

Henna Busk

Search in the Labour Markets

Empirical Evidence of the Role of
Technology and Sanctions



JYVÄSKYLÄ STUDIES IN BUSINESS AND ECONOMICS 151

Henna Busk

Search in the Labour Markets

Empirical Evidence of the Role of Technology and Sanctions

Esitetään Jyväskylän yliopiston kauppakorkeakoulun suostumuksella julkisesti tarkastettavaksi Ylistön YK-rakennuksen salissa YlistöKem4, marraskuun 14. päivänä 2014 kello 12.

Academic dissertation to be publicly discussed, by permission of the Jyväskylä University School of Business and Economics, in building YK, auditorium YlistöKem4 on November 14, 2014 at 12 o'clock noon.



UNIVERSITY OF JYVÄSKYLÄ

JYVÄSKYLÄ 2014

Search in the Labour Markets

Empirical Evidence of the Role of
Technology and Sanctions

JYVÄSKYLÄ STUDIES IN BUSINESS AND ECONOMICS 151

Henna Busk

Search in the Labour Markets

Empirical Evidence of the Role of
Technology and Sanctions



UNIVERSITY OF JYVÄSKYLÄ

JYVÄSKYLÄ 2014

Editors

Tuomo Takala

Jyväskylä University School of Business and Economics

Pekka Olsbo, Timo Hautala

Publishing Unit, University Library of Jyväskylä

URN:ISBN 978-951-39-5841-1

ISBN 978-951-39-5841-1 (PDF)

ISBN 978-951-39-5840-4 (nid.)

ISSN 1457-1986

Copyright © 2014, by University of Jyväskylä

Jyväskylä University Printing House, Jyväskylä 2014

ABSTRACT

Busk, Henna

Search in the labour markets: empirical evidence of the role of technology and sanctions

Jyväskylä: University of Jyväskylä, 2014, 154 p.

(Jyväskylä Studies in Business and Economics

ISSN 1457-1986; 151)

ISBN 978-951-39-5840-4 (nid.)

ISBN 978-951-39-5841-1 (PDF)

Finnish summary

Diss.

This thesis studies job search in the Finnish labour market. Both the jobseeker's and employer's points of view are considered. The thesis is based on three empirical articles as well as an introductory chapter that describes the theoretical framework and the development of the Finnish labour market during the past decade.

The first article examines unemployment benefit sanctions and their effect on the outflow from unemployment in Finland. The results imply that sanctions increase the exit rate from unemployment to work but that the effect differs according to the benefit received. Sanctions encourage unemployed on flat-rate labour market support to find jobs, whereas the encouraging effect for the unemployed receiving earnings-related allowance is modest.

The second article investigates the factors that affect employer search, as measured by vacancy duration. The focus of the study is to examine whether the Finnish public employment agency's (PES) implementation of an Internet-based service has had effects on the duration of employer search. According to the results, the introduction of the web service decreased the average duration of employer search. However, there are differences in the web-based vacancy filling at the regional level. The findings show that the web-based service shortened the average duration of vacancies only in certain regions, namely in the provinces of Western Finland, Oulu and Lapland, and that urban employers are more likely to benefit from the use of the online service.

The third and final article of this thesis also relates to Internet-based employer search, but explores it from a different angle. The duration until an employer chooses to withdraw a vacancy from the labour market is analysed. The results indicate that in the short run, the introduction of the PES online service did not have any impact on the employer's decision to withdraw vacancies from the labour market. In the long run, vacancies are withdrawn from the labour market more slowly through the online service than by contacting an employment office.

Keywords: job search, employer search, unemployment benefit sanctions, job vacancies, internet, duration

Author's address Henna Busk
School of Business and Economics
University of Jyväskylä
henna.nivalainen@ju.fi

Supervisors Jaakko Pehkonen
School of Business and Economics
University of Jyväskylä

Reviewers Heikki Räisänen
Ministry of Employment and the Economy
Helsinki, Finland

Sari Kerr
Wellesley Centers for Women (WCW)
Wellesley College
Wellesley, USA

Opponent Heikki Räisänen
Ministry of Employment and the Economy
Helsinki, Finland

ACKNOWLEDGEMENTS

The studies of this thesis were carried out during the years 2008 to 2013 when I was a PhD student at the Jyväskylä University School of Business and Economics (JSBE) and as a visiting researcher at the Government Institute for Economic Research (VATT). I would like to express my gratitude to VATT for providing me research facilities and data as well as to all of my colleagues, both at VATT and at the JSBE, with whom I have had the pleasure to work with. Especial thanks are extended to Dr Tomi Kyyrä for valuable comments and guidance in the timing-of-events analysis. Thanks also to Docent Heikki Räisänen and the Ministry of Employment and the Economy for the research data. As for the financial support, I am grateful to the Yrjö Jahnsson Foundation, the Alfred Kordelin Foundation and the University of Jyväskylä.

To my supervisor, Professor Jaakko Pehkonen, I owe my warmest thanks for his constant support, encouragement and guidance at all stages of this process. The discussions we have shared have been of great value. I also want to thank Dr Joachim Möller for arranging me a chance to visit the Institute for Employment Research (IAB), Nuremberg, Germany. Many thanks also to Dr Elke Jahn for acting as my host during the visit. The months I spent in the IAB were very educational and enjoyable, and also important for finalising this dissertation.

I would like to extend my appreciation for the pre-examiners, Docent Heikki Räisänen and Dr Sari Kerr, for their helpful comments and useful suggestions to improve this thesis. I am very grateful to Docent Heikki Räisänen for agreeing to act as my public examiner.

Finally, special recognition goes out to my parents, Irja and Antero, as well as to my dear siblings, Satu, Sami and Minna, and their families. Their love and support has been indispensable during the whole process. Many thanks also to all of my friends for cheering me up and maintaining the balance between work and personal life. To my husband Lauri, I owe my thanks for loving and understanding, and for standing by me in difficult times. Our son Daniel was born just as I was finishing this dissertation; he is the light of my life.

Helsinki, August 2014

Henna Busk

CONTENTS

ABSTRACT
ACKNOWLEDGEMENTS
CONTENTS

CHAPTER 1	9
INTRODUCTION	9
1.1 Background.....	9
1.2 Search in labour markets	11
1.2.1 Job search theory with sanctions.....	11
1.2.2 Employer search theory.....	15
1.2.3 The Internet as a search tool	19
1.3 Econometric methods.....	21
1.3.1 Survivor and hazard functions.....	22
1.3.2 Survival distributions	23
1.4 Unemployment benefit sanctions, recruiting and search technology in Finland	29
1.4.1 Introduction to the Finnish unemployment benefits system....	29
1.4.2 Unemployment benefit sanctions	32
1.4.3 Recruiting	35
1.4.4 Search technology	37
1.5 Overview of the thesis	41
1.5.1 Research data	41
1.5.2 Main results.....	45
1.5.3 Discussion.....	47
References.....	49
Appendices.....	57
CHAPTER 2.....	59
SANCTIONS AND THE EXIT FROM UNEMPLOYMENT IN TWO DIFFERENT BENEFIT SCHEMES	59
2.1 Introduction.....	60
2.2 Unemployment benefits and sanctions in Finland	61
2.2.1 Unemployment benefits in Finland.....	61
2.2.2 Sanctions in Finland.....	62
2.3 Theoretical framework and the empirical strategy.....	64
2.3.1 Job search theory and benefit sanctions.....	64
2.3.2 Empirical model for benefit sanctions.....	66
2.4 Data and descriptive evidence.....	67
2.5 The effects of sanctions on UI and LMS recipients	73
2.5.1 Exit rate from unemployment to work	74

2.5.2 Exit rate from unemployment to various labour market outcomes.....	81
2.6 Conclusions	83
References.....	84
CHAPTER 3.....	87
INTERNET-BASED EMPLOYER SEARCH AND VACANCY DURATION: EVIDENCE FROM FINLAND.....	87
3.1 Introduction.....	88
3.2 Recruitment channels and employer search.....	90
3.3 Empirical model and data	93
3.3.1 The duration model	93
3.3.2 The vacancy data	94
3.4 Internet-based employer search and vacancy duration.....	100
3.4.1 The web service and vacancy duration.....	100
3.4.2 The web service and vacancy durations across regions	104
3.4.3 Sensitivity analysis.....	108
3.5 Conclusions	110
References.....	111
Appendices.....	115
CHAPTER 4.....	125
IS THERE A LINK BETWEEN TECHNOLOGY AND UNSUCCESSFUL EMPLOYER SEARCH?	125
4.1 Introduction.....	125
4.2 A theory for unsuccessful employer search.....	127
4.3 Vacancies in Finland.....	130
4.3.1 Institutional background.....	130
4.3.2 The data	131
4.4 The web service and the duration of cancelled vacancies	136
4.4.1 The econometric approach.....	136
4.4.2 Estimation results.....	138
4.5 The long-term effect of technology on the duration of unsuccessful employer search.....	140
4.5.1 The duration model	140
4.5.2 Estimation results for the long-term effects of the web-based service	141
4.6 Conclusions	143
References.....	144
Appendices.....	147

CHAPTER 1

INTRODUCTION

1.1 Background

The search theory in labour markets dates back to the 1960s. Stigler (1962) stated that information in the labour market is seldom complete, and acquiring additional information is costly. Therefore, a worker will search for wage offers, and an employer will search for wage demands until the expected marginal returns equals the marginal costs of search. Holt and David (1966) further proposed that hiring a worker is the result of random search process through which a heterogeneous worker and a heterogeneous job are somehow matched to satisfy certain wage and skill criteria by a firm and a worker, respectively. They also stated that both the duration of unemployment and the duration of an open job vacancy are significant because the duration of search changes the behaviour of the jobseeker (e.g., wage-job preferences) and the recruiting firm (e.g., skill requirements and offering wages).

From the late 1980s, the so-called equilibrium search model and closely related UV curve together with matching function have become important tools for analysing labour market behaviour. In particular, the matching function, which represents the production of filled vacancies with job seekers and open vacancies as inputs, has increased in popularity among researchers (see, e.g., Petrongolo and Pissarides, 2001). According to the equilibrium search model, jobseekers and vacant jobs do not match immediately due to frictions in the matching process (Pissarides, 2000). These frictions are, for example, a skill mismatch between jobseekers and vacant jobs, regional mismatch problems and ranking behaviour by firms. Frictions are necessary to guarantee the quality of matches, but at worst, they slow down the matching process and cause structural unemployment. Lindeboom *et al.* (1994) conclude that advertisements and informal search channels are very effective in matching employed workers

and vacancies, whereas the employment office is very effective in matching unemployed workers and vacancies.

Since the 1960s, a large number of studies applying job search theory have been conducted. Most of the studies concentrate on the job search of unemployed workers, e.g., unemployment duration and unemployment benefits. More generous benefits have been observed to be important determinants of the unemployment duration because the length and the level of benefits has a negative effect on the search intensity of the unemployed, that is, on the probability of leaving unemployment (e.g., Meyer, 1990; Ham and Rea, 1987; Moffitt and Nicholson, 1982). Nonetheless, little is known about the effect of benefit sanctions on the search behaviours of the unemployed. The search theory states that benefit sanctions decrease the reservation wage level and increase the search effort of the unemployment jobseeker due to the reduced value of being unemployed (i.e., reduction of benefits). The first article of this dissertation gives new evidence on this matter. The question to be answered is: do benefit sanctions encourage the unemployed to find jobs? Furthermore, does the effect of sanctions vary according to the benefit received? The empirical evidence on this subject is scarce - both internationally and domestically. Moreover, this individual-level study brings new insights into the Finnish literature on job search. Prior Finnish studies on job search have been conducted at the regional level (e.g., Hynninen *et al.*, 2009), at the household level (e.g., Kyyrä, 1999) or concentrate on a specific group of the unemployed (Kyyrä, 2010; Kyyrä and Ollikainen, 2008).

Although a large number of studies have applied job search theory, few have considered issues related to employer search, which can be seen as a corresponding theory for the job search. For example, Barron and Bishop (1985) and Barron *et al.* (1985) investigated the effect of different factors such as firm size, training and labour market conditions on intensive search (the average time spent on recruiting per applicant) and extensive search (the average number of applicants and interviewed per employment vacancy) as well as on the hiring costs of an employer. They find that larger employers interview more applicants per employment offer and that the training provided by the employer as well as the positions that require higher levels of education are associated with more employer search. Additionally, there is a direct relationship between employer search and wages: higher wages (more productive workers) imply more employer search.

The second and third article of this dissertation contributes to the literature related to employer search. The two studies investigate job openings (vacancies) and their duration at the Finnish public employment service. The focus is to investigate what type of effects the technology has on both filling and cancelling vacancies. The term 'technology' refers to an online service of the public employment agency, which was introduced to employers in October 2002. Employers can use the web-based service to post announcements about job openings, change the status of positions when they are filled and cancel announcements. We are interested in whether using the web-based recruiting

method increases the efficiency of employer search measured by vacancy duration. Additionally, does the use of the web service have an effect on withdrawing vacancies from the labour market (sooner than later)? In addition to employer search, the two papers contribute to the literature on online search, which is a scarce field of study in labour economics despite being an increasingly common method of search in labour markets.

1.2 Search in labour markets

1.2.1 Job search theory with sanctions

In this thesis, the duration of unemployment is analysed using the results from the theory of job search (Mortensen, 1986). It should be noted that unemployment duration is considered a proxy for the expected duration of job search as it would be otherwise hard to measure.¹ According to the theory, a jobseeker is able to choose the search intensity s , and thus, job offers arrive according to the rate $\lambda(s)$ (increasing in s). These job offers are random drawings from a wage offer distribution $F(w)$. Each time a job offer arrives, an individual has to decide whether to accept the job or continue searching. If the jobseeker decides to continue searching, he loses income, or if he accepts the job, it is held forever at the same wage. During unemployment, a flow of benefits b is received, and a flow of search costs $c(s)$ has to be paid (increasing in s). To balance the costs of finding a better job, the individual chooses a reservation wage level such that marginal cost of another period of search is equal to the expected marginal income. In other words, a job offer is accepted if the wage is greater than the reservation wage and rejected otherwise. Thus, the probability that a random offer is acceptable, or exit rate from unemployment to work, can be characterised by a reservation wage ϕ and optimal search intensity s^* :

$$\theta_u = \lambda(s^*)[1 - F(\phi)]. \quad (1)$$

Sanctions, or temporary benefit reductions, are imposed to the unemployed if they do not comply with job search criteria.² They can be easily incorporated into the basic job search model. The rate at which sanctions are imposed is assumed to be $p(s)$. All individuals may receive a sanction, but the probability

¹ In more realistic job search models, the jobseekers include employed (and individuals outside the labour force) as well. However, on-the-job search is often difficult to measure. Instead, unemployment data are common and usually fairly easy to obtain for research purposes.

² The sanctioning practices, duration and magnitude of sanctions vary across countries (see Chapter 1.4.1 for more information). For example, in Finland, sanctions are always a 100% reduction in the benefit level, whereas in some countries, such as in Sweden, the benefits are only partly reduced. In Finland, there are two types of sanctions: fixed-term sanctions and conditional ones (see Chapter 1.4.2 for more information).

of sanctioning decreases as the search effort increases. If an unemployed person has a lower search level that is required by the system (s^*), he must decide whether to continue with the reduced search level or increase it to avoid the risk of being caught. The individual knows the relationship between s and $p(s)$, but he does not know in advance when a sanction will be implemented. Thus, the probability that an individual will receive a sanction, the sanction rate, can be written as

$$\theta_s = p(s), \quad (2)$$

where $p(s) = 0$ for $s \geq s^*$ and $p(s) > 0$ for $s < s^*$. In reality, sanctions are also implemented for reasons other than inadequate search effort, such as the refusal of work or a training programme offered by a public employment service. These can be thought of as signals for low search level ($s < s^*$), as the search intensity is often hard to measure.

Benefit sanctions can affect the search effort and the reservation wage of the unemployed in two ways³. First, the benefit sanction increases the search effort of a jobseeker due to reduced value of being unemployed, i.e., the reduction of the benefits. This is also known as the *ex-post effect* because the imposed benefit sanction encourages the unemployed worker to find a job (Abbring *et al.*, 2005; Van den Berg *et al.*, 2004; Jensen *et al.*, 2003). However, the effect is temporary because the unemployed individual knows the duration of the sanction and anticipates the moment at which the sanction expires. As the moment of expiration of the sanction approaches, the reservation wage increases and the search effort decreases. Second, the mere risk of being sanctioned may increase the search effort of the jobseeker because job search decisions are made based on the expected value of being unemployed (Boone and Van Ours, 2006; Rosholm and Svarer, 2008). This is also known as the *ex-ante effect*.

Previous studies on job search and sanctions

The length and the level of benefits are important determinants of the unemployment duration. The higher level of benefits increases the reservation wage of the unemployed and thus increases the duration of unemployment because the unemployed are more selective (Meyer, 1990; Fische, 1982). However, this effect is only short-term if the benefit entitlement period is restricted. The probability of leaving unemployment is observed to increase as the exhaustion date of unemployment insurance benefits approaches (e.g., Krueger and Mueller, 2010; Card *et al.*, 2007; Meyer, 1990). The willingness to accept job offers or to search for a job increases as the entitlement days decline. Thus, the duration (restriction) of an entitlement period is also important.

³ A more formal presentation of the model is given, for example, in Boone and Van Ours (2006). They present a general equilibrium model of a labour market with benefit sanctions.

Studies show that increasing the length of an entitlement period has negative effects on the probability of leaving unemployment (e.g., Meyer, 1990; Moffitt and Nicholson, 1982).

Previous studies on benefit sanctions indicate that even moderate benefit sanctions significantly increase the job-finding rates of unemployed (ex-post). A summary of these findings is given in Table 1. Abbring *et al.* (2005) discover that the incentive effect of a sanction on the job-finding rate is 58% for Dutch men and 67% for Dutch women. Similarly, Svarer (2011) estimates a re-employment rate increase of 123% for Danish men and 125% for Danish women. For Switzerland, Lalive *et al.* (2005) report that the exit rate from unemployment to work increases by 25% if a sanction warning is issued and by another 20% if a sanction is actually imposed. In Norway, sanctions increase the re-employment rate by 80% (Røed and Westlie, 2012). Van den Berg and Vikström (2009) find that the effect of sanctions is small in Sweden, only approximately 23%. All of these studies are related to earnings-related (UI) benefits, and only one study exists that has additionally considered other benefits, namely social assistance. For the Netherlands, Van den Berg *et al.* (2004) find that sanctions increase the exit rate from social assistance to work by 148%. It should be noted that the findings of Van den Berg *et al.* (2004) are not directly comparable to other studies because social benefits are very different from unemployment benefits.

Recent studies also demonstrate that reactions to sanctions differ among various unemployment groups. For example, in Denmark, male immigrants are more sensitive to sanctions than male natives (Svarer, 2011). In the Netherlands, the sanction effect is larger for new clients and for single parents (Van den Berg *et al.* 2004). The empirical findings related to the severity of sanctions are scarce and inconclusive. Svarer (2011) reports that tougher sanctions (three weeks) have greater effects on the re-employment rate than milder sanctions (two to three days). Van den Berg *et al.* (2004) find that the strictness of a sanction is not important because the effects are fairly similar regardless of the magnitude of the benefit reduction (5%, 10% or 20%). Similarly, the empirical evidence of the time-varying effects of sanctions is inconclusive. Røed and Westlie (2012) report that the effect of a sanction is relatively short-lived because once the sanction is completed, the hazard of re-employment is at its previous pre-sanction level. Similarly, Svarer (2011) finds that the effect is strong and positive during the first two months but diminishes three months after the imposition of a sanction. In contrast, Van den Berg *et al.* (2004) show that most of the increase in the job-finding rate occurs after the expiration of a sanction. Van den Berg and Vikström (2009) provide supporting evidence of the long-term effects of benefit sanctions.

The literature on the ex-ante effect of sanctions, i.e., the threat of receiving a sanction, is scarce, and this is most likely because measuring the threat effect is often difficult. However, in some countries such as in Switzerland, the unemployed receive warnings before the actual sanctions are imposed. In these cases, the ex-ante (threat) effect of sanctions can be examined. Boone *et al.* (2009) and Lalive *et al.* (2005) have analysed unemployment durations with two

sanction effects distinguished. They find that both the ex-ante and the ex-post effects are important and have a positive impact on the exit rate out of unemployment. The experimental study of Boone *et al.* (2009) also shows that in most cases, the ex-ante effect is even larger than the ex-post effect. Conversely, with Swedish data, Van den Berg and Vikström (2009) discovered that the ex-ante effect of sanctions does not have strong effect on the exit rate to re-employment. The results in this field of study are inconclusive.

