\theta_o - \lambda_o)} \cdot \\
& \left[ \frac{\theta_e \theta_o}{\lambda_e + \lambda_o} - \frac{\lambda_o \theta_e}{\lambda_e + \theta_o} - \frac{\lambda_e \theta_o}{\lambda_o + \theta_e} + \frac{\lambda_e \lambda_o}{\theta_e + \theta_o} \right].
\end{aligned}
\tag{10}
$$

The probability that a vacancy is filled by the public employment office, $Pr(T_e < T_o)$, is, again because of independence of $T_e$ and $T_o$, given by

$$
\begin{aligned}
Pr(T_e < T_o) \;=\; & \int_0^\infty f_{T_e}(t)(1 - F_{T_o}(t))\,\mathrm{d}t \\
=\; & \frac{\lambda_e \theta_e}{(\theta_e - \lambda_e)(\theta_o - \lambda_o)} \cdot \\
& \left[ \frac{\theta_o}{\lambda_e + \lambda_o} - \frac{\lambda_o}{\lambda_e + \theta_o} - \frac{\theta_o}{\lambda_o + \theta_e} + \frac{\lambda_o}{\theta_e + \theta_o} \right].
\end{aligned}
\tag{11}
$$

Proceeding in this manner we find an expected vacancy duration of 4.3 weeks in the sample mean. At the employment office the expected (latent) application process takes 0.4 weeks and the expected (latent) selection process 5.8 weeks. At the other channels these processes take slightly longer,

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[7] We now introduce channel subscripts again.

that is 1.8 and 8.5 weeks, respectively. This can be explained by the fact that this analysis concerns vacancies that are notified at the public employment office. Vacancies that can easily be filled using other channels, like informal contacts, will less often be notified at the employment office. The probability that a notified vacancy is filled by the employment office is 67% in the data mean.

Table 3 Expected vacancy durations (weeks) and the probability that a vacancy is filled by the public employment office[8]

| situation | $E[A_e]$ | $E[S_e]$ | $E[A_o]$ | $E[S_o]$ | $E[T]$ | $Pr(T_e < T_o)$ |
|---|---|---|---|---|---|---|
| data mean | 0.41 | 5.80 | 1.81 | 8.50 | 4.28 | 0.67 |
| ln(U/V) | | | | | | |
| 2.00 | 0.81 | 5.80 | 2.41 | 8.50 | 4.68 | 0.67 |
| 2.50 | 0.55 | 5.80 | 2.05 | 8.50 | 4.43 | 0.67 |
| 3.00 | 0.37 | 5.80 | 1.74 | 8.50 | 4.24 | 0.67 |
| 3.50 | 0.25 | 5.80 | 1.48 | 8.50 | 4.09 | 0.66 |
| med. method | | | | | | |
| self selection | 0.41 | 8.21 | 1.81 | 8.50 | 5.14 | 0.58 |
| administrative | 0.41 | 5.21 | 1.81 | 8.50 | 4.02 | 0.69 |
| selective | 0.41 | 5.61 | 1.81 | 8.50 | 4.20 | 0.68 |

Table 3 gives the expected lengths of the application and selection periods, the expected vacancy durations, and the probability that a notified vacancy is filled by the public employment office for selected unemployment-vacancies ratios and the three mediation methods. Again, we notice that a relatively high number of unemployed reduces the length of the application periods to a minimum. The effect of more intensive mediation on latent selection durations of vacancies at the employment office is clear. Both administrative and selective mediation shorten the selection period. The probability of the employment office filling a vacancy is lifted from 58% when applying self selection upto 69%(68%) when applying administrative (selective) mediation. Additionally, the expected vacancy duration is reduced from 5.1 weeks when applying selfselection downto 4.0(4.2) weeks when applying administrative (selective) mediation.

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[8]In the data mean $ln(U/V)$ equals 2.88.