TABLE 1 Summary of findings on the effect of unemployment benefit sanctions

Study	Country	Effect of a sanction on the exit rate to work	Other findings
Røed and Westlie (2012)	Norway	80%	-the effect of a sanction is short-term
Svarer (2011)	Denmark	123% men, 125% women	- strictness (duration) of a sanction is important -the effect of a sanction is short-lived - the effect of a sanction varies across the population (e.g., immigrants more responsive)
Van den Berg and Vikström (2009)	Sweden	23%	-the effect of a sanction is long-term
Lalive <i>et al.</i> (2005)	Switzerland	25% warning, 20% enforcement	
Abbring <i>et al.</i> (2005)	Netherlands	58% men, 67% women	
Van den Berg <i>et al.</i> (2004)	Netherlands	148% social assistance	- strictness (magnitude) of a sanction is not important -the effect of a sanction is long-term - the effect of a sanction varies across the population (e.g., new clients and single parents more responsive)

There has been a debate in the literature about which is more effective: counselling (job search assistance), monitoring (sanctions) or some combination of these two. For example, Fay (1996) and Heckman *et al.* (1999) find that job search assistance reduces the duration of unemployment. Dolton and O'Neill (1996) and Black *et al.* (2003) discover that both counselling and monitoring are effective in reducing the duration of unemployment. Moreover, McVicar (2010) shows that in the absence of a search monitoring system, the stock of unemployed individuals increases. Instead, Ashenfelter *et al.* (2005) and Van

den Berg and Van der Klaauw (2006) discover that counselling and (or) monitoring have little or no effect on the duration of unemployment. Manning (2009) claims that monitoring has negative effects if the search requirements are set too high. This view is supported by Van den Berg and Vikström (2009) and Arni *et al.*, (2012) who discover that the job quality, wage rate and hours worked are lower on average after a sanction, and sanctioned people often accept jobs at a lower occupational level. A recent study by Van der Klaauw and Van Ours (2011) reports that financial sticks (benefit sanctions) are more effective than financial carrots (re-employment bonuses) in increasing the exit rate from unemployment.

1.2.2 Employer search theory

The employer search theory states that the search for a suitable worker is costly in time and money, which limits the employer search (Lippman and McCall, 1976; Burdett and Cunningham, 1998). Each time an applicant arrives, the employer has to decide whether to accept the applicant or continue searching. If the employer decides to continue searching, he loses income, which corresponds to the difference between the expected productivity of the applicant and the wage paid. To balance the costs of finding a better candidate, the employer chooses a level of reservation productivity such that the marginal cost of another period of search is equal to the expected marginal income. The employer continues to search until he finds an applicant with productivity above the reservation productivity, which is the counterpart to the worker's reservation wage in the job search models. Thus, the probability that an employer finds an applicant acceptable, $P(t)$, can be characterised by a reservation productivity level z^* :

$$P(t) = [1 - F(z^*)]. \quad (3)$$

The decision to recruit an applicant is made under uncertainty in a sense that the productivity of a job applicant is not directly observable. Therefore, employers try to obtain information that can act as a good signal or an inference of the applicant's job capabilities. These observable characteristics can be fixed, such as sex and race, or alterable, such as education and experience (Spence, 1973). The productivity of a worker can be defined by the employer, for example, by interviewing the applicant or by performing tests on the applicant. Testing and interviewing applicants are costly in terms of time and money, which limits the search.

In the standard employer search model, the probability of filling a vacancy, $\theta_v(t)$, can be broken into two components: the arrival rate of applicants, $\delta(t)$, and the probability that an applicant is acceptable, $P(t)$ (i.e., the probability that the applicant's productivity is greater than the reservation level of productivity):

$$\theta_v(t) = \delta(t)P(t). \quad (4)$$

It is common that the data do not contain information about arrival rates and other variables that would enable the identification of the two components $\delta(t)$ and $P(t)$. Thus, a reduced-form employer search model is often used:

$$\theta_v(t) = \lambda(t, X), \quad (5)$$

where X is a vector of explanatory variables. The theory states that there are three sets of factors that influence the duration of an employer's search: the characteristics of the open position, the characteristics of the employer and the nature of the labour market, including the total number of jobseekers and open vacancies in the area (e.g., Barron *et al.*, 1985; Burdett and Cunningham, 1998).

According to the theory, employers need some time to acquire a pool of applicants and to select candidates from this pool. Some studies have argued that vacancy durations are periods of selection rather than search; that is, employers use a non-sequential search strategy (e.g., Van Ours and Ridder, 1993; Weber, 2000; Burdett and Cunningham, 1998; Gorter *et al.*, 1996). The applicants arrive shortly after the vacancy is posted, and the rest of the vacancy duration is used to select a new employee from the pool of applicants. In a sequential search, the employers decide whether to hire an applicant upon his arrival. The distinction between non-sequential and sequential search affects the interpretation of the results. For example, increased vacancy duration could either mean that vacancies have become harder to fill or that employers have become more selective (invest more in selecting applicants).

Previous studies on employer search

Most of the previous studies have examined the employers' choice of search methods (e.g., Hensens *et al.*, 2005; Gorter *et al.* 1996; Lindeboom *et al.*, 1994). For instance, Gorter *et al.* (1996) report that employers prefer advertisements as a first recruiting channel when looking for an applicant with work experience. Instead, a public employment agency is chosen as a first search method when no experience is required, the job is temporary and when the job is located in a small firm or in an industrial sector.

Some papers have examined the link between employers' use of search methods and vacancy duration. These studies also show that the use of different recruitment channels influences the length of a vacancy. For example, advertising increases the vacancy duration, whereas informal contacts reduce the duration (e.g., Van Ours and Ridder, 1992; Van Ours and Ridder, 1993). Moreover, Ropper (1988) discover that informal methods (e.g., contacts to former employees) were the fastest recruiting channels, the employment service was the most rapid formal method and a national newspaper advertisement was the slowest formal method. Similarly, Gorter and van Ommeren (1999) report that an informal contact is a more common and effective recruitment channel than advertising.

Relatively few studies have examined the determinants of the duration of employer search. The findings of these studies are summarised in Table 2. Job requirements concerning age, education, experience and long training period increase the vacancy duration (e.g., Behrenz, 2002; Burdett and Cunningham, 1998; Gorter *et al.*, 1996; Van Ours and Ridder, 1993; Van Ours and Ridder, 1992). The results related to employer characteristics are inconsistent and depend on the recruiting channel used. Burdett and Cunningham (1998) find that large firm size decreases the vacancy duration, whereas DeVaro (2005) show that employer size has no effect on the duration. Additionally, Gorter *et al.* (1996) report that the size of the firm has no effect on the duration of filling a job when using formal recruiting channels, whereas large firm size increases the duration when using informal contacts. Moreover, Gorter (1991) has found that vacant jobs in the public sector (governmental and non-governmental organisations) have longer vacancy durations than jobs in other sectors. These longer durations are caused by longer selection periods or difficulties in finding applicants with work experience or proper education in this sector.

Pellizzari (2011) found that employers invest relatively little in search and screening activities when recruiting for low-productivity jobs but screen more intensively when recruiting for jobs in higher occupational groups. Barron *et al.* (1985) have made similar observations. Their results indicate that there is a positive relationship between search and wages. Employers search more to find more productive workers, which leads to higher starting wages.

Gorter *et al.* (1996) as well as Chen and Eriksson (2009) have analysed the impact of business cycles on employer search. According to their results, employers adjust their skill requirements over the business cycles, and the requirements are stricter in recessions. In boom years, it takes longer to fill vacancies for low-skilled and elderly workers, whereas in recessions, there are no differences.

Behrenz (2001) has examined the recruitment behaviour of Swedish employers. He discovers that employers mainly recruit personnel to expand a certain activity of their firm. The duration of an average recruitment process is approximately one month. According to the results, experience and education are the most important variables when making the decision to choose an applicant for an interview, whereas professional competence, personal engagement and social competence are the most important variables when making the decision to hire an individual. To minimise the uncertainties related to the recruitment decision, employers place a great deal of value on the recruitment interview, personal contacts and references from former employers.

TABLE 2 Determinants of the duration of employer search

Determinant	Effect on the duration of employer search †	Empirical evidence
<i>Recruitment channels</i>		
informal	-	Gorter and van Ommeren(1999), Van Ours and Ridder (1993), Van Ours and Ridder (1992), Ropper (1988)
formal	+	Gorter and van Ommeren (1999), Van Ours and Ridder, (1993), Van Ours and Ridder (1992), Ropper (1988)
<i>Job requirements</i>		
age	+	Burdett and Cunningham (1998), Gorter <i>et al.</i> (1996)
education	+	Behrenz (2002), Burdett and Cunningham (1998), Van Ours and Ridder (1993), Van Ours and Ridder (1992)
work experience	+	Burdett and Cunningham (1998), Gorter <i>et al.</i> (1996), Van Ours and Ridder (1993), Van Ours and Ridder (1992)
training	+	Burdett and Cunningham (1998)
<i>Employer characteristics</i>		
(large) firm size	+/-	DeVaro (2005), Burdett and Cunningham (1998), Gorter <i>et al.</i> (1996)
public sector	+	Gorter (1991)

Note: † increase (+) or decrease (-) the duration of employer search as measured by vacancy duration.

Andrews *et al.* (2008) note that employer search is not always successful, i.e., all vacancies are not filled. According to their results, a fairly large proportion of vacancies is removed from the labour market, and the primary reason for this is skill shortages, especially in non-manual occupations. The importance of the cancelled vacancies has also been previously studied by Beaumont (1978), who discovers that one-third of all vacancies reported to the British PES are withdrawn from the market. The underlying reasons behind cancelled search process are low wage levels, bad working conditions and undesirable location of the firm. Recently, Rebien *et al.* (2014) also showed that 10% to 15% of the recruiting establishments in Germany had to cancel a vacancy due to unsuccessful search during the years 2008 to 2012. Their results indicate that lack of potential applicants and high skill requirements increase the probability of cancelling a vacancy, whereas recruitment alternatives, namely personal contacts, decrease the probability of cancelling a vacancy.

The literature on cancelled vacancies relies on the theory of non-participation because the process of withdrawing a vacancy is analogous to the

process of jobseekers leaving the labour market (Frijters and Van der Klaauw, 2006). The idea is that the applicant arrival rate and the productivity distribution of applicants may change with the elapsed duration of search, which in turn affects the employer's reservation productivity level and expected revenues (see, e.g., Andrews *et al.*, 2008). If the applicant arrival rate or the productivity distribution of applicants falls at some point in time, employers may choose to cancel a vacancy because it is more profitable to continue producing with an unfilled vacancy than it is to continue searching. In other words, vacancies with lower applicant arrival rates will have lower benefits to search, and thus, they are more likely to be cancelled.

Thomson (1966) states that firms sometimes experience difficulties in forecasting their labour demand. Vacancies are cancelled when firms realise that they have exaggerated their needs for labour. Another reason why firms may want to cancel a vacancy is that if no suitable candidates are found, firms may try to solve their staffing problems by other means, for instance, by re-organising tasks within the firm and then recruiting for job tasks that are easier to fill (Rebien *et al.*, 2014; Farm, 2009). Moreover, changes in the market situation and business activity, such as the cancellation of a large order (e.g., the shipping industry), can sometimes result in withdrawing an open vacancy from the labour market because additional manpower is no longer required.

1.2.3 The Internet as a search tool

The empirical evidence on the role of technology in the labour market is scarce, although the use of the Internet as a search tool for jobs and employees has been constantly increasing (e.g., Autor, 2001; Stevenson, 2009). The structure of the Internet recruitment varies between countries. In Finland, the website of the PES is the most frequently used Internet-based recruitment method. Similarly, in Sweden, Germany and France, the public employment agency plays a dominant role in recruitment via the Internet (Freeman, 2002). Instead, in the USA and UK, private online job boards are the most commonly used sites for recruitment and job search on the Internet (Freeman, 2002).

The search theory states that the Internet has several advantages and disadvantages (Table 3). For instance, online search enables more efficient matches between jobseekers and vacancies because more initial meetings and information are available for labour market participants (Bagues and Labini, 2009; Autor, 2001). By improving the access to information about available job searchers and job vacancies, the Internet reduces the overall time of the recruiting process. Moreover, the Internet has the ability to reduce search-related costs (Fister, 1999; Cober *et al.*, 2000; Verhoeven and Williams, 2008)⁴.

⁴ Reduced search costs increase the pool of applicants, which in turn makes better matches and increases the productivity and wages of employers and jobseekers. See for example, Bagues and Labini (2009), who have examined the impact of online labour market intermediaries on the university-to-work transition and found that online intermediaries have a positive effect on matching quality with increased wages (by 3%) of university graduates.

Additionally, the demand for labour may be less dependent on local market conditions. For example, the Internet makes it possible for a jobseeker from a distant area to apply for a job and succeed against less-qualified local candidates (Freeman, 2002). Online search may also act as a signal if employers assume that workers who search for jobs using the Internet are more likely to have desirable characteristics, such as technical skills and education (Stevenson, 2009; Fountain, 2005).

The online search can also have negative effects. While better job matches should reduce workers' incentive to change a job, the Internet makes it easier for workers to look for a new job while employed and for employers to replace them when they quit (Nakamura *et al.*, 2009). Additionally, lowering the cost of search may encourage jobseekers to simultaneously apply to many vacancies, thus creating an overwhelming number of (unqualified) applications (Autor, 2001; Galanaki, 2002; Verhoeven and Williams, 2008; Fountain, 2005; Hadass, 2004). Nevertheless, the benefits of Internet recruiting may still outweigh its costs, and even though the workers hired online are less qualified on average, they are also less costly to replace (Fountain, 2005; Hadass, 2004).

TABLE 3 Advantages and disadvantages of online search from an employer's perspective

Advantages	Disadvantages
- more efficient job-jobseeker matches (Autor, 2001; Bagues and Labini, 2009)	
- shorter recruiting times (Bagues and Labini, 2009)	
- better job matches reduce incentives for workers to switch jobs (Nakamura <i>et al.</i> , 2009)	- Internet makes it easier for the employed to look for new jobs (Nakamura <i>et al.</i> , 2009)
- reduces search-related costs (Fister, 1999; Cober <i>et al.</i> , 2000; Verhoeven and Williams, 2008)	- may produce overwhelming number of (unqualified) applications (Autor, 2001; Galanaki, 2002; Verhoeven and Williams, 2008; Fountain, 2005; Hadass, 2004)
- less qualified workers are less costly to replace (Fountain, 2005; Hadass, 2004)	
- demand for labour less dependent on local labour market conditions (Autor, 2001; Fountain, 2005)	
- online job search may act as a signal for employers of desirable characteristics, such as technical skills and education (Stevenson, 2009; Fountain, 2005)	

Previous studies on online search

The empirical evidence on the role of technology in the labour market is scarce, although the use of the Internet as a search tool for jobs and employees has been constantly increasing (e.g., Autor, 2001; Stevenson, 2009). Stevenson (2009) finds that the vast majority of those who use the Internet for job-seeking purposes are currently employed. Nonetheless, the variety of job search methods used by the unemployed has also increased, and job search behaviour has become more extensive. There is surprisingly little heterogeneity between demographic groups in the tendency to search for a job online. Kuhn and Skuterud (2004) discover that Internet job searchers are better educated, have previously worked in occupations with lower unemployment rates, and also have several other characteristics that are usually related to shorter unemployment durations. Accordingly, Internet job searchers had shorter unemployment durations than those that did not use the Internet as a job search method. However, holding the individual observable characteristics constant, unemployment durations were not shorter, and in some cases, they were even longer among workers who looked for work online compared to those who looked for work off-line. A decade later, Kuhn and Mansour (2011) revised the study of Kuhn and Skuterud (2004) and reported that Internet search decreases unemployment durations. They argue that the main reasons for the different results between the two decades are the improvements in the job search sites and job boards as well as the dramatic rise in the Internet use and connectivity among jobseekers and employers. Similarly, Bagues and Labini (2009) show that job searchers (university graduates) benefit from the use of the Internet. According to their results, online labour market intermediaries have a positive effect on matching quality with increased wages (by 3%) of university graduates.

Brencic and Norris (2009, 2010) are among the few who have studied online employer search. They find that employers who need to fill their vacancies immediately tend to specify fewer job requirements, provide more information about the job and remove vacancies more quickly from the job boards. The effect of new technologies on employer search remains an unexplored subject.

1.3 Econometric methods

The survival analysis examines the time to the occurrence of a certain event, often called failure. To measure duration, a time of origin, a time scale and the event that ends the duration must be defined precisely (Kiefer, 1988). This section describes some basic concepts in survival analysis and different survival time distributions for analysing vacancy and unemployment durations.

1.3.1 Survivor and hazard functions

Let T be a nonnegative random variable with continuous time denoting the time to a failure event (e.g., the duration until a vacancy is filled or an unemployed individual finds a job). The probability distribution of duration T can be specified by density function, $f(t)$, as follows

$$f(t) = P(t \leq T < t + dt). \quad (6)$$

The density function describes the probability that the failure event occurs in interval $[t, t + dt)$. The corresponding cumulative distribution function, $F(t)$, for duration T is

$$F(t) = \Pr(T \leq t) = \int_0^t f(u)du, \quad (7)$$

which indicates the probability of surviving until time t . Similarly, the survivor function, $S(t)$, which is the reverse cumulative distribution for T , can be expressed as

$$S(t) = 1 - F(t) = 1 - P(T \leq t) = P(T > t) = \int_t^\infty f(u)du. \quad (8)$$

The survivor function reports the probability of surviving beyond time t . In other words, it is the probability that there is no failure event prior to t . The function equals 1 at $t = 0$ and decreases toward zero as t approaches infinity (the survivor function is a monotone and non-increasing function of time).

All three functions (6)-(8) are alternative methods of specifying a distribution, and the choice of specification depends on convenience (Kiefer, 1988). A very useful function for duration analysis is the hazard function, $h(t)$,

$$h(t) = \lim_{dt \rightarrow 0} \frac{P(t \leq T < t + dt | T \geq t)}{dt} = \frac{f(t)}{S(t)}, \quad (9)$$

which describes the limiting probability that the failure event occurs in a given interval $[t, t + dt)$ conditional on that there has been no failure event prior to t . (Kalbfleisch and Prentice, 1980). The hazard function can vary from zero (no risk at all) to infinity (the certainty of failure). Given the hazard function (9), functions (6)-(8) are completely determined. The relation of these functions can be expressed as follows

$$h = \frac{f}{S} = \left(\frac{dF/dt}{S} \right) = \left(\frac{\frac{dS}{dt}}{S} \right) \rightarrow h(t) = \frac{-d \ln S(t)}{dt}. \quad (10)$$

The hazard function is a definition of duration dependence. At a certain point in time, positive duration dependence exists when $dh(t)/dt > 0$ and negative duration dependence exists if $dh(t)/dt < 0$ (Kiefer, 1988).

In the next section, the parametric (and semiparametric) methods for analysing survival data are described. However, a very popular non-parametric method is the Kaplan-Meier (1958) estimator of the survival function

$$\hat{S}(t) = \prod_{t(r) \leq t} \left[\frac{n-r}{n-r+1} \right]^{\delta_r}. \quad (11)$$

Before calculating the Kaplan-Meier estimates, the data need to be sorted by time t . For each ordered observation $t(r)$, the survival estimates are calculated such that r describes the ordinal number of time t and n is the total number of observations in the dataset. The indicator variable δ_r denotes whether the observation r is censored ($\delta_r = 0$) or not ($\delta_r = 1$).

1.3.2 Survival distributions

There are two types of families of survival time distributions: *proportional hazards* and *accelerated failure times*. The difference between these two parametric specifications mainly lies in their interpretation of the coefficients of the explanatory variables. The proportional hazards model is popular and relatively simple to interpret: the effect of a covariate is to multiply the hazard by some constant. The accelerated failure time model is used less often but is also very easy to interpret: the effect of a covariate is to multiply the predicted event time by some constant (Kiefer, 1988). Thus, the accelerated failure time approach is useful if one is interested in the sign or significance of a covariate effect on the duration (Van den Berg, 2001). Instead, if the parameters of the individual hazard are of interest, the proportional hazards approach is a better choice.

In survival analysis, it is unreasonable to assume that the time to an event that is conditional on covariates follows the normal distribution; that is, the residuals are assumed to be normally distributed. A more reasonable distributional form of the error term leads to a parametric or a semiparametric model. The main difference between these models is that the baseline hazard of the models can either be left unestimated (semiparametric Cox model) or may take a specific parametric form (parametric model). Additionally, the semiparametric analysis is a combination of separate binary-outcome analyses at each failure time, whereas parametric analysis is a combination of several analyses at all possible failure times.

Proportional hazards models

Proportional hazards (PH) models are usually written as

$$h_i(t) = h_0(t) \exp(\mu + \beta' x_i), \quad (12)$$

where $\exp(\cdot)$ is some function chosen, μ is the intercept and $h_0(t)$ is the baseline hazard at time t , which is independent of individual characteristics. These are proportional because the hazard subject i faces is multiplicatively proportional to the baseline hazard.

There are several different survival distributions available for PH models. The Cox (1972) model is a semiparametric and less restrictive approach. The Cox regression suggests that the hazard rate for the i th subject in the data is

$$h(t|x_i) = h_0(t)\exp(\beta'x_i), \quad (13)$$

where the regression coefficients β are to be estimated from the data. The Cox model has no intercept because it is merged into the baseline hazard. The baseline hazard, the hazard when all covariates are zero, is given no particular parameterisation and can be left unestimated. The model makes no assumptions about the shape of the hazard over time. It only assumes that whatever the general shape, it is the same for everyone. One subject's hazard is a multiplicative replica of another's. Comparing subject i to m , the model states that

$$\frac{h(t|x_i)}{h(t|x_m)} = \frac{\exp(\beta x_i)}{\exp(\beta x_m)}, \quad (14)$$

which is constant, assuming the covariates x_i and x_m do not change over time.

The Cox model parameters can be estimated by the method of partial maximum likelihood. The partial likelihood function is

$$L = \prod_{i=1}^m \prod_{j=1}^{k_i} \frac{\exp(x'_{ij(i)}\beta_i)}{\sum_{k \in R(t_{ij})} \exp(x'_{ik}\beta_i)}, \quad (15)$$

where k_i is the number of failure events due to cause j , t_{ij} denotes the i th such event's time, $R(t_{ij})$ is the risk set at time t_{ij} and $j(i)$ is the index of the cases that failed at time t_{ij} (Kalbfleisch and Prentice, 1980; Cox, 1975). The overall partial likelihood is a product of m partial likelihoods, one for each type of failure and each identical to the partial likelihood that one would obtain by treating all other causes of failures as censored cases.

Under PH specification, the exponentiated coefficients are referred to as *hazard rates* or *hazard ratios*. A hazard rate above one for the covariate implies that the event (e.g., filling a vacancy) is more likely with this variable, while a hazard rate below one indicates the opposite.

Other commonly used distributions for PH models are Weibull, exponential and log-logistic. These are summarised in Table 4. Given the hazard function $h(t)$, survivor function $S(t)$ and density function $f(t)$ can be calculated for each distribution (see section 1.3.1).

TABLE 4 Summary of parametric PH models

Distribution of T	$h(t)$	$S(t)$	$f(t)$
Exponential	λ	$\exp(-\lambda t)$	$\lambda \exp(-\lambda t)$
Weibull	$\lambda p t^{p-1}$	$\exp(-\lambda t^p)$	$\lambda p t^{p-1}$
Log-logistic	$\frac{\lambda p t^{p-1}}{1 + \lambda t^p}$	$\frac{1}{1 + \lambda t^p}$	$\frac{\lambda p t^{p-1}}{(1 + \lambda t^p)^2}$

Source: Kiefer (1988), Lawless (1982).

Testing the PH assumption

A crucial assumption in the Cox model, like in all PH models, is that the hazards are proportional. Despite its importance, the proportionality assumption is rarely tested in previous empirical analyses. It has been shown that the estimation of a PH model when the hazards are not proportional can lead in biased estimates, incorrect standard errors and false interpretations of the impact of explanatory variables (Kalbfleisch and Prentice, 1980; Klein and Moeschberger, 2003). Other areas of research (e.g., clinical trials) have concluded that violations in the PH assumption are the rule rather than the exception (e.g., Singer and Willett, 1993; Box-Steffensmeier and Zorn, 2001; Kay and Kinnersley, 2002).

Testing the assumption of proportionality can be performed statistically and graphically. Schoenfeld (1982) residuals plotted against time are one of these statistical tests⁵. The test assesses the correlation between the Schoenfeld residuals and the rank order of times. If the PH assumption holds for a particular covariate, the Schoenfeld residuals for that covariate will not be related to survival time. The log-log plot is a graphical method for assessing the PH assumption. If the PH assumption holds for a particular covariate, then the log-log Kaplan-Meier survival estimates plotted against times for that covariate should yield parallel lines (Kleinbaum and Klein, 2005). If the lines cross, then there is evidence against the PH assumption.

⁵ The Schoenfeld residual is the covariate value for the vacancy i filled at time t_i minus the expected value of the covariate for the risk set at time t_i (i.e., an average of the covariate weighted by each vacancy's likelihood of being filled at t_i). In the Schoenfeld residual test, the null hypothesis of zero slope is tested, which is equivalent to testing that the log hazard-ratio function is constant over time (e.g., Kleinbaum and Klein, 2005). Thus a rejection of the null hypothesis of a zero slope indicates deviation from the PH assumption. In other words, the test assesses the correlation between the Schoenfeld residuals and time.

Accelerated failure time models

The accelerated failure time model (AFT) is a parametric model that provides an alternative to the PH model. Some studies argue that the regression parameter estimates from AFT models are more robust to omitted covariates and are less sensitive to the choice of the probability distribution of the random effects than PH models (see, e.g., Hougaard, 1999; Lambert *et al.*, 2004). Nevertheless, accelerated failure time models have not been widely used in the literature.

In an AFT model, the survivor function at time t , is assumed to be the form

$$S(t|x_i) = S_0(t/\psi_i), \quad (16)$$

where $S_0(t)$ is the baseline survivor function and $\psi_i = \psi_i(x_i)$ is an acceleration factor that depends on the covariates according to the formula

$$\psi_i(x_i) = \exp(\beta'x_i), \quad (17)$$

where the vector of covariates measured is denoted as x_i . The corresponding hazard function is

$$h(t|x_i) = \frac{1}{\psi_i} h_0(t/\psi_i), \quad (18)$$

where $h_0(t)$ is the baseline hazard. This model can also be expressed as a log linear model for the random variable T_i (the survival time of the i th subject) by writing

$$\log T_i = \mu + \beta'x_i + \sigma\varepsilon_i, \quad (19)$$

where μ is the intercept, σ is the scale parameter and ε_i is a random variable that is assumed to have a particular distribution, which determines the distribution of survival time T_i (Lambert *et al.*, 2004; Hougaard, 1999; Cox and Oakes, 1984).

The distributions of the error term ε_i and the corresponding distributions of survival time T_i in the AFT framework are summarised in Table 5. In the Weibull (and exponential) model, the error term follows the extreme value distribution with scale parameter λ and shape parameter p . The exponential model is a special case of a Weibull model, when the shape parameter equals one, i.e., it is constant. In the log-normal model, for one, the error term follows a standard normal distribution with a mean zero and a standard deviation σ . Finally, in the log-logistic regression, the error term follows a logistic distribution with a mean zero and a standard deviation $\frac{\pi\gamma}{\sqrt{3}}$. (Cox and Oakes, 1984; Hougaard, 1999; Cleves *et al.*, 2008.)

The Weibull, exponential and log-normal models are all special cases of the generalised gamma model, which has three parameters: λ , κ and σ . The generalised gamma distribution becomes a Weibull distribution if $\lambda = 1$, an exponential distribution if $\kappa = \sigma = 1$ and a log-normal distribution if $\kappa = 0$.

TABLE 5 Summary of parametric AFT models

Distribution of ε_i	Distribution of T_i
Extreme value (1 parameter)	Exponential
Extreme value (2 parameters)	Weibull
Logistic	Log-logistic
Normal	Log-normal
Log-Gamma	Generalized Gamma

Source: Cox and Oakes (1984), Hougaard (1999), Cleves *et al.* (2008).

Statistical criteria can be used to compare the AFT models. The nested AFT models (Weibull, exponential and log-normal) can be compared using the likelihood ratio test (Greene, 2008). However, the likelihood ratio test does not work in more complicated situations in which the models being compared are not nested (e.g., log-logistic). In these cases, more general tests for model comparisons should be used. One method for selecting between non-nested models is the Akaike (1974) information criterion test, which can be written as

$$AIC = -2\ln L + 2(k + c), \quad (20)$$

where k is the number of model covariates and c is the number of model-specific distributional shape parameters in the model. The AFT model with the smallest AIC score is assumed to be the best fit.

The parameters of the AFT model can be estimated using the method of maximum likelihood. The likelihood function for the model selected is

$$L = \int_0^{\infty} \left\{ \prod_{i=1}^{n_i} h(t_i|x_i)^{d_i} S(t_i|x_i) \right\} dt, \quad (21)$$

where t_i is the observed failure time for the i th of n_i vacancies ($i = 1, 2, \dots, n_i$). The event indicator is denoted as d_i , so that it gets the value of 1 if the failure is observed, and 0 otherwise (Lambert *et al.*, 2004; Pan, 2001). Given the maximum likelihood estimates of the parameters, likelihood ratio tests can be used to assess the need for inclusion of random effects as well as the other covariates.

Under the AFT model specification, the exponentiated coefficients are referred to as *time rate* or *time ratios*. A time ratio above one for the covariate

implies that this prolongs the time to the event, while a time ratio below one indicates that an earlier event is more likely.

Piecewise constant hazard model

The piecewise constant (PCE) model is a flexible (semi)parametric model assuming that the baseline hazard is constant within pre-specified survival time intervals, but the constants may be different for different intervals. In this model, the durations are observed in disjoint time intervals and all the intervals are of unit length (e.g., a week or a month). The observed duration for each subject i corresponds to the interval $[t_i - 1, t_i)$. The log-likelihood can be written as

$$\log L = \sum_{i=1}^n \left\{ c_i \log \{ h_{t_i}(X_{it_i}) \prod_{s=1}^{t_i-1} [1 - h_s(X_{is})] \} + (1 - c_i) \log \{ \prod_{s=1}^{t_i} [1 - h_s(X_{is})] \} \right\}, \quad (22)$$

where variable c_i is a indicator variable that receives a value of unity if the event has not occurred until the observation period ends, and the hazard in the j th interval is

$$h_j(X_{ij}) = 1 - \exp\{-\exp[X'_{ij}\beta + \theta_j]\}. \quad (23)$$

In the PCE model, there is a separate parameter, θ_j , for each interval. When estimating the model, we cannot include all of the interval dummy variables, θ_j , as well as a constant in the estimation model because that would introduce perfect collinearity between the regressors (e.g., Jenkins, 1997).

Unobserved heterogeneity

In the empirical analysis, the unobserved covariates can affect the estimation results. In the survival literature, the unobserved heterogeneity terms are sometimes called frailties. They can be included in all of the models described in this section. For example, a PH model with unobserved heterogeneity terms, v , can be written as

$$h_i(t) = h_0(t) \exp(\mu + \beta' x_i) v. \quad (24)$$

The heterogeneity terms are unobservable positive quantities estimated from the data. They capture the impact of omitted variables on the estimates or measurement error in the recorded regressors or survival times. A key assumption is that they are distributed independently of time t and coefficients x (Vaupel *et al.*, 1979). Furthermore, for the parameters to be identified, we have to make some assumptions about the distribution of the heterogeneity terms.

There are several distributions available, for instance, gamma, inverse-Gaussian and discrete distributions (e.g., Lambert *et al.*, 2004; Hougaard, 1984; Heckman and Singer, 1984). The gamma distribution has been widely used in the literature, and a very common and convenient assumption is that the heterogeneity terms are gamma-distributed with mean 1 and variance θ , where the variance is estimated from the data (e.g., Pan, 2001; Hougaard, 1999; Glidden and Self, 1999; Vaupel *et al.*, 1979). In addition to the gamma distribution, the discrete distribution with unrestricted mass points is also often used, especially in unemployment duration studies (for a survey of duration methods see, e.g., Van den Berg, 2001). PH models with unobserved heterogeneity are sometimes referred to as mixed proportional hazard (MPH) models.

1.4 Unemployment benefit sanctions, recruiting and search technology in Finland

1.4.1 Introduction to the Finnish unemployment benefits system

In the Finnish unemployment benefits system, there are two types of benefits: unemployment allowance, which can be basic (UA) or earnings-related (UI), and a flat-rate labour market support (LMS)⁶. Eligibility for UI benefits requires membership (for at least 10 months) in an unemployment insurance fund⁷ and an employment history of at least 43 weeks during the last 28 months prior to unemployment ('employment condition')⁸. The basic unemployment allowance is paid by the Social Insurance Institution (*Kansaneläkelaitos* KELA) and is payable to all unemployed jobseekers between ages 17 and 64 who do not belong to a UI fund but who fulfil the employment condition. The maximum duration of both the UI and UA allowances is 500 benefit days, i.e., approximately two years⁹. The waiting period in both benefits is 7 business days. If a person is not eligible for UI or UA allowance or is unemployed for more than 500 benefit days, then he is entitled to LMS paid by KELA. The LMS

⁶ The UI benefit is based on the prior earnings of the unemployed, which at maximum is 90% of the income level. In the year 2009, the average amount of UI allowance paid was 55.20 euro per day (1187€ per month). Instead, the UA allowance and LMS are paid by the daily rate, which is bound to the national pension index (which follows the cost-of-living index). In the year 2009, the average amounts of UA or LMS paid were 25.63 euro per day (551€ per month), which is approximately half of the average UI allowance.

⁷ The unemployment insurance fund is a private fund, an independent fund or a fund that is specific to a trade union. Both membership in an union and a membership in an unemployment insurance fund are voluntary. To the author's knowledge, voluntary unemployment insurance systems are used mainly in Nordic countries, namely in Finland, Sweden and Denmark.

⁸ After 2010, the employment condition was reduced to 34 weeks (instead of 43 weeks).

⁹ Older unemployed individuals (those over 55) who receive UI allowances are eligible for extended benefits until they reach retirement age (62 years old).

is always means-tested (with respect to household income), but the duration is essentially unlimited¹⁰. With LMS, the waiting period is usually 5 business days, but if the jobseeker is 17-24 years old without a professional education, the waiting period is 5 months.

Regardless of the unemployment allowance type, the unemployed must also satisfy the following eligibility conditions to receive benefits and to avoid sanctions: a) register with the public employment service (PES) as an unemployed jobseeker, b) actively search for a full-time job, c) apply for jobs suggested by the PES, d) accept ALMPs arranged by the PES and e) renew his/her status as an unemployed jobseeker by reporting regularly to the PES. Moreover, at the beginning of an unemployment spell, a compulsory job-search plan is made that specifies how the unemployed individual will look for work and whether training or some other ALMP measures are needed to promote employment. The search activity is evaluated by the PES every 3-6 months by interviewing the unemployed individual¹¹. In practice, the unemployed individual explains to the caseworker how he has looked for work and to which jobs he has applied during the past months. Violations of criteria b-e or inadequate search efforts as evaluated by the PES via interviews result in sanctions.

In the context of Finnish unemployment, it is important to mention that in the early 1990s, Finland experienced a very deep recession, and as its consequence, the unemployment rate increased enormously from 3% in 1990 to 17% in 1994. Since the 1990s, Finland has made great efforts to decrease the unemployment rate, which constantly decreased until the end of year 2008. In 2008, the unemployment rate was the lowest (6%) since the recession started, but after the European economic crisis that started in the fall of 2008, the unemployment rate has slightly increased (8% from 2009 onward)¹².

The Finnish sanction occurrence rate, or sanctions as a percentage of the unemployment spells, increased throughout the 20th century and peaked during the year 2008: from 7% in 2003 to 12% in 2008 (Figure 1). This is most likely due to the 2006 policy reform by which the sanctioning of the long-term unemployed was tightened. The main purpose of the reform was to activate the long-term unemployed, that is, individuals who were on LMS for over 500 benefit days or on UI for the maximum 500 benefit days and on LMS for over 180 benefit days thereafter. For these individuals, active labour market policy (ALMP) measures were offered more frequently, and the refusal of these

¹⁰ After 2013, the legislation changed such that the LMS is no longer means-tested. Moreover, officially, the maximum duration of LMS is 48 years.

¹¹ The interviewing interval is case-specific. Usually, the interval is shorter (2-4 weeks) at the beginning of the unemployment spell and increases as the unemployment duration increases. However, the legislation dictates that the search activity has to be evaluated during the 3rd and 6th months of unemployment and every 6 months thereafter. In addition, usually young unemployed individuals have to visit the employment office more frequently throughout the period of unemployment.

¹² The European economic crisis refers to the situation that started in 2008 when some European countries, such as Greece, failed to generate enough economic growth to make their ability to pay back the debts they had built up in past decades. The crisis has had far-reaching consequences around the world.

measures (as well as refusal of work) implied more severe sanctions than before: the exclusion of unemployment benefits until five months of work, education or ALMP measures is performed. Before the reform, a similar course of action led to a sanction for only 60 days with no conditions regarding work or ALMPs. The simultaneous decrease in the number of unemployment spells implies that the peak in the sanction rate in 2007 was due to the policy change and not due to the increased number of the unemployed (Figure 1). It would be interesting to analyse the threat effect of the year 2006 policy change by which the sanctioning of the long-term unemployed was tightened in Finland. Hämäläinen *et al.* (2009) provide some descriptive evidence regarding the re-employment rate of the long-term unemployed before and after the reform. They found that the likelihood of participating in ALMP measures increased due to the reform, especially among the long-term unemployed who had been on LMS for over 500 benefit days. However, the reform had no clear effect on the re-employment rate for these same individuals. Thus, the study concludes that this group of long-term unemployed had difficulties in finding a job.

Unemployment has been and still is an important research topic in Finland due to the economic history of the country, namely the 1990s recession. Nonetheless, the empirical analysis on the effect of sanctions has received little attention, although the Finnish government is constantly reforming the benefit entitlement rules. For instance, in 2010, the employment condition was reduced to 34 weeks instead of 43 weeks. The impacts of this reform on unemployment remain to be explored.

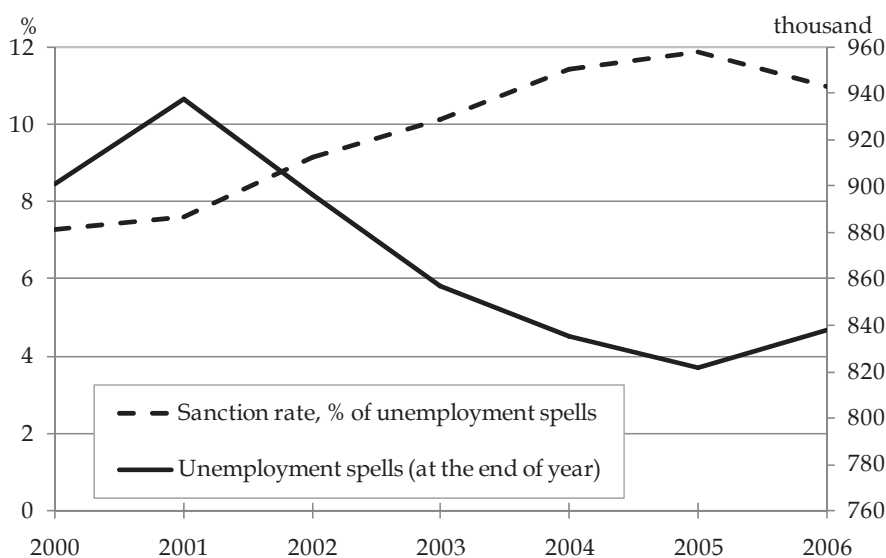


FIGURE 1 Unemployment rate and the sanction rate during the years 2000-2010.
Source: own calculations from The Unemployment Data of the Ministry of Employment and the Economy

1.4.2 Unemployment benefit sanctions

Job search monitoring is the process of checking whether the unemployed are actually searching effectively for a job instead of prolonging their unemployment. Sanctions, or the temporary exclusion of unemployment benefits, are an important part of the monitoring system. However, some infringements are easier and faster to observe than others. At the start of the unemployment spell, the jobseeker has to give information about himself (e.g., education and working history), his previous job and the reason he became unemployed. In terms of these characteristics, the jobseeker has to apply for the jobs suggested and accept suitable job offers or training arranged by the unemployment agency. This type of misbehaviour is easy to observe. Instead, the monitoring of job search activity is more difficult. The search activity is evaluated by the employment office every 3-6 months by interviewing the unemployed individual. Thus, the monitoring of job search activity is more difficult, and usually, misbehaviour in this category is detected with a delay.

In Finland, there are two types of sanctions: fixed-term sanctions and conditional ones. Fixed-term sanctions expire after the predetermined duration (30-90 days), whereas conditional (obligation-to-work) sanctions can be completed only when certain amount (90-150 days) of work, education or ALMPs has been performed by the unemployed individual. Sanctions are always 100% of the unemployment benefit level. Moreover, sanctions do not reduce the number of benefit entitlement days (500); instead, the benefit entitlement days are only postponed by the period of a sanction. Additionally, getting a sanction does not exclude benefits from the time spent in an ALMP measure that promotes employment¹³. Thus, sanctions are intended to encourage the unemployed either to find a job or participate in an ALMP program. It is also worth mentioning that the unemployed who have received a sanction may apply other benefits from KELA, such as social assistance and housing allowance¹⁴. Although with social assistance, the benefit can be reduced by 20% or 40% depending on the sanction (repeated violation 40%). However, because the social assistance is means-tested, the reduction is not always used (the decision is made by the caseworker).

Table 6 represents the reasons and the duration of benefit sanctions in Finland. A voluntary quit is sanctioned by a 90-day period without benefits, but if the job in question is for fewer than 5 days, the sanction is reduced to 30 days. Similarly, a refusal of work leads to 60 days of benefit stoppage, but if the job in question is for fewer than 5 days, the sanction is reduced to 30 days. If prior to

¹³ These ALMP measures are labour market training, work and training try-outs, integration measures for immigrants, preparatory training for the work life, self-motivated studies and rehabilitative work.

¹⁴ Social assistance is available to those who do not qualify for any of the other benefits or who still remain under a defined income threshold. In the year 2009, the social assistance was on average 417€ per month for single parents and single-person households. The housing allowance is available to everyone whose income is sufficiently low, at a maximum of 80% of housing costs. In 2009, the housing allowance was on average 254€ per month.

unemployment, a jobseeker has spent fewer than 6 weeks in the labour market during the last 6 months without an acceptable cause, a sanction for 60 days will be imposed. Acceptable causes are full-time studies, military or non-military service, maternity leave, taking care of children less than 3 years of age, institutionalisation and sickness.

Refusing or dropping out of an ALMP measure as well as several reasons related to the neglect of job-search plan agreements leads to a loss of benefits for 60 days. For young jobseekers (under 25 years of age) and for the long-term unemployed (over 500 benefit days), similar conduct means the exclusion of benefits until 150 days of work, education or some ALMP measures (e.g., labour market training, work and training try-outs) have been performed. These are so-called conditional sanctions. Similarly, repeated refusals of work, ALMP measures or similar courses of action cause the obligation to work for 90 days.