# 6 Conclusions

We have separated empirically application and selection durations in a competing risk model. Application periods are relatively short, especially when the number of unemployed per vacancy is large. This supports the nonsequential search assumption. More intensive mediation seems to shorten selection periods at the employent office, but this could partly be due to a sample selectivity bias. This bias exists when employment offices select vacancies for intensive mediation in which they have a comparative advantage over other search channels. Since this does not seem to be a very sensible action, we think that our results show that public employment offices are able to increase efficiency by offering more intensive matching services.

Clearly, more information on the mediation process is needed to get unambiguous measures of the performance of intensive mediation methods. Furthermore, the manner in which the duration dependence is specified may be somewhat to restrictive. A more flexible specification, like in Van Ours [6] might sharpen our conclusions. These considerations indicate that the presented results are not yet fully satisfying. They also suggest, however, that improvements are possible, which could lead to more valuable results. We think that the framework set up in this paper is flexible enough to support this, although we need more information to be succesful in doing so.

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# A  Definition of variables

- Vacancy duration: time period between the notification and the filling of a job vacancy

- Employment offices A-D: dummies

- **Occupation** (Occupational code of the public employment offices (ARBI-code)): metal: ARBI-code 3; construction: ARBI-code 5; services: ARBI-code 10, 12, 13; others: ARBI-code 4, 6–9, 11, 14–17, 99

- **Education**
  Secondary/higher: Secondary level, higher academic or vocational schooling

- **Size of the firm**
  size 10-50 employees; size 50-100 employees; size >100 employees; reference group: size 0-10 employees

- Temporary job; reference group: steady job

- Parttime job: less than or equal to 20 hours per week; reference group: more than 20 hours per week

- Employer's dissatisfaction: if the employer indicates the use of other recruitment channels; reference group: if the employer indicates that he only uses the public employment office as recruitment channel

- **Mediation method**
  Administrative matching: if the vacancy information is matched with information about registered job seekers
  Selective matching: if, additional to administrative matching job seekers are screened with respect to ability, working experience, motivation, etcetera
  Reference group: selfselection

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## B  Means of variables used in the analysis by filling channel

|  | empl. | other | total |
|---|---|---|---|
| administrative matching | 0.57 | 0.51 | 0.54 |
| selective matching | 0.28 | 0.26 | 0.27 |
| metal/construction | 0.33 | 0.27 | 0.32 |
| service-second/high | 0.23 | 0.28 | 0.25 |
| 10–50 employees | 0.33 | 0.33 | 0.33 |
| 50–100 employees | 0.11 | 0.11 | 0.11 |
| more than 100 employees | 0.17 | 0.11 | 0.15 |
| other recruitment channel | 0.11 | 0.27 | 0.17 |
| temporary job | 0.47 | 0.40 | 0.45 |
| parttime job | 0.29 | 0.32 | 0.30 |
| U/V | 24.0 | 22.3 | 23.4 |
| vacancy duration (weeks) | 4.00 | 5.29 | 4.43 |
| total number | 322 | 179 | 501 |

**Table 1** Estimates of $\lambda$ and $\theta$ without unmeasured heterogeneity[9]

| | $\lambda_e$ | | $\lambda_o$ | | $\lambda$ | |
|---|---|---|---|---|---|---|
| $\ln(U/V)$ | 0.61 | (2.0) ** | 0.19 | (0.9) | 0.49 | (1.9) * |
| empl. dissatisfaction | −1.21 | (1.2) | 0.15 | (0.3) | −0.82 | (1.4) |
| employment office 1 | 0.79 | (1.1) | 0.42 | (0.9) | 0.73 | (1.5) |
| employment office 2 | 1.37 | (1.0) | 0.18 | (0.3) | 0.87 | (0.9) |
| employment office 3 | 0.90 | (0.7) | 0.42 | (0.7) | 0.59 | (0.6) |
| employment office 4 | 3.66 | (2.2) ** | −0.61 | (0.9) | 3.08 | (2.2) ** |
| **mediation method** | | | | | | |
| administrative | −1.23 | (1.4) | −0.89 | (1.1) | −0.77 | (1.1) |
| selective | 0.14 | (0.2) | 0.65 | (0.7) | 0.17 | (0.3) |
| **constant** | | | | | | |
| $\mu_1$ | −1.37 | (1.3) | −1.97 | (2.3) ** | −1.23 | (1.4) |