TABLE 6 Reason and duration of benefit sanctions

Reason	Duration
Voluntary quit	90 days
Voluntary quit, less than 5 days	30 days
Less than 6 weeks in the labour market during the last 6 months	60 days
Refusal of work	60 days ^a
Refusal of work, less than 5 days	30 days
Refusing or dropping out of an ALMP	60 days ^a
Repeated refusal of work or an ALMP	exclusion of benefits for 90 days (conditional sanction)
Job-search plan	
- refusal of participating in making or inspection of the plan	60 days
- neglect of job-search plan agreements (refusal of work and training try-outs, integration measures for immigrants or preparatory training for the working life)	60 days
- repeated neglect of job-search plan agreements	exclusion of benefits for 90 days ^b (conditional sanction)

Notes: ^aA sanction for the young unemployed (under 25 years of age) and for the long-term unemployed (over 500 benefit days) is exclusion of benefits for 150 days. ^bA sanction for earnings-related benefit receivers is 60 days.

Source: Unemployment Security Act (Työttömyysturvalaki 30.12.2002/1290).

In the case of voluntary quit, a number of reasons for involuntary quit from the point of view of the individual are recognised, for example, if the employer neglects salary payments or endangers work safety. During the first 90 days of unemployment, a jobseeker is also entitled to refuse a job that does not correspond to his vocational skills. Vocational skills are acknowledged when a jobseeker has a vocational education and one year of work experience, or if he has no vocational education and two years of work experience. However, the unemployed individual is obligated to accept a job that does not correspond to his vocational skills if the employment agency decides that there are not such

jobs available in the travel-to-work area (municipal). A jobseeker can also refuse a job if there is not a reasonable time to organise day-care for his or her children or if the job in question is against his or her religious or similar beliefs. In reality, these special conditions are rarely used.

Benefit sanctions in Europe

The period and the level of benefit sanctions differ greatly across countries. Most of the sanctions in Finland are with a fixed duration of 60 days, but they can last up to five months. In other European countries, the duration of benefit sanctions may in some cases be longer but not always 100% of the benefit level. For example, in the Netherlands, the sanctions are typically only a 20% reduction of the benefit level (Van den Berg *et al.*, 2004). Similarly, in Sweden, the sanctions are commonly a 25% reduction in the benefits (Van den Berg and Vikström, 2009).

There are many variations in the duration of sanctions for voluntary quit. In Finland, Germany, and Switzerland, the (maximum) duration of sanctions for voluntary quit is 12 weeks, whereas in Norway, Denmark and Sweden, it is only 3-8 weeks (Grubb, 2000; Douglas *et al.*, 2011). Belgium has the strictest sanction policies because voluntary quit can lead up to 52 weeks of benefit stoppage. The duration of benefit sanctions related to the (first) refusal of work is in most countries the same as that for the voluntary quit. Finland and Germany are an exception because the sanction in question is 8 weeks in Finland and only 3 weeks in Germany. Moreover, Belgium and Switzerland are the only countries that give warnings to the unemployed before implementing a sanction (Lalive *et al.*, 2005; Douglas *et al.*, 2011).

TABLE 7 Unemployment benefit sanctions in selected European countries

Country	Sanction occurrence, % ^a	Duration and magnitude of a sanction for ^b	
		voluntary quit	(first) refusal of work
Finland	10.2	12 weeks	8 weeks
Sweden	0.8	6-8 weeks (45-60 days)	6 weeks (40 days), 25%
Norway	10.8	8 weeks	8 weeks
Denmark	4.3	3 weeks	3 weeks
Iceland	-	6 weeks (40 days)	6 weeks (40 days),
Netherlands	36.0	8 weeks, 20%	8 weeks, 20%
United Kingdom	10.3	0-26 weeks	0-26 weeks, 100% or a smaller reduction
Switzerland	40.3	6-12 weeks	6-12 weeks
Germany	1.1	12 weeks	3 weeks
Belgium	4.2	4-52 weeks	4-52 weeks, 100% or a smaller reduction

Notes: ^aThe sanction occurrence rate is defined as sanctions during benefit periods as percentage of the average stock of benefit claims, 1997-1998 (Gray, 2003). Information for the Netherland is from Boone and Van Ours (2006).^b The magnitude of a sanction is 100% reduction in the benefit level if not otherwise mentioned.

Source: Grubb (2000), Van den Berg *et al.* (2004), Van den Berg and Vikström (2009), Douglas *et al.* (2011), Directorate of Labour Iceland (2008).

Table 7 summarises the information discussed above. It also includes the sanction occurrence rate for sanctions that are imposed during a benefit period; that is, sanctions for voluntary quits are omitted. It seems that Sweden (0.8%) has the lowest and Switzerland (40.3%) the highest occurrence rates among the eleven European countries considered; Finland (10.2%) stands somewhere in the middle¹⁵.

1.4.3 Recruiting

Recruitment channels can be divided into two broad categories: informal (friends, relatives, former and present employees) and formal (advertisements, public and private employment agencies) (Russo *et al.*, 2000). Employers often prefer informal recruitment channels because they provide good initial screening and give potential applicants more information about the job, which may improve potential matches (Van Ours, 1994; Lindeboom *et al.*, 1994). Although there are no direct costs associated with informal channels, employers sometimes complain about the low number of applicants they attract (Mencken and Winfield, 1998). Thus, many employers also use formal recruitment channels despite their disadvantages. For example, employers often use advertisements despite the direct costs of placing them and the indirect costs of screening the numerous applicants that respond. PES have no direct costs, but employers sometimes complain that the applicants through this channel are less likely to accept jobs, which creates higher screening costs per vacancy (Barron and Mellow, 1982).

Studies have shown that unemployed jobseekers who use PES tend to experience longer spells of unemployment than their peers who use other search methods (e.g., Thomas, 1997)¹⁶. Similar observations have been made with regard to employer search; informal contacts and advertising are more common and effective recruitment channels than other formal channels (e.g., Gorter and Van Ommeren, 1999; Gorter *et al.*, 1996). Thomas (1997) suggested that many jobseekers that approach PES have already tried other search methods unsuccessfully. Similarly, employers who announce their vacancies using PES may have had little or no success with other channels in the past. It is also possible that employers who announce their vacancies via PES have had positive experiences with using it in the past.

In Finland, the use of informal channels in recruiting is a common practice. In 2007, notifications to own personnel (60%) and direct contacts to former employees (55%) covered a large share of all recruitments (Figure 2). A recent study by Räisänen (2011) shows that although the informal channels are often

¹⁵ Venn (2012) has made similar findings when calculating an indicator for the strictness of sanctions in 36 OECD countries. Sanctions are strictest in the USA (5) and most modest in Japan (1); Finland (3.5) stands somewhere in the middle.

¹⁶ The study compares two groups of registered unemployed at the British PES: PES and non-PES. Non-PESs are the unemployed who have used informal channels instead of PES to find a job; PES includes the unemployed who have used career offices or job centres to find a job.

used in Finland, they are not very efficient; the PES and newspaper ads are the most efficient channels.

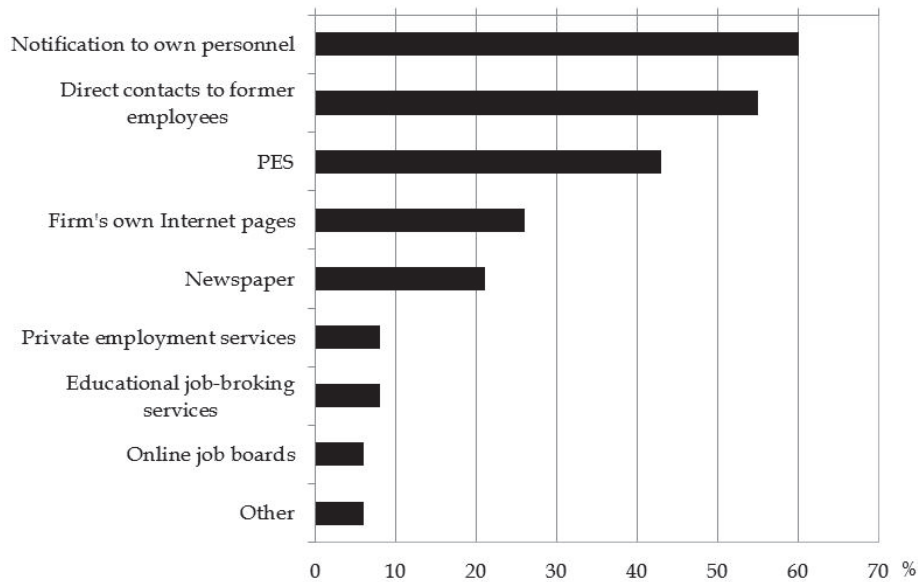


FIGURE 2 Finnish recruiting channels in 2007.

Note: Employers may have used several recruiting channels simultaneously.

Source: Tuomaala (2008)

The most commonly used formal recruiting channel in Finland is the PES, with a market share of 43% (Figure 2). If the informal channels are excluded from the analysis, the market share of the PES is over 60% and has been since 1994 (Figure 3). The reason for the common use of the PES is its ability to reduce the employer's recruitment costs. The benefit of using free public services is highest when recruiting for occupations with high labour turnover.

The use of the Finnish PES varies within regions and industries. In 2007, the market share of the PES was over 80% in Southeastern Finland, North Karelia and Lapland but under 60% in Uusimaa and Northern Ostrobothnia (Appendix 1). Moreover, industries with highly educated workers use the service less than others¹⁷. For example, in 2006, the market share of the PES in the agriculture and forestry industry was almost 80%, whereas it was less than 60% in the industry of business services (Appendix 2). It has been argued that the public job-broking reaches low-productivity applicants, which may

¹⁷ After the early 1990s recession, the market share of PES in recruiting was very high due to large range of unemployed registered at PES (e.g., both high- and low-educated individuals). The market share of PES has declined over the years mainly due to change in the PES jobseeker structure: highly educated jobseekers tend to search for a job elsewhere.

influence the employer's decision to employ the free service (Russo *et al.*, 2000)¹⁸. The more selective the PES (pre-screening activities on e.g., motivation, ability and work experience), the more it is exploited by employers (Windolf, 1986).

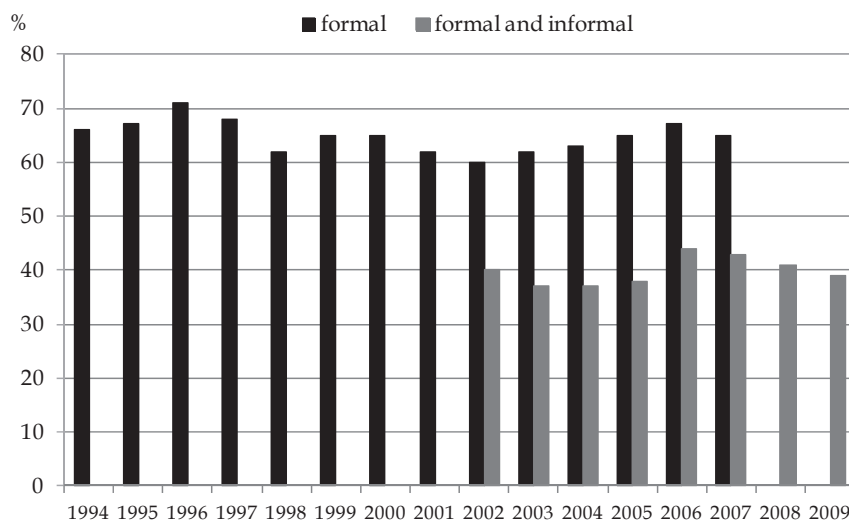


FIGURE 3 Market share of the PES in recruiting during the years 1994-2009.
Source: Hämäläinen (2007), Tuomaala (2008).

1.4.4 Search technology

The Internet is becoming an increasingly common method of search in the labour market as Internet connections are improved and people learn to utilise new technology. This observation was also made by the Finnish PES, which in October 2002 introduced an Internet-based recruitment service for employers. Employers registered with the PES can use the system to post announcements about new vacancies, modify information about existing vacancies, change the status of positions when they are filled and cancel announcements. Through this web service, job advertisements are posted immediately to the PES website, where jobseekers can search for suitable jobs.

The main difference between the web service and the traditional PES (i.e., employment offices) is that the web service does not require the assistance of employment officials. Furthermore, the web service is available 21 hours per day and 7 days per week, whereas employment offices are open only during regular business hours. Therefore, the web service is a flexible alternative that is accessible at various times and from different locations.

¹⁸ Studies have shown that employers tend not to hire workers with long unemployment spells because this duration signals low productivity. This is also known as the "stigma" effect (e.g., Vishwanath, 1989; Kollman, 1994; Omori, 1997).

According to search theory, the effects of the Internet on search outcomes are not obvious - they can be positive or negative (see Section 1.2.3). For instance, the Internet reduces application (search) costs, which should increase the pool of applicants and, in turn, make better matches and increase the productivity and wages of employers and jobseekers. In general, lower search costs should reduce unemployment, but there is no consistent evidence to support that Internet use shortens periods of unemployment (e.g., Kuhn and Skuterud, 2004; Kuhn and Mansour, 2011). Moreover, due to the increased numbers of applicants, employers may spend significant time screening and interviewing candidates, which increases the average duration of vacancies and the employer's search costs (Autor, 2001).

The effects of the Internet on search outcomes may also depend on the demographic structure and the knowledge of how to employ information technology. Prior studies indicate that individuals seeking work via the Internet tend to be well-educated on average (Stevenson, 2009). Moreover, young people are usually more eager to use the Internet and to become aware of new innovations in the information technology sector than older generations. Unfortunately, we do not have information on what types of people look for work through the PES website or what types of people are hired to the vacancies posted through the web service¹⁹. However, we know that there are regional differences in the use of the PES (Appendix 1) and thus most likely in the use of the web service (see Chapter 3). It is also likely that the use of online services varies between industries because all industries are not technology-intensive (e.g., construction), and as a result, they are slow to acquire and implement new information technologies (Haas *et al.*, 2001; Seneviratne *et al.*, 1999). A recent study by Brencic and Norris (2012) shows that not all employers use online search tools when posting their vacancies on online job boards (Monster.com), regardless of the fact that the tools offered are free and intended to facilitate the search. Additionally, a Finnish survey study on firms operating in the region of Savonlinna indicates that more than half of the employers did not know about the Internet-based employer services of the PES, and less than 10% of the respondents had used these services. However, almost 60% of the respondents would be willing to use web-based services, and the main reasons for doing so is the PES's knowledge about local issues and labour conditions as well as the free use of the services (Ahokas and Sanio, 2012).

Finland is a large and sparsely populated country with a rapidly ageing population. The regional differences in the population structure are also reflected in Internet use across regions. For example, the share of individuals who have never used a computer is highest in Eastern Finland (19%) and lowest in Southern Finland (10% in 2007) (Appendix 3). Nonetheless, the Internet

¹⁹ It is up to the employer to decide how specific information about the open job is given. The mandatory information to be included in a job posting is as follows: employer information (name, address and phone), the name of the work task (e.g., occupation), the number of hired applicants, job duration, working time, job type and location of the job. The job posting also includes a verbal description of the work tasks (not visible from the data).

access in Finnish households has increased significantly since the year 2000, from 51% in 2004 to 81% in 2010 (Eurostat).

A comparison of Internet access in Finnish households across the different regions shows that there are notable differences between eastern parts of Finland and the rest of the country (Figure 4). In 2006, 55% of households in Eastern Finland had Internet access, whereas the equivalent share was between 65%-67% in all of the other major regions. By the year 2010, these differences diminished, and all of the major regions are now within the range of 81%- 86%.

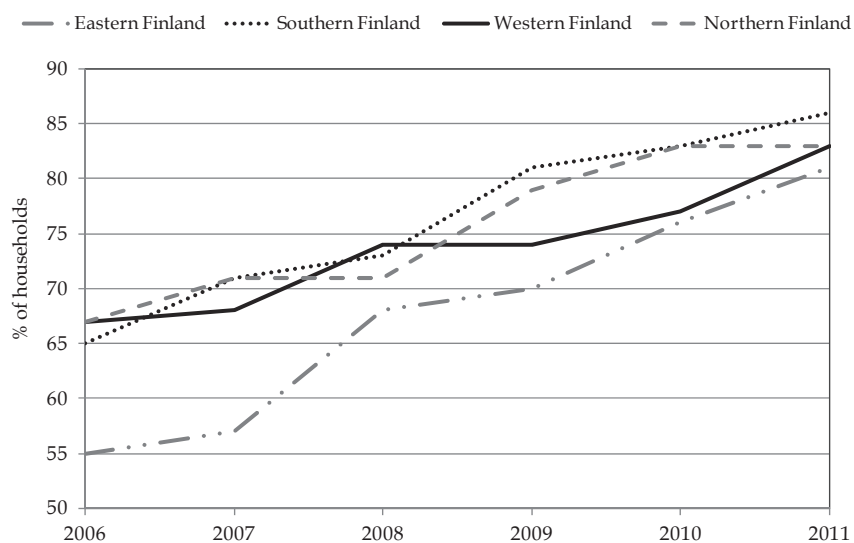


FIGURE 4 Internet access (%) of households in major (NUTS2) regions, 2006-2011.
Source: Eurostat

In Finnish businesses, Internet access has grown moderately since the year 2000 (Figure 5). The level of Internet access among firms (with at least 5 employees) has increased from 84% in 2000 to 96% in 2008. Instead, the share of broadband connections among firms has experienced a huge growth from less than 40% in 2002 to almost 90% in 2008. Unfortunately, a regional comparison of the differences in Internet access among firms is not possible due to data limitations.

According to the reports made by the United Nations (2009) and the European Commission (2010), Finland is one of the leading countries in Europe in broadband provision (66% of the households in 2008). In addition, Finland has a high number of regular Internet users (68% of the population in 2008). The share of individuals who use the Internet for interaction with public authorities (62%) is relatively large as well (Table 8). Nonetheless, compared to other Nordic countries, Finland has the lowest provision of households with Internet access: 72%. In 2008, the equivalent share was over 80% in Sweden, Norway and Denmark and almost 90% in Iceland. Finland is particularly behind other

Nordic countries in providing Internet access to households that live in sparsely populated areas (69%).

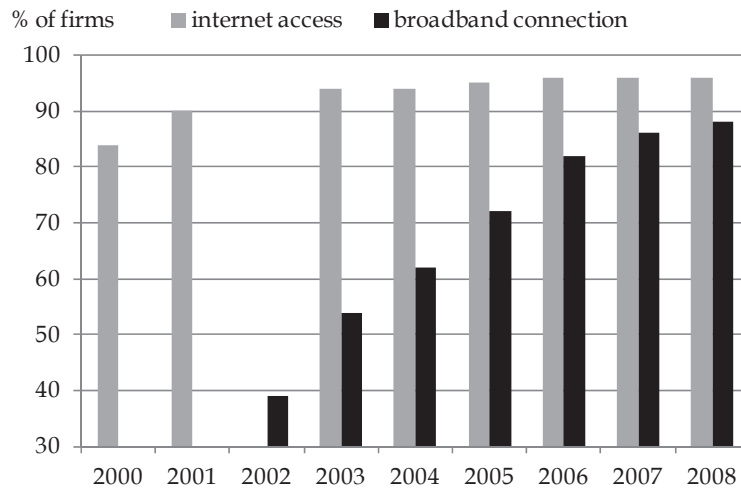


FIGURE 5 The share of firms (more than 5 employees) with Internet access, 2000-2008.
Source: Statistics Finland

TABLE 8 Level of Internet access (%) of households in 2008, all households and households living in sparsely populated areas.

Country	Internet access (%) of households		Individuals (%) using Internet for interaction with public authorities ^b
	All households	Households in sparsely populated areas ^a	
Finland	72	69	62
Sweden	84	81	59
Norway	84	82	72
Denmark	82	77	49
Iceland	88	87	74
EU 25 average	62	55	36

Note: ^a Sparsely populated refers to less than 100 inhabitants per km². ^b At least one of the following services: for obtaining services from public authorities' websites, for downloading official forms and for sending filled in forms.

Source: Eurostat

1.5 Overview of the thesis

In this section, we give an overview of the thesis. First, we introduce the research data used in the articles. Second, the main findings of this dissertation are reported. Finally, we conclude this section with a discussion of the results, data limitations and topics for future research.

1.5.1 Research data

In this thesis, we use two datasets, both of which are from the Ministry of Employment and the Economy. The first dataset, *The Unemployment Data*, includes information on all persons registered as jobseekers to the PES during the years 2003 to 2009. Different types of characteristics of unemployed jobseekers are also available in the data, such as gender, age, education, occupation, citizenship, native language and place of residence. Importantly, the data include information about unemployment benefit sanctions. From the registers of the Financial Supervisory Authority (*Finanssivalvonta*) and the Social Insurance Institution (*Kansaneläkelaitos*), we were able to determine the types of benefits received by each unemployed individual and the remaining benefit days at the start of an unemployment spell. Moreover, with the employment records from the Finnish Centre for Pensions (*Eläketurvakeskus*), we were able to verify the ending dates of unemployment periods.

In total, almost 600,000 sanctions were imposed during the years 2003-2009 (Table 9). It should be noted that we only analysed the first imposed sanction during each unemployment spell, and therefore, the number of sanctions is lower than in the official records. The most common reason for sanctions was voluntary quit (32%) and refusing or dropping out of an ALMP measure (33%)²⁰. Moreover, the share of sanctions related to the refusal of work decreased during the observation period, whereas the share of sanctions related to refusing or dropping out of ALMP measure increased. Overall, the number of sanctions decreased after the year 2003, peaked during the year 2008, and started to decrease thereafter. This is most likely due to the policy reform in 2006 by which the sanctions of the long-term unemployed were tightened (see chapter 1.4.1). More detailed descriptions of the data are given in Chapter 2.

The unemployment data used in this thesis are unique because they include information about all Finnish unemployed persons registered at the PES, and they also merge information from other important Finnish authorities. Many of the previous studies on benefit sanctions have used relatively small samples that are often restricted to small geographic areas or even to specific industries (see, e.g., Van den Berg *et al.*, 2004; Lalive *et al.*, 2005; Abbring *et al.*, 2005). Moreover, our data enable us to compare the effect of sanctions for individuals receiving two different unemployment benefits: earnings-related

²⁰ It is worth mentioning that most of the unemployed who have received a sanction for voluntary quit are earnings-related benefit receivers.

benefits and flat-rate labour market support. Most existing studies have examined the effect of sanctions on unemployment duration for individuals receiving unemployment insurance benefits. An exception is the work of Van den Berg *et al.* (2004), who analyse the effect of sanctions on the transition from social assistance to work²¹.

TABLE 9 Number and share of sanctions by incidents during the years 2003-2009

Sanction	2003	2004	2005	2006	2007	2008	2009	Total
Voluntary quit	23,000 (35%)	25,800 (36%)	27,500 (34%)	28,100 (32%)	28,700 (30%)	27,800 (28%)	26,700 (29%)	187,600 (32%)
Less than 6 weeks in the labour market	9,000 (14%)	8,900 (13%)	9,100 (11%)	9,300 (11%)	10,100 (11%)	11,700 (12%)	13,900 (15%)	72,000 (12%)
Refusal of work	8,600 (13%)	8,300 (12%)	8,700 (11%)	8,800 (10%)	9,700 (10%)	8,600 (9%)	6,500 (7%)	59,200 (10%)
Refusing or dropping out of ALMP	18,600 (28%)	20,400 (29%)	24,000 (29%)	29,000 (33%)	33,700 (35%)	35,600 (37%)	33,000 (36%)	194,300 (33%)
Repeated refusal of work or ALMP	1,700 (3%)	2,600 (4%)	6,400 (7%)	4,200 (5%)	5,600 (6%)	6,400 (7%)	5,500 (6%)	32,300 (6%)
Neglect of job search plan	4,700 (7%)	5,200 (7%)	5,900 (7%)	7,200 (8%)	7,200 (8%)	7,100 (7%)	6,200 (7%)	43,600 (7%)
Repeated neglect of job search plan	200 (0.3%)	200 (0.3%)	300 (0.4%)	400 (0.5%)	500 (0.5%)	500 (0.5%)	400 (0.4%)	2,500 (0.4%)
All sanctions	65,800 (100%)	71,500 (100%)	81,900 (100%)	87,000 (100%)	95,500 (100%)	97,600 (100%)	92,100 (100%)	591,500 (100%)

The second dataset of this thesis, *The Vacancy Data*, includes vacancy notifications posted in the Finnish PES during the years 2002 to 2008. The micro data include information on various vacancy and employer characteristics, including job duration, job type, working time, the employer sector and employer size. In addition, the PES office in which the vacancy is announced and the regional classification of each office are available²². Furthermore, from the Employment Service Statistics, we were able to include variables that

²¹ It should be noted that social assistance is not entirely comparable with unemployment benefits due to the different eligibility criteria.

²² It should be noted that the location of the job and the location of the announcing PES office can vary.

describe labour market tightness, that is, the monthly stock of open vacancies and unemployed jobseekers of each PES office.

In this thesis, vacancy duration refers to the period between the start and end dates of a vacancy posting at PES²³. In the data, some vacancies have a predefined closing date, which means that the vacancy is posted for a predetermined duration (i.e., the application period is fixed). In other words, some vacancies are closed after a predefined duration regardless of the identification of a suitable job candidate. Because the actual outcome and duration of (and the probability of filling) these predefined vacancies is unknown, these vacancies are excluded from the data²⁴. Åland, which is an autonomous island, is also excluded due to its exceptional labour market conditions.

A job notification may include one or several vacancies that the employer seeks to fill. A problem with these multiple vacancies is that we only have information on the vacancy that was filled (or cancelled) last; thus, we do not know how many of the multiple workplaces were actually filled. Hence, the duration and the probability of filling are not observed for all of the vacancies. Therefore, multiple vacancies are excluded from the data²⁵.

The vacancies in the data are either (i) filled or (ii) cancelled. Both filling and cancelling a vacancy can be conducted either (a) through the PES office or (b) through the PES web service. The web service is a technical platform in which the employer can log into the system and add new vacancies, change the status of open vacancies when they are filled or cancel them. The web service is available 21 hours per day and 7 days per week, whereas the PES offices are open only during regular business hours. Because the data are from the PES, some vacancies are filled by job assignments (30%). Job assignment is a policy measure that requires an unemployed job seeker to contact an employer that the PES has deemed suitable or risk a benefit sanction. There are also vacancies that have 'other' outcomes: filled by other search channels and enough applicants to remove notification from the PES²⁶.

In total, 812,000 open vacancies were announced during the observation period (Table 10). It should be noted that due to the data restrictions, the total number of vacancies is lower than in the official records. The percentage of filled vacancies varied between 76% and 80% during the observation period.

²³ Recently, there has been a discussion on the recruitment process and the definition of a vacancy. Farm (2009) argues that not every hiring process begins with a job vacancy (e.g., recalls from former employees and the hiring of a spontaneous job applicant). Register-based data such as ours cannot account for these instantaneous hirings, that is, hirings with non-existent recruitment processes.

²⁴ The share of predefined vacancies is approximately 35% of all job notifications. Excluding predefined vacancies from the data decreases the average vacancy duration by one day.

²⁵ The share of multiple vacancies in a single notification is approximately 20% of all job notifications. There are 1.6 open vacancies on average in each job notification.

²⁶ We consider these two as separate outcomes because we want to focus on a single recruiting channel (the PES) and because the outcome for vacancies that have enough applicants to support removal from the PES is not known even though they are most likely filled.

The most interesting finding is the increase in the proportion of vacant jobs filled through the web service from 0% to 10% between 2002 and 2008, that is, after the introduction of the new web-based service. The percentage of vacancies with other outcomes (e.g., filled by other means) decreased from 15% to 10% between 2002 and 2008, and at the same time, the percentage of cancelled job openings increased from 6% to 10%.

TABLE 10 Number, percentage and mean duration of vacancies by outcome, 2002-2008

Outcome	2002	2003	2004	2005	2006	2007	2008	Total
Filled	80,700 (79%) 13.8	79,100 (79%) 14.4	73,600 (76%) 15.4	82,500 (76%) 17.1	88,700 (76%) 18.4	116,200 (80%) 19.4	113,000 (80%) 15.7	633,900 (78%) 16.5
through PES office	80,300 (78%) 13.7	76,600 (77%) 14.2	70,600 (73%) 15.2	76,900 (71%) 16.9	82,000 (70%) 17.8	104,400 (71%) 19.0	99,300 (70%) 15.7	590,100 (73%) 16.2
through web service	400 (0.4%) 31.7	2,500 (2%) 20.6	3,000 (3%) 20.6	5,600 (5%) 20.1	6,700 (6%) 25.6	11,800 (8%) 23.2	13,700 (10%) 16.2	43,700 (5%) 20.7
Withdrawn (cancelled)	6,000 (6%) 26.1	6,000 (6%) 27.3	6,300 (7%) 28.7	6,900 (6%) 31.3	9,400 (8%) 33.0	12,400 (8%) 33.2	14,200 (10%) 23.6	61,200 (8%) 29.0
through PES office	5,900 (6%) 26.1	5,700 (6%) 27.4	5,800 (6%) 29.2	6,000 (6%) 31.9	7,500 (6%) 35.0	9,500 (6%) 35.5	10,000 (7%) 26.2	50,400 (6%) 30.4
through web service	100 (0.1%) 29.7	300 (0.3%) 25.3	500 (0.5%) 22.3	900 (1%) 26.7	1,900 (2%) 25.0	2,900 (2%) 26.0	4,200 (3%) 17.1	10,800 (1%) 22.3
Other ^a	15,700 (15%) 22.7	14,600 (15%) 23.4	16,700 (17%) 24.5	19,300 (18%) 26.4	18,500 (16%) 28.7	17,500 (12%) 30.6	14,300 (10%) 24.5	116,600 (14%) 26.0
All vacancies	102,400 (100%) 15.9	99,700 (100%) 16.5	95,600 (100%) 17.9	108,700 (100%) 19.7	116,600 (100%) 21.2	146,100 (100%) 21.9	141,500 (100%) 17.4	811,600 (100%) 18.8

Note: ^a 'Other' outcome include filled by other means and enough applicants to remove notification from the PES.

Table 10 also shows the mean duration of vacancies grouped by outcome and time period. The average duration of all of the vacancies was 19 days, but the duration varied depending on the type of search method the employers used. The average duration was approximately 16 days for vacancies filled through the PES offices and 21 days for vacancies filled through the web service. However, the duration of vacancies filled through PES offices has increased, whereas the duration of vacancies filled through the web service decreased

during the observation period. The longest durations were observed for the cancelled vacancies (29 days) and for the vacancies with other outcomes (26 days). However, using the web service to cancel a vacancy (22 days) produces shorter vacancy durations than when cancelling a vacancy through a PES office (30 days).

The notable difference between this thesis and the existing studies on employer search lies with the data. We use register-based data, whereas most of the previous studies on vacancy duration have used surveys (e.g., DeVaro, 2005; Burdett and Cunningham, 1998; Gorter *et al.* 1996; Van Ours and Ridder, 1993; Van Ours and Ridder, 1992). To our knowledge, the studies by Behrenz (2002) and Brencic and Norris (2010, 2012) constitute an exception. Both the surveys and register-based data have their advantages and disadvantages. For example, register data usually have many more observations, but the information is more limited. Instead, surveys include diverse information on the subject of interest, but the sample sizes are smaller, and sometimes, there are issues related to the reliability of the answers. Moreover, the measurement (and definition) of vacancy duration may also vary. With register-based data, the information is often available at the daily level, whereas in surveys, it is given in weeks or months (e.g., compare studies by Brencic and Norris, 2010 and DeVaro, 2005). Thus, both of the data collection methods may involve some measurement error.

1.5.2 Main results

This dissertation analyses search in Finnish labour markets. Both the jobseeker's and employer's points of view are considered, as they are both important in the job-jobseeker matching process.

The first article of this dissertation (*Chapter 2*) studies benefit sanctions and their effect on the rate of exit from unemployment in Finland. The study employs unemployment data from the Ministry of Employment and the Economy with additional information on unemployment benefits gathered from registers of Financial Supervisory Authority (FIVA) and the Social Insurance Institution (KELA). The data cover the unemployed registered at the Finnish PES during the years 2003-2009. The empirical analysis is performed by using the timing-of-events approach, which allows for a distinction between the selection and causal effects of sanctioning as well as the time-varying effect of sanctioning. The study is the first to analyse the effect of sanctions on the exit rate from unemployment to work by comparing two different benefit schemes: earnings-related benefits (UI) and flat-rate labour market support (LMS). In this article, we also analyse the effect of sanctions on the exit rate from unemployment to active labour market policy (ALMP) measures and movement outside the labour force.

The results imply that sanctions increase the outflow from unemployment to work but that the effect differs according to the benefit received; LMS recipients react to sanctions more strongly than UI recipients do. An on-going sanction increases the job-finding rate of UI recipients by 13% and that of LMS

recipients by 80%. A completed sanction also increases the re-employment rate of LMS recipients (32%) but has no effect on UI recipients. According to the results, sanctions encourage the unemployed on LMS to find jobs, whereas they encourage the unemployed on UI to exit the labour force. The encouraging effect of sanctions on ALMP programmes is relatively small and statistically significant only among LMS receivers.

The second research paper (*Chapter 3*) investigates the factors that affect employer search. We use large register data on open vacancies posted at the Finnish PES during the years 2002 and 2003. The observed vacancy durations, that is, the time until a vacancy is filled with a jobseeker, are used as a proxy for the duration of employer search, and a piecewise constant hazard function is used to analyse these durations. The focus of the study is to examine whether the Finnish PES' implementation of a web-based service in October 2002 has had positive effects on recruiting. Through the web service, employers can post job advertisements to the PES website, where jobseekers can search for suitable jobs. The main advantage of the service is that it does not require the assistance of PES officials, and it is a flexible alternative that is accessible at various times (21 hours per day and 7 days per week) and from different locations. Nonetheless, from the theory point of view, the expected effects of online search are largely unexplored, and they can be positive or negative; the main conclusion depends on which of these effects dominates.

According to the results, the web-based service improved employer search because the probability of filling a vacancy was (14%) larger after the web service was introduced to employers. However, these results are modest and sensitive to regional variation. We find that the use of the online service decreased the average duration of employer search only in certain regions, namely in the Employment and Economic Development (TE)centres of Varsinais-Suomi, Northern Ostrobothnia and Lapland. It seems that the web service offers an alternative recruiting method for employers that urban employers especially exploit. It is possible that we find only modest results because our time period is short and thus, the employers were not yet fully aware of the new online service right after its introduction.

The third and final article of the thesis (*Chapter 4*) also relates to employer search but explores it from a different angle. We analyse cases in which employer search is unsuccessful. In other words, the duration until an employer chooses to withdraw (cancel) a vacancy from the labour market is explored. In this study, register data on open vacancies posted at the Finnish PES during the 2002-2003 period is utilised. By employing a difference-in-differences approach, we investigate whether the introduction of the PES's web-based service in October 2002 has influenced the speed of cancelling vacancies. The estimation results suggest that in general, the introduction of the online service has not influenced the employers' decision to withdraw a vacancy from the labour market.

We also examined the long-term effects of the web service by estimating a competing-risks AFT model for vacancies cancelled through the PES offices or

through the web-based service of the PES during the years 2002-2008. The results support our main findings. In the long run, vacancies are removed from the PES more quickly by using the basic service methods, that is, by contacting the PES office, than by using the web-based service of the PES. It could be that because the services provided by the PES are free, cancelling a vacancy later has no direct costs for the employer. Thus, there are no incentives for the employers to cancel vacancies any faster via online than via a PES office. It is also possible that the web-based service of the PES is merely a flexible recruiting alternative for the employers and a service that is accessible across various times and locations.

1.5.3 Discussion

The empirical analysis of the effect of sanctions has received little attention in Finland even though the government is constantly reforming its benefit entitlement rules. For example, in 2010, the employment condition was reduced to 34 weeks instead of 43 weeks. The purpose of this thesis is to provide new evidence in the field of benefit sanctions. The results show that sanctions do encourage the unemployed to find jobs. However, perhaps more attention should be given to UI benefit receivers because the sanction rate and the responsiveness to sanctions of these individuals are relatively low compared to individuals receiving flat-rate LMS. One explanation for these results is that most of the sanctions imposed for UI beneficiaries are fixed-term and relatively short in duration (60 days), whereas LMS recipients typically receive more severe sanctions (the exclusion of benefits for 90-150 days) that require work, education or ALMP measures until the eligibility for benefits is re-granted. Perhaps one way to increase the responsiveness to sanctions, especially among UI receivers, would be to change the fixed-term sanctions into conditional ones. In other words, sanctions could be shorter in duration, but they would require more effort on behalf of the unemployed (education, work and/or ALMP measures). It is known that the long-term unemployed have difficulties getting back into the labour market. Therefore, it would make more sense to encourage the unemployed to look for work in the early stages of their unemployment, i.e., during the first 500 benefit days of UI allowance. Another interesting question is whether the system in Finland should have more incentives - carrots instead of sticks - for the unemployed. Perhaps a financial carrot (a re-employment bonus) would be more effective than a financial stick (a sanction)²⁷. During the years 2013-2015, a re-employment bonus experiment will be performed in 61 Finnish municipalities²⁸. In this experiment, a long-term unemployed

²⁷ According to search theory, re-employment bonuses should have positive effects on the re-employment probability because they decrease the reservation wage of the jobseeker (Meyer, 1988). In reality, re-employment bonuses can have positive or negative effects (see, e.g., Van der Klaauw and Van Ours, 2011; Kettunen, 1993; Meyer, 1988).

²⁸ For more information, see e.g., the following website (in Finnish): <http://www.stm.fi/vireilla/lainsaadantohankkeet/toimeentulo_ja_vakuutusasiat/tyottomyysturvan_muutokset> (accessed 15 July 2014).

individual may receive re-employment bonus equal to one month of labour market support when he finds a job. The results of this experiment remain to be seen.

Although this study provides some answers, it also leaves many questions unanswered. For instance, it would be interesting to examine the effect of the year 2006 policy reform by which the sanctioning of the long-term unemployed was tightened. The 2006 reform is expected to have an encouraging effect on the job-finding rates of the unemployed. However, Moreover, it would be intriguing to analyse how benefit sanctions have affected the quality of the subsequent jobs. The quality could be measured by the duration of a job and/or by the wage level. Some of the early work on the subject suggests that the sanctioned unemployed often accept jobs with lower earnings and shorter durations than non-sanctioned individuals do (Van den Berg and Vikström, 2009; Arni *et al.*, 2012). Additionally, Finnish unemployed individuals (regardless of receiving a sanction) have been found to accept jobs that do not increase or even reduce their household disposable income (Kyyrä, 1999). The reservation wage level of the (single) unemployed has decreased since the year 1996 (Talouden rakenteet 2011; 2007). Thus, the effect of sanctions on the quality of subsequent jobs is an important topic for future research.

Another purpose of this thesis is to provide evidence in the field of Internet-based employer search. The Internet is becoming an increasingly common method of search in the labour market. The results of this thesis indicate that the PES web-based service has had a modest positive effect on vacancy durations. The results also imply that the web service is merely an alternative recruiting method for employers that urban employers particularly exploit. It might even be that employers are not fully aware of the online services of the PES, and thus, promoting these services might be beneficial (Ahokas and Sanio, 2012). It seems that the PES has made similar conclusions because it launched a media campaign in the summer of 2013 to promote the services of the PES; advertisements were made on the radio and at PES offices via posters and brochures²⁹. At the same time, the web pages of the PES were updated, and a new mobile application (*Työpaikkahaku*) was introduced to jobseekers. Because our analysis and conclusions are based on a relatively short observation period, follow-up studies are needed to evaluate the long-term effects of the PES's online service. Additionally, it would be interesting to investigate whether the advertisement campaign has increased the use of the PES's online service. The new mobile application might influence vacancy durations, and exploring its effects on the filling rates would also be intriguing.

Although the results show that the web service has only a modest effect on the duration of employer search, it can help the PES to run more efficiently. Due to the limited resources of the PES, the time spent on selecting appropriate candidates for employers is taken from the time counselling the jobseekers.

²⁹ More detailed information is given (in Finnish) at the following website: <http://www.te-palvelut.fi/te/fi/nain_asioint_kanssamme/te_palvelut/ajankohtaista/03_2013/2013-06-06-01/index.html> (accessed 15 July 2014).

Therefore, being more selective makes the PES less able to help jobseekers to find jobs. The online service of the PES may overcome this allocation problem. The employers and jobseekers do not always need consultation; thus, the web-based service makes it possible to concentrate on those in need of assistance. At the moment, we are not able to examine this interesting possibility; thus, the topic waits for better research data.

Finally, this thesis also examines unsuccessful employer search, a subject that has been ignored in the literature. Unfortunately, we are not able to study the reasons behind unsuccessful employer search. We can only show that cancelled vacancies exist in the Finnish labour market and that the employer's decision to withdraw a vacancy has not been affected by the introduction of information technology, that is, the PES's web-based service. Thus, the underlying reason(s) why an employer chooses to withdraw a vacancy from the labour market is something that requires more research with more suitable data.

References

- Abbring, J., Van den Berg, G. and Van Ours, J. (2005). The effect of unemployment insurance sanctions on the transition rate from unemployment to employment. *The Economic Journal* 115, 602-630.
- Ahokas, M. and Sanio, A. (2012). Recognizability, usage and image of labor administration's electronic employer services within the operating region of Savonlinna Employment and Economic Development Office (in Finnish). Bachelor's thesis. Business Management, Mikkeli University of Applied Sciences.
- Akaike, H. (1974). A new look at the statistical model identification. *IEEE Transactions on Automatic Control* 19, 716-723.
- Andrews, M., Bradley, S., Stott, D. and Upward, R. (2008). Successful employer search? An empirical analysis of vacancy duration using micro data. *Economica* 75, 455-480.
- Arni, P., Lalive, R. and Van Ours, J. (2012). How effective are unemployment benefit sanctions? Looking beyond unemployment exit. Forthcoming in *Journal of Applied Econometrics*.
- Ashenfelter, O., Ashmore, D. and Deschenes, O. (2005). Do unemployment insurance recipients actively seek work? evidence from randomized trials in four US states. *Journal of Econometrics* 125, 53-75.
- Autor, D. (2001). Writing the labor market. *Journal of Economic Perspectives* 15, 25-40.
- Bagues, M. and Labini, M. (2009). Do online labor market intermediaries matter? The impact of AlmaLaurea on the university-to-work transition. In D. Autor (ed.), *Studies of labor market intermediation*, The University of Chicago Press: Chicago.