| | $\theta_e$ | | $\theta_o$ | | $\theta$ | |
|---|---|---|---|---|---|---|
| metal/construction | −0.22 | (1.0) | −0.45 | (1.1) | −0.31 | (1.6) |
| services | −0.37 | (1.5) | −0.16 | (0.4) | −0.26 | (1.4) |
| 10–50 employees | −0.03 | (0.1) | −0.14 | (0.4) | −0.10 | (0.6) |
| 50–100 employees | −0.15 | (0.4) | −0.66 | (1.0) | −0.22 | (0.8) |
| $\geq$ 100 employees | 0.15 | (0.5) | −0.65 | (1.3) | −0.13 | (0.6) |
| empl. dissatisfaction | −0.28 | (0.5) | 0.72 | (1.1) | 0.16 | (0.5) |
| temporary job | 0.42 | (2.1) ** | 0.06 | (0.2) | 0.31 | (1.9) * |
| part time job | −0.23 | (1.0) | 0.33 | (0.8) | −0.12 | (0.7) |
| **mediation method** | | | | | | |
| administrative | 0.66 | (2.4) ** | 1.08 | (1.1) | 0.33 | (1.5) |
| selective | 0.43 | (1.6) | −0.18 | (0.3) | 0.30 | (1.4) |
| **constant** | | | | | | |
| $\nu_1$ | −2.08 | (7.2) ** | −1.71 | (2.8) ** | −1.40 | (6.2) ** |

| **loglikelihood** | −440.2 | | −259.2 | | −576.2 | |

[9] Absolute values of t-statistic in parentheses; **: significant on a 5%-level; *: significant on a 10%-level. $\lambda$ and $\theta$ are estimates of a single risk reference model.

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**Table 2** Estimates of $\lambda$ and $\theta$

| without unmeasured heterogeneity | | | | |
|---|---|---|---|---|
| | $\lambda_e$ | | $\lambda_o$ | |
| ln $(U/V)$ | 0.78 | (2.5) ** | 0.33 | (0.9) |
| empl. dissatisfaction | −1.35 | (1.4) | 0.25 | (0.3) |
| employment office 1 | 1.02 | (1.4) | . | |
| employment office 2 | 0.87 | (0.6) | . | |
| employment office 3 | 1.68 | (1.5) | . | |
| employment office 4 | 3.12 | (1.8) * | . | |
| **constant** | | | | |
| $\mu_1$ | −2.47 | (3.7) ** | −1.58 | (1.5) |
| | $\theta_e$ | | $\theta_o$ | |
| metal/construction | −0.17 | (0.8) | −0.41 | (1.2) |
| services | −0.34 | (1.5) | −0.06 | (0.2) |
| 10–50 employees | 0.01 | (0.0) | −0.24 | (0.9) |
| 50–100 employees | −0.17 | (0.5) | −0.63 | (1.5) |
| $\geq$ 100 employees | 0.14 | (0.5) | −0.61 | (1.5) |
| empl. dissatisfaction | −0.29 | (0.6) | 0.40 | (1.0) |
| temporary job | 0.40 | (2.1) ** | 0.17 | (0.7) |
| part time job | −0.21 | (1.0) | −0.06 | (0.2) |
| **mediation method** | | | | |
| administrative | 0.45 | (1.9) * | . | |
| selective | 0.38 | (1.5) | . | |
| **constant** | | | | |
| $\nu_1$ | −2.04 | (7.2) ** | −1.88 | (5.3) ** |
| loglikelihood | −441.3 | | −263.6 | |
| **with unmeasured heterogeneity** | | | | |
| | $\lambda_e, \theta_e$ | | $\lambda_o, \theta_o$ | |
| loglikelihood | −438.7 | | −262.6 | |

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