- Barron, J. and Bishop, J. (1985). Extensive search, intensive search, and hiring costs: new evidence on employer hiring activity. *Economic Inquiry* 23, 363-382.
- Barron, J., Bishop, J. and Dunkelberg, W. (1985). Employer search: The interviewing and hiring of new employees. *The Review of Economics and Statistics* 67, 43-52.
- Barron, J. and Mellow, W. (1982). Labor contract formation, search requirements, and use of a public employment service. *Economic Inquiry* 20, 381-387.
- Beaumont, P. (1978). The duration of registered vacancies: an explanatory exercise. *Scottish Journal of Political Economy* 25, 75-87.
- Behrenz, L. (2002). The employment service and vacancy durations. *Evaluation Review* 26, 602-617.
- Behrenz, L. (2001). Who gets the job and why? an explorative study of employers' recruitment behavior. *Journal of Applied Economics* 4, 255-278.
- Black, D., Smith, J., Berger, M. and Noel, B. (2003). Is the threat of reemployment services more effective than the services themselves? evidence from random assignment in the UI system. *American Economic Review* 93 (4). 1313-1327.
- Boone, J., Sadrieh, A. and Van Ours, J. (2009). Experiments on unemployment benefit sanctions and job search behaviour. *European Economic Review* 53, 937-951.
- Boone, J. and Van Ours, J. (2006). Modeling financial incentives to get the unemployed back to work. *Journal of Institutional and Theoretical Economics* 162, 227-252.
- Box-Steffensmeier, J. and Zorn, C. (2001). Duration models and proportional hazards in political science. *American Journal of Political Science* 45, 972-988.
- Brencic, V. and Norris, J. (2012). Employers on-line recruitment and screening practises. *Economic Inquiry* 50, 94-111.
- Brencic, V. and Norris, J. (2010). Do employers change job offers in their online job ads to facilitate search? *Economic Letters* 108, 46-48.
- Brencic, V. and Norris, J. (2009). Employer's online search: an empirical analysis. *Industrial Relations* 48, 684-709.
- Burdett, K. and Cunningham, E. (1998). Towards the theory of vacancies. *Journal of Labor Economics* 16, 445-478.
- Card, D., Chetty, R. and Weber, A. (2007). The spike at benefit exhaustion: leaving unemployment system or starting a new job? *The American Economic Review* 97, 113-118.
- Chen, L. and Eriksson, T. (2009). Vacancy duration, wage offers and job requirements: pre-match data evidence. Working Paper 09-6. Department of Economics, Aarhus School of Business, University of Aarhus.
- Cleves, M., Gould, W., Gutierrez, R. and Marchenko, Y. (2008). *An Introduction to Survival Analysis Using Stata*. 2nd edition. Stata Press: Texas, USA.
- Cober, R., Brown, D., Blumental, A., Doverspike, D. and Levy, P. (2000). The quest for the qualified job surfer: it's time the public sector catches the wave. *Public Personnel Management* 29, 479-496.

- Cox, D. (1975). Partial likelihood. *Biometrika* 62, 269-276.
- Cox, D. (1972). Regression models and life tables. *Journal of the Royal Statistical Society, Series B (Methodological)* 34, 187-202.
- Cox, D. and Oakes, D. (1984). *Analysis of Survival Data*. London: Chapman and Hall.
- DeVaro, J. (2005). Employer recruitment strategies and the labor market outcomes of new hires. *Economic Inquiry* 43, 263-282.
- Directorate of Labour Iceland (2008). The right to unemployment benefits. Available at: http://www.eures.is/files/Rau%C3%B0i%20b%C3%A6klingurinn%20%C3%A1%20ensku_1575575153.pdf (accessed 11 November 2012).
- Dolton, P.J. and O'Neill, D. (1996). Unemployment duration and the Restart effect: some experimental evidence. *Economic Journal* 106, 387-400.
- Douglas, I., Kerminen, P., Meling, T. and Peura, J. (2011), Työttömyysturvan menettäminen työvoimapolitiittisesti moitittavan menettelyn takia (in Finnish). TEM Analyses 31/2011, Ministry of Employment and the Economy, Helsinki.
- European Commission (2010). Europe's digital competitiveness report 2010. Luxembourg: Publications Office of the European Union.
- Farm, A. (2009). Unemployment and vacancies. Working paper 8/2009, Swedish Institute for Social Research (SOFI), Stockholm University.
- Fay, R. (1996). Enhancing the effectiveness of active labour market policies: evidence from programme evaluations in OECD Countries. OECD Labour Market and Social Policy Occasional Papers 18, Paris.
- Fishe, R.P.H. (1982). Unemployment insurance and the reservation wage of the unemployed. *The Review of Economics and Statistics* 16, 12-17.
- Fister, S. (1999). Online recruiting: good, fast and cheap? *Training* 36, 26-28.
- Fountain, C. (2005). Finding a job in the Internet age. *Social Forces* 83, 1235-1262.
- Freeman, R. (2002). The labour market in the new information economy. *Oxford Review of Economic Policy* 18, 288-305.
- Frijters, P. and van der Klaauw, B. (2006). Job search with non-participation. *The Economic Journal* 116, 45-83.
- Galanaki, E. (2002). The decision to recruit online: a descriptive study. *Career Development International* 7, 243-251.
- Glidden, D. and Self, S. (1999). Semiparametric likelihood estimation in the Clayton-Oakes failure time model. *Scandinavian Journal of Statistics* 26, 363-372.
- Gorter, C., Nijkamp, P. and Rietveld, P. (1996). Employers' recruitment behaviour and vacancy duration: an empirical analysis for the Dutch labour market. *Applied Economics* 28, 1463-1474.
- Gorter, C. and van Ommeren, J. (1999). Sequencing, timing and filling rates of recruitment channels. *Applied Economics* 31, 1149-1160.
- Gorter, C. (1991). The dynamics of unemployment and vacancies on regional labour markets. Dissertation. Amsterdam: Tinbergen Institute.

- Gray, D. (2003), National versus regional financing and management of unemployment and related benefits: the case of Canada. OECD Social, Employment and Migration Working Papers No. 14, Paris.
- Greene, W. (2008). *Econometric Analysis*. Prentice Hall: New Jersey.
- Grubb, D. (2000), Eligibility criteria for unemployment benefits. OECD Economic Studies No. 31, Paris.
- Haas, C., Glover, R., Tucker, R. and Terrien, R. (2001). Impact of the Internet on the recruitment of skilled labor. Report No. 17, Center for Construction Industry Studies, University of Texas, Austin.
- Hadass, Y.(2004). The effect of internet recruiting on matching of workers and Employers. Available at: http://econ.tau.ac.il/papers/applied/Hadass_paper.pdf (accessed 6 June 2012).
- Ham, J. and Rea, S. (1987). Unemployment insurance and male unemployment duration in Canada. *Journal of Labor Economics* 5, 325-353.
- Heckman, J., Lalonde, R. and Smith, J. (1999). The economics and econometrics of active labor market programs. In Ashenfelter, O. and Card, D. (eds.), *Handbook of Labor Economics*, Vol. 3, Amsterdam: Elsevier.
- Heckman, J. and Singer, B. (1984). The identifiability of the proportional hazard model. *The Review of Economic Studies* 51, 231-241.
- Henkens, K., Remery, C. and Schippers, J. (2005). Recruiting personnel in a tight labour market: an analysis of employers' behaviour. *International Journal of Manpower* 26, 421-433.
- Holt, C. and David, M. (1966): The concept of job vacancies in a dynamic theory of the labor market. In the National Bureau of Economic Research (ed.) *The Measurement and Interpretation of Job Vacancies*, New York:Columbia University Press, 73-110.
- Hougaard, P. (1999). Fundamentals of survival data. *Biometrics* 55, 13-22.
- Hougaard, P. (1984). Life table methods for heterogeneous populations: distributions describing the heterogeneity. *Biometrika* 71, 75-83.
- Hynninen, S.-M., Kangasharju, A. and Pehkonen, J. (2009). Matching inefficiencies, regional disparities, and unemployment. *Labour* 23, 481-506.
- Hämäläinen, H. (2007). Työvoiman rekrytointi toimipaikoissa vuonna 2006 (in Finnish). <http://www.mol.fi/mol/fi/99_pdf/fi/06_tyoministerio/06_julkaisut/10_muut/rekrytointi2006.pdf> (Accessed 21 August 2013).
- Hämäläinen, K., Tuomala, J. and Ylikännö, M. (2009). Työmarkkinatuen aktivoinnin vaikutukset (in Finnish).TEM-publications 7/2009, Ministry of Employment and the Economy, Helsinki.
- Jenkins, S. (1997).Discrete time proportional hazards regression. *Stata Technical Bulletin* 39, 22-32.
- Jensen, P., Rosholm, M. and Svarer, M. (2003). The response of youth unemployment to benefits, incentives, and sanctions. *European Journal of Political Economy* 19, 301-316.
- Kalbfleisch, J. and Prentice, R. (1980): *The Statistical Analysis of Failure Time Data*. New York : John Wiley& Sons.

- Kaplan, E. and Meier, P. (1958): Nonparametric estimation from incomplete observations. *Journal of the American Statistical Association* 53, 457-481.
- Kay, R. and Kinnersley, N. (2002). On the use of the accelerated failure time model as an alternative to the proportional hazards model in the treatment of time to event data: a case study in influenza. *Drug Information Journal* 36, 571-579.
- Kettunen, J. (1993). Increasing incentives for reemployment. *Finnish Economic Papers* 6, 51-60.
- Kiefer, N. (1988). Economic duration data and hazard functions. *Journal of Economic Literature* 26, 646-679.
- Kollman, R. (1994). The duration of unemployment as a signal. *Economic Letters* 45, 373-377.
- Kuhn, P. and Mansour, H. (2011). Is Internet job search still ineffective? Discussion Paper 5955, Institute for the Study of Labor (IZA), Bonn.
- Kuhn, P. and Skuterud, M. (2004). Internet job search and unemployment durations. *The American Economic Review* 94, 218-232.
- Klein, J. and Moeschberger, M. (2003). *Survival analysis: Techniques for Censored and Truncated Data*. 2nd edition. New York: Springer.
- Kleinbaum, D.G. and Klein, M. (2005). *Survival Analysis: A Self-Learning Text*. 2nd edition. New York: Springer.
- Krueger, A. and Mueller, A. (2010). Job search and unemployment insurance: new evidence from time use data. *Journal of Public Economics* 94, 298-307.
- Kyyrä, T. (2010). Partial unemployment insurance benefits and the transition rate to regular work. *European Economic Review* 54, 911-930.
- Kyyrä, T. (1999). Post-unemployment wages and economic incentives to exit from unemployment. VATT-Research Reports 56, Government Institute for Economic Research, Helsinki.
- Kyyrä, T. and Ollikainen, V. (2008). To search or not to search? the effects of UI benefit extension for the older unemployed. *Journal of Public Economics* 92, 2048-2070.
- Lalive, R., Zweimuller, J. and Van Ours, J. (2005). The effect of benefit sanctions on the duration of unemployment. *Journal of the European Association* 3, 1386-1417.
- Lambert, P., Collett, D., Kimber, A. and Johnson, R. (2004). Parametric accelerated failure time models with random effects and an application to kidney transplant survival. *Statistics in Medicine* 23, 3177-3192.
- Lawless, J. (1982). *Statistical models and methods for lifetime data*. 2nd edition. New York: John Wiley & Sons.
- Lindeboom, M. Van Ours, J. and Renes, G. (1994). Matching employers and workers: An empirical analysis on the effectiveness of search. *Oxford Economic Papers* 46, 45-67.
- Lippman, S. and McCall, J. (1976). The economics of job search: a survey. *Economic Inquiry* 14, 347-368.
- Manning, A. (2009). You can't always get what you want: The impact of the UK jobseeker's allowance. *Labour Economics* 16, 239-250.

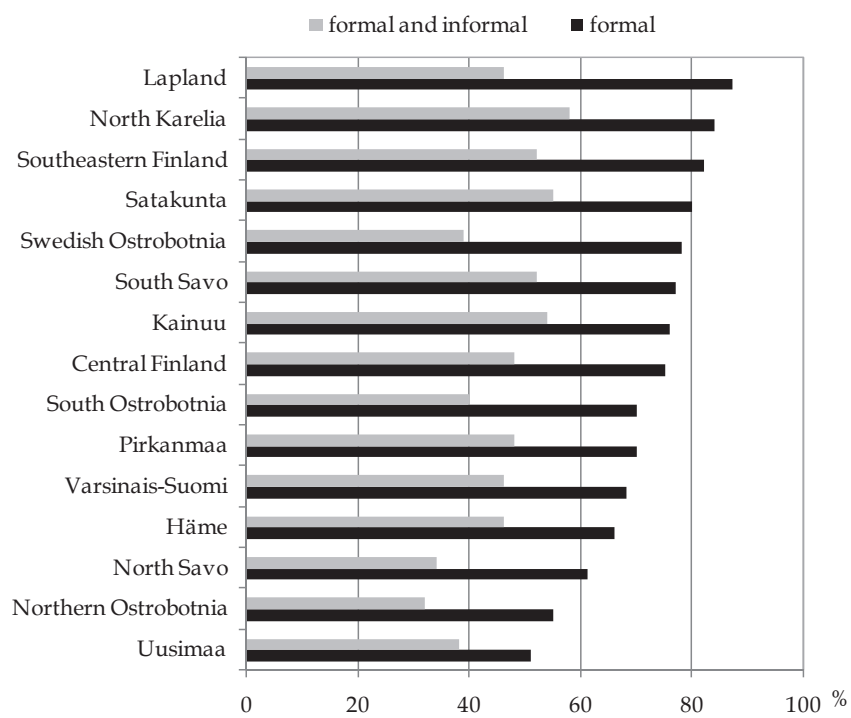
- Mcvicar, D. (2010). Does job search monitoring intensity affect unemployment? Evidence from Northern Ireland. *Economica* 77, 296-313.
- Mencken, F. and Winfield, I. (1998). In search of the right stuff: the advantages and disadvantages of informal recruiting practices in external labor markets. *American Journal of Economics and Sociology* 57, 135-153.
- Meyer, B. (1990). Unemployment insurance and unemployment spells. *Econometrica* 58, 757-782.
- Meyer, B. (1988). Implications of the Illinois reemployment bonus experiments for theories of unemployment and policy design. NBER Working Paper No. 2783, Cambridge.
- Moffitt, R. and Nicholson, W. (1982). The effect of unemployment insurance on unemployment: the case of federal supplement benefits. *The review of Economics and Statistics* 64, 1-11.
- Mortensen, D. (1986): Job search and labor market analysis. In Ashenfelter O. and Layard R. (eds.), *Handbook of Labor Economics*, Vol. 2, Amsterdam: North-Holland.
- Nakamura, A., Shaw, K., Freeman, R., Nakamura, E. and Pyman, A. (2009). Jobs online. In Autor, D. (ed.), *Studies of labor market intermediation*, Chicago: The University of Chicago Press.
- Omori, Y. (1996). Stigma effects of nonemployment. *Economic Inquiry* 35, 394-416.
- Pan, W. (2001). Using frailties in the accelerated failure time model. *Lifetime Data Analysis* 7, 55-64.
- Pellizzari, M. (2011). Employers' search and the efficiency of matching. *British Journal of Industrial Relations* 49, 25-53.
- Petrongolo, B. and Pissarides, C. (2001). Looking into the black box: A survey of the matching function. *Journal of Economic Literature* 29, 315-431.
- Pissarides, C. (2000). *Equilibrium Unemployment Theory*. 2nd edition. Cambridge: MIT Press.
- Rebien, M., Kubis, A. and Müller, A. (2014). Success and failure in the operational recruitment process: contrasting the outcomes of search. IAB Discussion Paper 7/2014, Institute for Employment Research (IAB), Nürnberg.
- Røed, K. and Westlie, L. (2012). Unemployment insurance in welfare states: the impacts of soft duration constraints. *Journal of the European Economic Association* 10, 518-554.
- Rosholm, M. and Svarer, M. (2008). The threat effect of active labour market programmes. *Scandinavian Journal of Economics* 110, 385-401.
- Ropper, S. (1988): Recruitment methods and vacancy duration. *Scottish Journal of Political Economy* 35, 51-64.
- Russo, G., Rietveld, P., Nijkamp, P. and Gorter, G. (2000). Recruitment channel use and applicant arrival: An empirical analysis. *Empirical Economics* 25, 673-697.
- Räisänen, H. (2011). Rekrytoinnin mustan laatikon avaaminen: rekrytoinnin syyt, rekrytointiongelmät ja hakukanavat Suomessa v.2010 (in

- Finnish). TEM-analyses 38/2011, Ministry of Employment and the Economy, Helsinki.
- Schoenfeld, D. (1982). Partial residuals for the proportional hazards regression model. *Biometrika* 69, 239-241.
- Seneviratne, I., Schexnayder, C. and Wiezel, A. (1999). Establishing a world wide web presence. *Practise Periodical on Structural Design and Construction* 4, 69-74.
- Singer, J. and Willett, J. (1993). It's about time: using discrete-time survival analysis to study duration and the timing of events. *Journal of Educational Statistics* 18, 155-195.
- Spence, M. (1973). Job market signaling. *Quarterly Journal of Economics* 87, 355-374.
- Stevenson, B. (2009). The Internet and job search. In D. Autor (ed.), *Studies of labor market intermediation*, Chicago: The University of Chicago Press.
- Stigler, G. (1962): Information in the labor market. *Journal of Political Economy* 70, 94-105.
- Svarer, M. (2011). The effect of sanctions on exit from unemployment: evidence from Denmark. *Economica* 78, 751-778.
- Talouden rakenteet 2011 (in Finnish). VATT Publications 59, Government Institute for Economic Research, Helsinki.
- Talouden rakenteet 2007 (in Finnish). Talouden rakenteet, Government Institute for Economic Research, Helsinki.
- Thomas, J. (1997). Public employment agencies and unemployment spells: reconciling the experimental and nonexperimental evidence. *Industrial and Labor Relations Review* 50, 667-683.
- Thomson, W. (1966). Collection and use of job vacancy data in Canada. In National Bureau of Economic Research (ed.), *The measurement and interpretations of job vacancies*, New York: Columbia University Press.
- Tuomaala, M. (2008). Työvoiman hankinta toimipaikoissa vuonna 2007 (in Finnish). TEM analyses 5/2008, Ministry of Employment and the Economy Finland.
- United Nations (2009). Information society policies. Annual world report 2009. Available at: http://portal.unesco.org/ci/en/files/29547/12668551003ifap_world_report_2009.pdf/ifap_world_report_2009.pdf (accessed 4 July 2012).
- Van den Berg, G. (2001). Duration models: specification, identification and multiple durations. In Heckman, J. and Leamer, E. (eds.), *Handbook of Econometrics*, Vol. 5, Amsterdam: Elsevier.
- Van den Berg, G. and Van der Klaauw, B. (2006). Councelling and monitoring of unemployed workers: theory and evidence from a controlled social experiments. *International Economic Review* 47, 895-936.
- Van den Berg, G., Van der Klaauw, B. and Van Ours, J. (2004). Punitive sanctions and the transition rate from welfare to work. *Journal of Labor Economics* 22, 211-241.

- Van den Berg, G. and Vikström, J. (2009). Monitoring job offer decisions, punishments, exit to work, and job quality. Discussion Papers 4325, Institute for Study of Labor (IZA), Bonn.
- Van der Klaauw, B. and Van Ours, G. (2011). Carrot and stick: How re-employment bonuses and benefit sanctions affect exit rates from welfare. *Journal of Applied Econometrics* 28, 275-296.
- Van Ours, J. (1994). Matching unemployed and vacancies at the public employment office. *Empirical Economics* 19, 37-54.
- Van Ours, J. and Ridder, G. (1993). Vacancy durations: Search or selection? *Oxford Bulletin of Economics and Statistics* 55, 187-198.
- Van Ours, J. and Ridder, G. (1992). Vacancies and the recruitment of new employees. *Journal of Labor Economics* 10, 138-155.
- Vaupel, J., Manton, K. and Stallard, E. (1979): The impact of heterogeneity in individual frailty on the dynamics of mortality. *Demography* 16, 439-454.
- Venn, D. (2012). Eligibility criteria for unemployment benefits: quantitative indicators for OECD and EU countries. OECD Social, Employment and Migration Working Papers No. 131, Paris.
- Verhoeven, H. and Williams, S. (2008). Advantages and disadvantages of Internet recruitment: a UK study into employers' perceptions. *International Review of Business Research Papers* 4, 364-373.
- Vishwanath, T. (1989). Job search, stigma effect and escape rate from unemployment. *Journal of Labor Economics* 7, 487-502.
- Weber, A. (2000). Vacancy durations: A model for employer's search. *Applied Economics* 32, 1069-1075.
- Windolf, P. (1986). Recruitment, selection and internal labour markets in Britain and Germany. *Organization Studies* 7, 235-254.

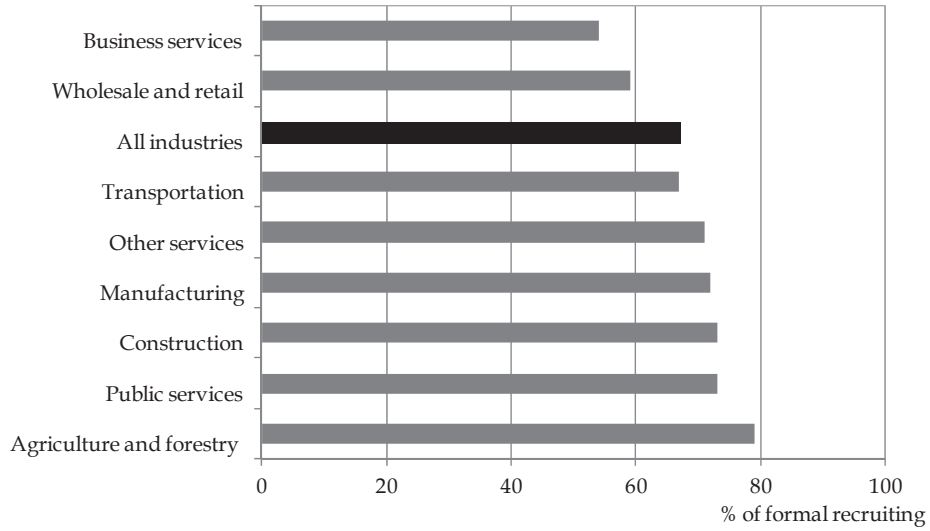
APPENDICES

Appendix 1 Market share of the PES within regions (TE-centres) in 2007



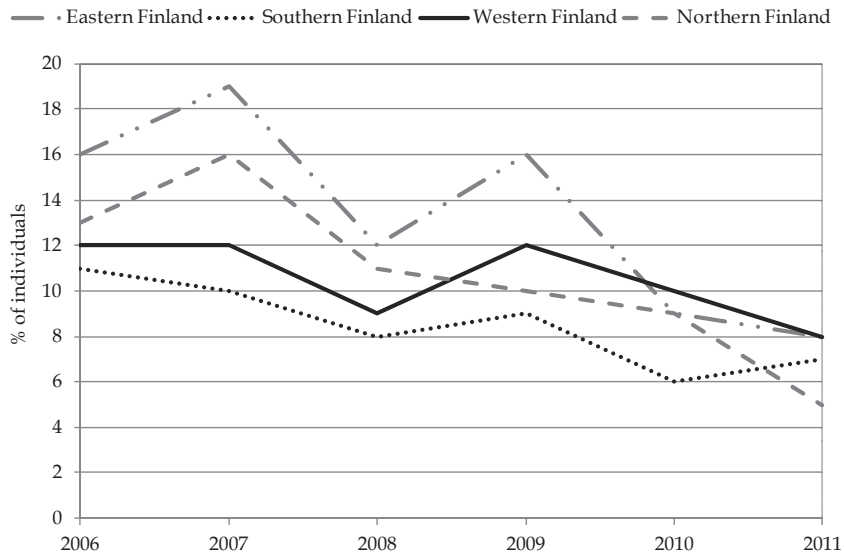
Source: Tuomaala (2008)

Appendix 2 Market share of the PES within industries in 2006



Source: Hämmäläinen (2007)

Appendix 3 Individuals who have never used a computer across major (NUTS2) regions, 2006-2011.



Source: Eurostat

CHAPTER 2

SANCTIONS AND THE EXIT FROM UNEMPLOYMENT IN TWO DIFFERENT BENEFIT SCHEMES*

Abstract. This paper investigates the effect of benefit sanctions on the exit rate from unemployment using a unique set of rich register data on unemployed Finnish individuals. The timing-of-events approach is applied to distinguish between the selection and causal effects of sanctioning. The results imply that the effect of sanctions differs according to the benefits received. Sanctions encourage unemployed individuals receiving flat-rate labour market subsidies (LMS) to find jobs, whereas unemployed individuals receiving earnings-related (UI) allowances to leave the labour force. The encouraging effect of sanctions on active labour market policy programmes is relatively small and statistically significant only among LMS recipients.

Keywords: unemployment, benefits, sanctions

JEL classification: C41, J64, J65

* An earlier version of this paper was presented at the 28th Annual Congress of the European Economic Association in Gothenburg, 2013. The author would like to thank Jaakko Pehkonen, Roope Uusitalo and participants in various seminars for their useful comments and suggestions. Special gratitude is extended to Tomi Kyyrä for invaluable assistance with the timing-of-events model. Financial support from the Alfred Kordelin Foundation is gratefully acknowledged. The author is grateful for the hospitality enjoyed at the Government Institute for Economic Research (VATT). Acquiring the research data was part of the project (no.133930) financed by the Academy of Finland.

2.1 Introduction

There is a wide range of literature relating to unemployment duration and benefits (e.g., Meyer, 1990; Ham and Rea, 1987; Moffitt and Nicholson, 1982). Nonetheless, little is known about the effect of benefit sanctions. A small body of empirical literature indicates that even moderate benefit sanctions increase the job-finding rates of the unemployed (e.g., Abbring *et al.*, 2005; Lalive *et al.*, 2005; Van den Berg *et al.*, 2004). Recent studies also suggest that the effect of sanctions decreases over their elapsed duration, and that the effects differ for various types of unemployed individuals (Svarer 2011). For example, male immigrants are more sensitive to sanctions than male natives. Few previous studies have examined the *ex ante effects* of sanctions, in which the mere threat of sanctions is assumed to affect the job search efforts of the unemployed. The results in this field of study are inconclusive. Both Lalive *et al.* (2005) and Boone *et al.* (2009) find that the *ex ante* effect is important because it stimulates the outflow from unemployment. Conversely, Van den Berg and Vikström (2009) find that the *ex ante* effect does not have a strong influence on the re-employment rate.

This paper investigates the effect of sanctions on the exit rate from unemployment. Sanctions, which are temporary benefit exclusions, are imposed on the unemployed when suitable job offers or active labour market policy (ALMP) programmes are rejected and when job search efforts are deemed inappropriate. We use large register data from the 2003–2009 period to perform a separate analysis for wage-related (UI) and flat-rate labour market support (LMS) benefit recipients. This study represents the first attempt to conduct such an analysis. We also perform a diverse set of sensitivity analyses. We examine the strictness of sanctions, whether sanctions influence the exit rate from unemployment to work and whether the influence of sanctions varies over time. To determine whether some individuals react to sanctions more strongly than others, we allow sanctions to interact with the characteristics of the unemployed.

The contribution of this paper is to provide new evidence to the sparse existing literature on benefit sanctions. Most previous studies have examined the effect of sanctions on unemployment duration for individuals receiving unemployment insurance benefits. An exception is the work of Van den Berg *et al.* (2004), who analyse the effect of sanctions on the transition from welfare (social assistance) to work. Our study is the first to provide a comparison of two different benefit schemes. It is important to investigate the effect of sanctions for different types of benefits because individuals receiving UI benefits differ from individuals receiving LMS benefits in terms of their employment opportunities and background and because UI benefits exceed flat-rate LMS. The data set that we use is large and diverse, whereas most previous studies have used relatively small samples that were often restricted to small geographic areas (see, e.g., Van den Berg *et al.*, 2004; Lalive *et al.*, 2005). In this paper, we also analyse the effect

of sanctions on the exit rate from unemployment to ALMP programmes and outside the labour force. Røed and Westlie (2012) conduct the first study suggesting that sanctions not only increase the rate of exit to work but also increase the rate of exit to education and ALMP programme.

The remainder of this paper is organised as follows. In Section II, we present a brief introduction to the Finnish unemployment benefit system and sanctions. The theoretical framework and econometric methods that are used in this study are discussed in Section III. Section IV describes the data that are used. The empirical findings of this study are presented in Section V, and Section VI concludes the paper.

2.2 Unemployment benefits and sanctions in Finland

In this section, we explain the structure of the Finnish unemployment benefit system and sanctions. This introductory description highlights the aspects of the system that are relevant to our study. The information given applies to the period from 2003 to 2009, which is the observation period in our study.

2.2.1 Unemployment benefits in Finland

There are two types of unemployment benefits: an UI allowance and a LMS¹. Eligibility for UI benefits requires membership in an unemployment insurance fund (either a private/independent fund or a fund that is specific to a trade union²) and an employment history of at least 10 months during the last 28 months prior to unemployment ('the employment condition')³. The maximum duration of UI is 500 business days, i.e., approximately two years⁴. If a person does not fulfil the employment condition or is unemployed for more than 500 days, then he is entitled to LMS paid by the Social Insurance Institution (*Kansaneläkelaitos* KELA). The LMS is always means tested (with respect to household income), but the duration is essentially unlimited⁵.

The UI benefit is based on prior earnings of the unemployed and varies between 45% and 90% of the previous income level. By contrast, the LMS is paid at a flat daily rate that was (without child support) 25.63€ (551€/month) in

¹ A third unemployment benefit, basic allowance (UA), is granted to unemployed individuals who do not belong to an insurance fund but who fulfill the employment condition. The UA is paid by KELA for 500 days, and the level equals the LMS. UA recipients (7% of the unemployed) were not included in this analysis because they are few in number.

² Both membership in a union and membership in an unemployment insurance fund are voluntary.

³ After 2010, the employment condition was reduced to 34 weeks (instead of 43 weeks).

⁴ Older unemployed individuals (those over 55) who receive UI allowances are eligible for extended benefits until they reach retirement age (62-65 years old).

⁵ After 2013, the legislation has changed such that the labour market support is no longer means-tested. Moreover, officially the maximum duration of LMS is 48 years.

2009. During the same year, the daily UI allowance was 55.20€ (1,187€/month). Table 1 summarises the information on unemployment benefits.

Unemployed individuals who receive a sanction may apply other benefits from KELA, such as social assistance (SA) and/or housing allowance (HA), although the SA can be reduced by 20% or 40% depending on the sanction (40% for repeated violations)⁶. Because the SA is means-tested, the reduction is not always used (the decision is made by a KELA caseworker). Individuals can receive unemployment benefits and SA simultaneously if their incomes are sufficiently low.

TABLE 1 Unemployment benefits in Finland in 2009

	Earnings-related allowance (UI)	Labour market support (LMS)
Paid by	Unemployment insurance funds	KELA
Eligibility	member of a fund for at least 10 months and 43 weeks of work during the last 28 months	not eligible for UI or UI has been exhausted
Maximum duration	500 days	no limit
Waiting period	7 days	5 days
Means tested	no	yes
Taxable income	yes	yes
Average daily (monthly) rate	55.20€ (1,187€)	25.63€ (551€)

Source: Employment and Economic Development Office, KELA

2.2.2 Sanctions in Finland

In Finland, an unemployed individual must satisfy the following eligibility conditions to receive benefits and to avoid sanctions: a) register with the public employment service (PES) as an unemployed person, b) actively search for a full-time job, c) apply to jobs suggested by the PES, d) accept ALMPs arranged by the PES, e) participate in making a job search plan⁷ and f) report to the PES on a regular basis and discuss the job search plan. Violations of criteria b–f or inadequate search efforts as evaluated by the PES via interviews⁸ results in

⁶ In 2009, the average SA and HA for a single person were 417€/month and 254€/month, respectively.

⁷ A compulsory job search plan is created at the beginning of unemployment and specifies how the unemployed will seek for work (e.g., which jobs to apply to) and whether ALMP measures are needed to promote employment.

⁸ The interviewing interval is case-specific; the interval is typically short (two to four weeks) at the beginning of unemployment and increases as unemployment duration increases (three to six months). The search effort is deemed inadequate, for example, if a jobseeker has not been applying to jobs or has not participated in the ALMP measures recorded in the job search plan.

sanctions. Sanctions do not reduce the number of benefit entitlement days; benefits are merely postponed by the period of the sanction. In addition, receiving a sanction does not exclude benefits from the time spent in an ALMP measure. Thus, sanctions are intended to encourage unemployed individuals either to find a job or to participate in an ALMP programme.

Most of the sanctions are temporary and have fixed duration of 60 days. In some cases, conditional sanctions (henceforth, 'exclusion of benefits') are imposed, rendering an individual ineligible for unemployment benefits until 90 days of work, education or ALMP measures have been completed. For the long-term unemployed (over 500 benefit days) and for the young unemployed (under 25 years of age), the sanctions are stricter: the exclusion of benefits for 150 days.

Table 2 summarises the reasons for and the duration of benefit sanctions. Refusal of work leads to 60 days of benefit cessation, but if the duration of the job in question is fewer than five days, then the sanction is reduced to 30 days. Similarly, refusing or dropping out of an ALMP measure and several reasons related to the job search plan lead to a loss of benefits for 60 days. Repeated refusal to comply with any of the requirements (within 12 months) results in a 90-day exclusion of benefits⁹. All sanctions entail a 100% reduction in benefits.

TABLE 2 Reasons for and duration of benefit sanctions

Reason for a benefit sanction	Duration
Refusal of work	60 days ^a
Refusal of work, fewer than five days	30 days
Refusing or dropping out of ALMP	60 days ^a
Repeated refusal of work or ALMP	exclusion of benefits for 90 days
Job search plan	
- refusal to participate in creating or inspecting a job search plan	60 days
- neglect of job search plan agreements (refusal of work and training try-outs, integration measures for immigrants or work-life preparatory training)	60 days
- repeated neglect of job search plan agreements	exclusion of benefits for 90 days ^b

Notes: ^a The sanction for the young unemployed (under 25 years of age) and for the long-term unemployed (over 500 benefit days) is the exclusion of benefits for 150 days. ^b The sanction for UI benefit recipients is 60 days.

Source: Unemployment Security Act (*Työttömyysturvalaki 30.12.2002/1290*). Available in Finnish at <<http://www.finlex.fi/fi/laki/ajantasa/2002/20021290>> (accessed 15 May 2012).

The process of imposing a sanction includes a number of stages. The first stage is the observation of misconduct by the PES caseworker, by a potential employer or by the ALMP programme staff. The second stage begins when the PES notifies the paying authorities about the sanction. In this stage,

⁹ Except for UI allowance recipients, repeated neglect of the job search plan leads to a 60-day sanction.

unemployment benefits immediately cease, and the unemployed individual is informed about the sanction and its duration. During the second phase, the unemployed individual is asked to reflect on the misconduct in writing, typically within a month.

In the third stage, a binding decision regarding the sanction is made by the Labour Commission, which is a committee consisting of representatives of labour and employer organisations. The period between the establishment of noncompliance and the final decision regarding the sanction is typically one to two months. Noncompliance does not always result in a sanction if there is a good, well-documented reason for noncompliance, and in these cases, unemployment benefits are paid retroactively; otherwise, the sanction is continued. The sanctioned individual can appeal to the Unemployment Appeal Board, which typically makes a decision within six months. In rare cases, the decision is in favour of the appellant, and the unemployment benefits are paid retroactively. The final level of appeal authority is the Insurance Court.

2.3 Theoretical framework and the empirical strategy

This section briefly describes job search theory and the empirical model that is based on this theory. The expected effect of sanctions on the behaviour of the unemployed is discussed on a general level, as several previous studies have provided finer and more formal details regarding this effect (see, e.g., Abbring and Van den Berg, 2003; Lalive *et al.*, 2005; Abbring *et al.*, 2005; Van den Berg *et al.*, 2004). The empirical model for benefit sanctions is also discussed in a general sense for the same reason.

2.3.1 Job search theory and benefit sanctions

The exit rate from unemployment can be analysed using the theory of job search (Mortensen, 1977). During unemployment, a flow of benefits is received, and a flow of search costs must be paid. A jobseeker is able to choose the search intensity s such that job offers arrive and search costs increase according to the rates $\lambda(s)$ and $c(s)$, respectively. Each time a job offer arrives (random drawings from a wage offer distribution $F(w)$), an individual must decide whether to accept the job or to continue searching and lose income. To balance the costs of finding a better job, the individual chooses a reservation wage level such that the marginal cost of another period of search is equal to the expected marginal income. The exit rate from unemployment to work, θ_u , can be characterised by a reservation wage ϕ and optimal search intensity s^* : $\theta_u = \lambda(s^*)[1 - F(\phi)]$.

Sanctions can be introduced into the model by assuming that the rate at which a sanction is imposed is $p(s)$. All individuals may receive sanctions, but the probability of sanctioning decreases as the search effort increases. If an unemployed individual has a lower search intensity level than is required by

the system (s^*), then he must decide whether to continue with the reduced search level or to increase efforts to avoid the risk of being caught. The individual knows the relationship between s and $p(s)$, but he does not know in advance when a sanction will be implemented. Thus, the sanction rate can be written as $\theta_s = p(s)$, where $p(s) = 0$ for $s \geq s^*$ and $p(s) > 0$ for $s < s^*$. In reality, sanctions are also implemented for reasons other than inadequate search effort, such as refusal of work or refusal of an ALMP measure offered by the PES. Such refusals can be considered indicators of a low search level ($s < s^*$), as search intensity is often difficult to measure.

Benefit sanctions affect unemployment duration in two ways. First, the mere risk of being sanctioned may increase the search efforts of unemployed individuals because job search decisions are made based on the expected value of being unemployed (Rosholm and Svarer, 2008; Lalive *et al.*, 2005). This effect is also known as the *ex ante effect* or the *warning effect*. Second, an additional *ex post effect* emerges when a sanction is imposed (Abbring *et al.*, 2005; Van den Berg *et al.*, 2004). The idea is that a benefit sanction decreases the reservation wage level and increases the search efforts of the jobseeker as a result of the reduced value of being unemployed (i.e., the exclusion of benefits). The effect is temporary because the unemployed individual knows the duration of the sanction; furthermore, as the expiration of the sanction approaches, the reservation wage increases, whereas the search effort of the unemployed individual decreases. However, it is argued that the effect of a sanction may also be positive after expiration of a sanction because of the increased monitoring and additional job search assistance provided by the PES and because of the desire of the unemployed to avoid future sanctions (e.g., Van den Berg *et al.*, 2004).

The results of the existing studies on the effects of sanctions can be summarised as follows. Abbring *et al.* (2005) indicate that the incentive effect of a sanction on the job-finding rate is 58% for Dutch men and 67% for Dutch women. Similarly, Svarer (2011) estimates a re-employment rate increase of 123% for Danish men and 125% for Danish women. For Switzerland, Lalive *et al.* (2005) report that the exit rate from unemployment to work increases by 25% if a sanction warning is issued and by another 20% if a sanction is actually imposed. In Norway, sanctions increase the re-employment rate by 80% (Røed and Westlie 2012). Van den Berg and Vikström (2009) find that the effect of sanctions is small in Sweden, only approximately 23%. All of these studies are related to UI benefits, and to the best of our knowledge, there is only one study that has additionally considered benefits other than UI. For the Netherlands, Van den Berg *et al.* (2004) find that sanctions increase the exit rate from SA to work by 148%¹⁰. The results of Van den Berg *et al.* (2004) and Abbring *et al.* (2005) indicate that the effect of sanctions is greater for Dutch unemployed individuals collecting SA than for Dutch unemployed individuals receiving UI benefits.

¹⁰ It should be noted that the findings of Van den Berg *et al.* (2004) are not directly comparable to other studies due to the fact that social benefits are very different from unemployment benefits (e.g., due to eligibility criteria).

2.3.2 Empirical model for benefit sanctions

We use a timing-of-events model to analyse the effects of benefit sanctions on unemployment duration (Abbring and Van den Berg, 2003). The causal effect of sanctions on the exit rate is determined using a mixed proportional hazard (MPH) model and an assumption of non-anticipation. The MPH model is standard in the duration literature (e.g., Van den Berg, 2001). The non-anticipation assumption, which entails that unemployed individuals cannot fully anticipate the actual timing of sanctions, is justified because sanctions in the data are imposed almost immediately after observations of misconduct (see Section 2.2).

The timing-of-events model allows us to disentangle the selection effects from the causal effects of sanctioning the unemployed. The selection effect is important because the decision to impose a sanction may depend on characteristics of unemployed individuals that are not observable from the data, such as attitude and motivation, which also affect the re-employment rate. To account for this endogeneity, we jointly model the timing of imposing a sanction with exit from unemployment to work¹¹. In other words, we simultaneously estimate an individual's risk of being sanctioned, h_s , and the hazard of re-employment, h_u . The two simultaneously estimated functions are as follows:

$$\begin{aligned}
 h_s(t|x_t, v_s) &= \exp(\beta'_s x + \varphi_s Z'(t + \tau) + \alpha_1 UI_{120} + \alpha_2 UI_{60} + \alpha_3 UI_0 + \lambda_s(t) + v_s), \\
 h_u(t|t_s, t_e, x_t, v_u) &= \exp(\beta'_u x + \delta_1 D_1(t_s < t \leq t_e) + \delta_2 D_2(t_e < t) + \varphi_u Z'(t + \\
 &\quad \tau) + \alpha_1 UI_{120} + \alpha_2 UI_{60} + \alpha_3 UI_0 + \lambda_u(t) + v_u), \quad (1)
 \end{aligned}$$

where $\lambda(t)$ is the baseline hazard and x is a function of covariates. The duration of unemployment until the imposition of a sanction is denoted by t_s , and the duration until the expiration of a sanction is denoted by t_e . The time-varying indicators for *on-going* and *completed* sanctions are $D_1(t_s < t \leq t_e)$ and $D_2(t_e \leq t)$, respectively. Thus, parameters δ_1 and δ_2 are our primary interest because they measure the time-varying effects of sanctioning. Furthermore, the baseline hazard is specified as piecewise-constant, indicating that the baseline hazard is allowed to vary between different pre-specified survival time intervals. The changes in the labour market conditions are accounted for by 31 time-varying calendar time (year-quarter) dummies, $Z'(t + \tau)$, where t denotes the elapsed duration of unemployment and τ denotes the calendar time at the beginning of the unemployment spell. Similarly, benefit exhaustion is considered via three time-varying indicators, UI_{120} ($61 \leq r \leq 120$), UI_{60} ($0 < r \leq 60$) and UI_0 ($r = 0$), describing the remaining UI benefit days r at time t .

¹¹ The use of timing-of-events approach is supported by Gaure *et al.* (2007), who show that the estimates of the treatment effects are robust, even when there are large unobserved sorting problems involved.

In the timing-of-events model, the selection effect arises from the correlation between the heterogeneity terms. The unobserved heterogeneity terms, v_u and v_s , are assumed to follow a bivariate discrete distribution. The associated probabilities are denoted as follows:

$$\begin{aligned} p_1 &= \Pr(V_u = v_u^1 = 0, V_s = v_s^1 = 0), \\ p_2 &= \Pr(V_u = v_u^1, V_s = v_s^2), \\ p_3 &= \Pr(V_u = v_u^2, V_s = v_s^1), \\ p_4 &= \Pr(V_u = v_u^2, V_s = v_s^2), \end{aligned}$$

where $0 \leq p_i \leq 1$ for $i = 1, \dots, 4$ and $\sum_{i=1}^4 p_i = 1$. Multiple unemployment spells for the same individuals and the time-varying covariates enhance the identification of the MPH model in the sense that the identification is less dependent on the proportionality assumption (e.g., Gaure *et al.*, 2007; Brinch, 2007).

2.4 Data and descriptive evidence

The micro data that are used in this study are obtained from the Ministry of Employment and the Economy and include information on all persons registered with PES as jobseekers. An unemployment spell (measured in days) is defined as the time between a jobseeker's registration with PES and the jobseeker's finding or accepting a job offered by PES. We focus on and follow individuals who enter unemployment during the period from January 1, 2003, to December 31, 2009, and we determine whether these individuals leave unemployment by the time the observation period ends (December 2010)¹². The data include information on sanctions: the reason for sanctions and the starting and ending dates of each sanction. Different types of characteristics of unemployed jobseekers are also reflected in the data, such as, gender, age, education, occupation, unemployment fund membership, citizenship, native language and place of residence¹³. Regional unemployment rates are obtained from the Labour Force Survey of Statistics Finland.

We restrict the data as follows. First, we limit the analysis to unemployed individuals between 25 to 49 years of age because the eligibility criteria for individuals under 25 years of age are particularly strict, whereas those for individuals over 50 years of age are rather loose¹⁴. These age groups also differ

¹² The ending dates of unemployment periods have been verified with the employment records from the Finnish Centre for Pensions (ETK).

¹³ Åland, which is an autonomous island, is excluded from the data because of its exceptional labour market conditions.

¹⁴ Unemployed under 25 years of age without a professional education have a five month waiting period before receiving unemployment benefits. In addition, the sanction is always the exclusion of benefits for 150 days. Instead, aging unemployed who receive UI allowance are eligible for an extended unemployment allowance after the maximum 500 benefit days. The extended allowance is paid until they reach the age

in regards to their employment prospects; finding a job is often more difficult for young and elderly individuals due to the lack of experience and age discrimination. Second, temporarily laid-off and disabled individuals as well as persons who moved abroad are excluded from the data. Third, unemployment spells at the beginning of an ALMP measure are censored. Fourth, we omit individuals with sanctions that are imposed at the beginning of the unemployment period because the timing-of-events model cannot identify the selectivity involved. Fifth, long unemployment durations are censored from 30 months (2.5 years) onwards¹⁵.

From the registers of the Financial Supervisory Authority (FSA) and KELA, we are able to determine the type of the benefit received by each unemployed individual and the remaining benefit days at the beginning of an unemployment spell. This information is important for several reasons. First, the probability of finding a job is twice as high for those who receive a UI allowance than for those who receive a means-tested allowance (Lilja, 1993). Second, the job search intensity of unemployed individuals increases when the exhaustion date of the UI benefits approaches (e.g., Krueger and Mueller, 2010; Card *et al.*, 2007; Virjo *et al.*, 2006).

The resulting sample data consist of more than one million unemployment spells, of which approximately 31,000 spells (3.1%) included a sanction period¹⁶. The share of sanctions varied from 1.3% to 4.4% during the 2003–2009 period. Nearly 70% of the sanctions were imposed for 60 days, and 31% of the cases led to the exclusion of benefits for 90–150 days (Table 3). Less than 1% of the sanctions had a duration of 30 days. During the 2003–2009 period, the share of sanctions related to refusal of work decreased, and the share of sanctions related to refusing or dropping out of an ALMP measure increased.

Table 3 also includes the distribution of sanctions for UI and LMS recipients. During the observation period, LMS beneficiaries received sanctions more frequently than UI beneficiaries because most of the severe sanctions are imposed on the long-term unemployed (individuals who have exhausted their UI benefits and received LMS thereafter or who have been receiving LMS for more than 500 days)¹⁷. These individuals are monitored more closely, and ALMP measures are offered to them more frequently. Thus, with LMS, 41% of the cases lead to exclusion of benefits for 90 to 150 days, whereas the equivalent share with UI is only 3%.

limit for old-age pension. The old-age pension can be applied at the age of 62-65 years.

¹⁵ We merge unemployment spells in which the gap between two subsequent spells is smaller than two weeks.

¹⁶ The resulting sample consists of nearly 20% of all sanction cases during the 2003–2009 period. The share is low because of the restrictions imposed on the data: the exclusion of sanctions imposed at the beginning of the unemployment period (47%) and the exclusion of sanctions for those under 25 years old (25%) or over 50 years old (10%).

¹⁷ The most common reason for a sanction for an unemployed individual receiving UI is voluntary quitting, which is not considered in this analysis. For individuals receiving LMS, the most common reasons for sanctions are refusal of work and refusal to comply with an ALMP measure.

TABLE 3 Distribution of sanctions by incident, duration and allowance type

Incident	Sanction duration				Total
	30 days	60 days	90 days	150 days	
<i>Earnings-related (UI)</i>					
Refusal of work		3,223 (53.5%)			
Refusal of work, fewer than five days	133 (2.2%)				
Refusal of ALMP ^a		2,148 (35.6%)		117 (1.9%)	
Repeated refusal of work or ALMP			44 (0.7%)		
Neglect of job search plan		324 (5.4%)			
Repeated neglect of job search plan ^b		38 (0.6%)			
Total	133 (2.2%)	5,718 (95.1%)	44 (0.7%)	117 (1.9%)	6,027 (100%)
<i>Labour market support (LMS)</i>					
Refusal of work		4,130 (18.5%)			
Refusal of work, fewer than five days	80 (0.4%)				
Refusal of ALMP ^a		2,317 (29.8%)		8,367 (37.5%)	
Repeated refusal of work or ALMP			722 (3.2%)		
Neglect of job search plan		2,317 (10.4%)			
Repeated neglect of job search plan			68 (0.3%)		
Total	80 (0.4%)	13,104 (58.7%)	790 (3.5%)	8,367 (37.5%)	22,341 (100%)
<i>All unemployed individuals</i>	233 (0.8%)	21,231 (68.5%)	834 (3.3%)	8,484 (27.4%)	30,990 (100%)

Notes: ^a The sanction for long-term unemployed individuals (duration of more than 500 days) is the exclusion of benefits until 150 days of work, education or labour market policy measures are performed. ^b The sanction for UI recipients is 60 days.

The selected descriptive statistics for UI and LMS are presented in Table 4. These statistics are related to unemployment spells rather than to individuals. Moreover, the descriptive statistics for non-sanctioned individuals are practically identical to the statistics for the entire population in each sample because of the low number of sanctions. Overall, there appear to be more women and highly educated individuals receiving UI than receiving LMS. Furthermore, more immigrants and individuals aged 25–29 appear to be receiving LMS than UI.

TABLE 4 Selected descriptive statistics (means) for sanctioned and non-sanctioned unemployed individuals by allowance type

	Earnings-related allowance (UI)		Labour market support (LMS)	
	Sanction	No sanction	Sanction	No sanction
Mean duration of unemployment spell, days (s.d.)	316.6 (245.3)	139.7 (150.5)	276.7 (254.4)	142.2 (179.1)
Number of unemployment spells	6,027	369,797	22,341	521,972
Number of individuals	5,992	195,891	21,769	262,999
Outflow from unemployment to				
work	0.62	0.73	0.58	0.58
an ALMP measure	0.26	0.19	0.27	0.30
outside of the labour force	0.12	0.08	0.15	0.12
Women	0.57	0.65	0.42	0.57
Non-Finn	0.03	0.02	0.12	0.11
Swedish-speaking	0.02	0.02	0.01	0.02
Age				
25–29	0.20	0.18	0.23	0.25
30–34	0.19	0.20	0.19	0.18
35–39	0.17	0.16	0.15	0.15
40–44	0.21	0.21	0.20	0.19
45–49	0.19	0.21	0.19	0.18
Education				
Primary	0.28	0.20	0.48	0.34
Upper secondary level	0.53	0.49	0.41	0.44
Lowest-level tertiary	0.11	0.13	0.06	0.08
Higher-degree-level tertiary	0.08	0.18	0.05	0.13
Regional unemployment rate, % (s.d.)	8.6 (2.6)	9.2 (2.7)	8.2 (2.6)	8.8 (2.6)
UI benefit level, €/day	49.9 (11.9)	51.7(13.1)		
UI_0 (benefits lapsed) ^a	0.26	0.08		
UI_{60} (1–60 days until benefits lapse) ^a	0.32	0.13		
UI_{120} (61–120 days until benefits lapse) ^a	0.35	0.15		
Member of UI fund	1	1	0.14	0.40
Number of unemployment days 0–1 year ago				
0–49	0.49	0.44	0.41	0.46
50–99	0.03	0.03	0.02	0.03
100–149	0.02	0.02	0.01	0.02
150–199	0.01	0.01	0.01	0.01
200–249	0.01	0.01	0.01	0.01
250–299	0.00	0.00	0.00	0.00
300–365	0.00	0.00	0.00	0.00
Number of unemployment days 1–2 years ago				
0–49	0.02	0.03	0.01	0.02
50–99	0.02	0.03	0.01	0.02
100–149	0.02	0.02	0.01	0.02
150–199	0.02	0.02	0.01	0.02
200–249	0.01	0.01	0.01	0.01
250–299	0.01	0.01	0.01	0.01
300–365	0.03	0.02	0.04	0.03

Notes: The statistics are related to unemployment spells.^a Measured as time-invariant.

There are approximately 370,000 and 522,000 unemployment spells for UI and LMS recipients, respectively (Table 4). The exit to work is higher with UI (73%) than with LMS (58%). With respect to both types of benefits, more exits from the labour force (12% to 15%) occurred when sanctions were imposed. In addition, sanctioned individuals receiving UI participated in ALMPs (26%) more often than non-sanctioned individuals (19%), whereas the opposite applies for LMS. There are fewer women among the group of sanctioned unemployed individuals than among non-sanctioned unemployed individuals, regardless of the benefits received. Similarly, highly educated individuals are sanctioned less frequently than those with lower levels of education.

Many of the unemployed individuals had several periods of unemployment during the observation period. The unemployment history is summarised by the number of unemployment days accumulated within a year and within one to two years prior to the current unemployment period. Most of the sanctioned individuals had relatively little unemployment history (0–49 days) before receiving a sanction, which suggests that there may be some unawareness of the sanction rules. This finding is particularly applicable to the UI allowance (49%). Moreover, UI benefit exhaustion appears to have occurred (during the current unemployment period) more often with sanctioned individuals (26%) than with non-sanctioned individuals (8%). Among the LMS recipients, some individuals (40%) exhausted their UI benefits prior to the current unemployment period (*members of a UI fund*), and relatively few of these individuals received a sanction (14%).

Graphical evidence of the effect of sanctions

Figures 1a and 1b depict the weekly exit rate from unemployment to work for LMS and UI recipients, respectively, who received a sanction during or before the week in question (*sanctioned*) and for recipients who did not receive a sanction by that week but may subsequently receive a sanction (*non-sanctioned*). From the fourth week onwards, the LMS hazard of sanctioned individuals is above the LMS hazard of non-sanctioned individuals, indicating that sanctions increase the re-employment rate (Figure 1a). On average, the job-finding rate of sanctioned individuals is nearly 80% higher than that of non-sanctioned individuals. In contrast, the effect of sanctions on the re-employment rate of UI benefit receivers appears to be much smaller, 26% on average (Figure 1b).

Figure 2 presents the empirical sanction hazard by allowance type. The probability of receiving a sanction is approximately 0.1% for UI receivers for the first 10 months (40 weeks), but the sanction rate subsequently begins to increase as the elapsed duration of unemployment increases. After two years (100 weeks) of unemployment, there is a peak in the sanction rate, most likely resulting from the exhaustion of benefits. For LMS receivers, the sanction rate is higher for the first four months (16 weeks) and decreases thereafter to a steady level of 0.3%. Both ends of the figures contain significant variation because of the small number of sanctions for long durations of unemployment.

These figures suggest that sanctions have positive effects on the re-employment rate of unemployed individuals but that this effect is larger for LMS recipients than for UI recipients. Nonetheless, the empirical hazards do not account for differences in observed and unobserved characteristics, which are important. These issues are covered in the following section.

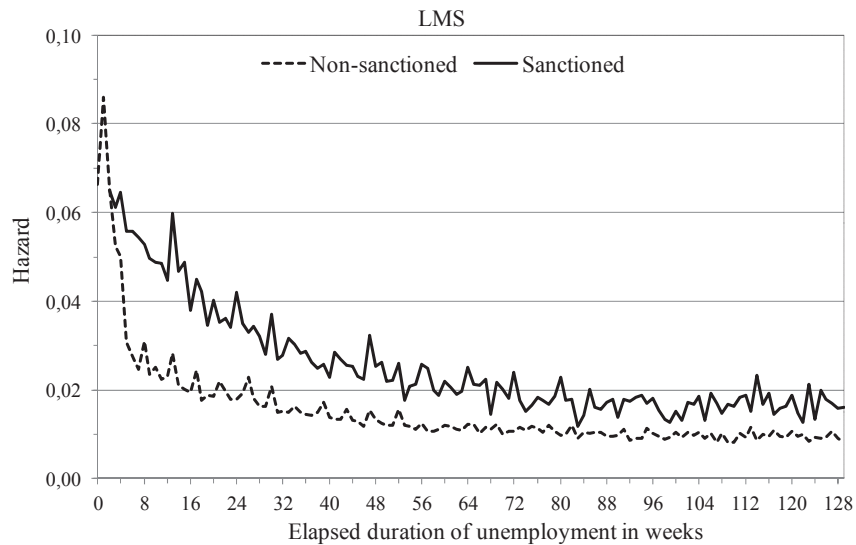


FIGURE 1a Empirical exit rates to work for sanctioned and non-sanctioned LMS recipients

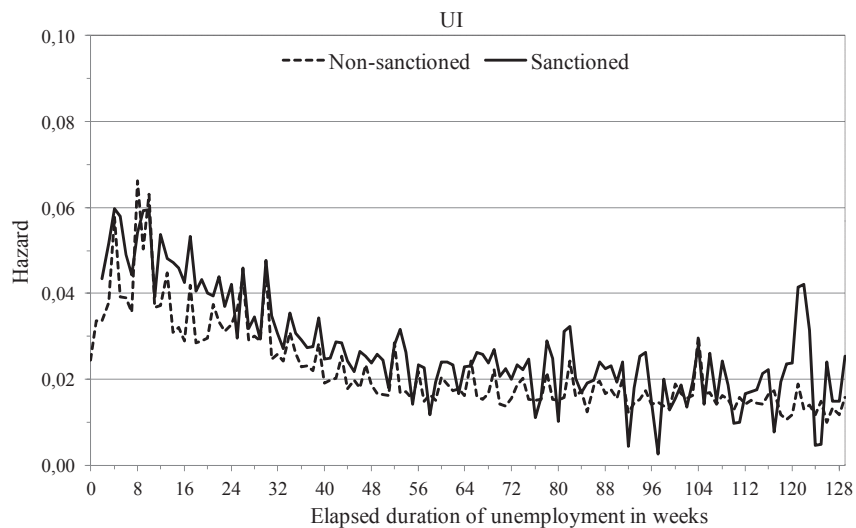


FIGURE 1b Empirical exit rates to work for sanctioned and non-sanctioned UI recipients

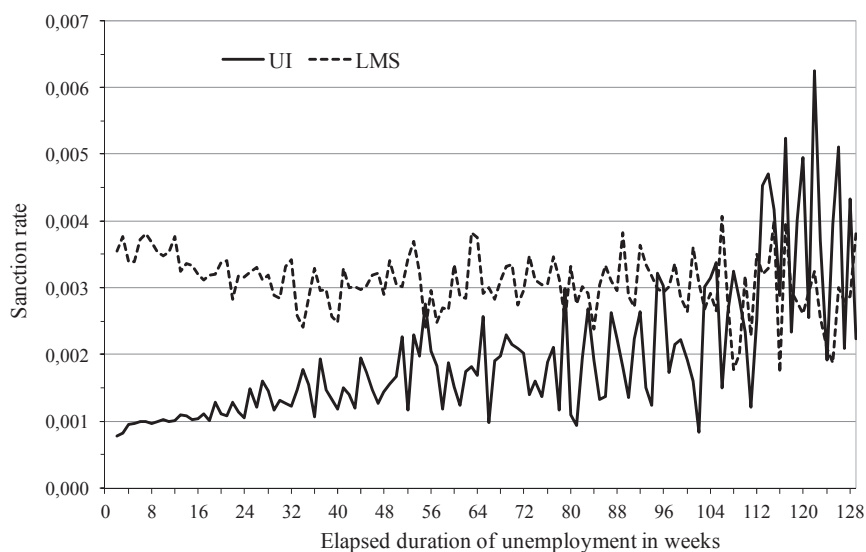


FIGURE 2 Empirical sanction rate for UI and LMS recipients

2.5 The effects of sanctions on UI and LMS recipients

This section analyses whether the imposition of a sanction increases the exit rate from unemployment to work among UI and LMS recipients¹⁸. Both models include the same set of explanatory variables, except that for UI, there are also three time-varying indicators for the remaining benefit days, whereas for LMS, there is a variable (*member of UI fund*) describing whether UI was exhausted at some point during previous unemployment spells¹⁹. All exits from unemployment to states other than employment are treated as censored observations. Subsequently, we also analyse the effect of a sanction for various labour market outcomes: exit from unemployment to an ALMP measure and outside of the labour force.

¹⁸ We model the time elapsed until the first sanction was imposed during each unemployment period (for similar approaches, see, e.g., Van den Berg *et al.* 2004, Abbring *et al.* 2005, Lalive *et al.* 2005 and Svarer 2011).

¹⁹ Imposition of a sanction may also depend on the characteristics of the employment agency (e.g., Boockmann *et al.*, 2009). Estimating a model with 138 unemployment agency dummies did not affect the results. The sanction estimates for LMS (UI) recipients was 0.60 (0.11) for an on-going sanction and 0.27 (-0.08) for a completed sanction. Agency dummies are discarded because the estimation process was computationally demanding and because the results did not change significantly.

2.5.1 Exit rate from unemployment to work

Table 5 presents the estimation results for the timing-of-events model by allowance type²⁰. The results suggest that unemployed individuals receiving LMS are more responsive to sanctions than UI benefit recipients. When a sanction is imposed, the incentive to find a job increases by 80% ($100 * (\exp(0.59) - 1) = 80$) for unemployed individuals receiving LMS. For individuals collecting UI benefits, the job-finding rate increases by 13%. Completed sanctions also increase the re-employment rate by 32% with LMS but have no significant effect on UI. The results are surprising because we expected a larger increase in re-employment for individuals receiving UI than for those receiving LMS because of the larger decrease in benefit level. One possibility is that because UI receivers already exhibit high search intensity levels, receiving a sanction does not (significantly) increase their search intensity, whereas the reverse applies to those receiving LMS. It is also possible that the low number of UI benefit sanctions influences the results. For both benefits, we also estimate a basic model without correlated heterogeneity. The results imply that neglecting the relation between heterogeneity terms leads to overestimating the effect of a sanction, although the bias is relatively small²¹.

²⁰ We also attempt to estimate a model with more than two mass points; the results show that the associated probabilities converged to zero and that the log-likelihoods did not significantly improve.

²¹ The estimates for the basic LMS (UI) model were 0.64 (0.19) and 0.34 (0.01) for ongoing and completed sanctions, respectively. The full results are available from the author.

TABLE 5 Results for the timing-of-events model by allowance type

	Earnings-related (UI)		Labour market support (LMS)	
	I Sanction rate Coeff. (s. e.)	II Exit rate Coeff. (s. e.)	III Sanction rate Coeff. (s. e.)	IV Exit rate Coeff. (s. e.)
Sanction				
On-going		0.12*** (0.03)		0.59*** (0.01)
Completed		-0.04* (0.03)		0.28*** (0.02)
Women	-0.10*** (0.04)	0.16*** (0.01)	-0.15*** (0.02)	0.16*** (0.01)
Non-Finn	0.39*** (0.07)	-0.22*** (0.02)	-0.07*** (0.02)	-0.46*** (0.01)
Swedish-speaking	-0.06 (0.10)	0.08*** (0.02)	-0.16*** (0.02)	0.10*** (0.02)
Age				
30-34	-0.10*** (0.04)	-0.10*** (0.01)	0.01 (0.02)	-0.16*** (0.01)
35-39	-0.09** (0.04)	-0.13*** (0.01)	-0.02 (0.02)	-0.26*** (0.01)
40-44	-0.22*** (0.04)	-0.14*** (0.01)	-0.08*** (0.02)	-0.32*** (0.01)
45-49	-0.39*** (0.04)	-0.16*** (0.01)	-0.14*** (0.02)	-0.36*** (0.01)
Education				
Upper secondary level	-0.09*** (0.03)	0.10*** (0.01)	-0.12*** (0.02)	0.10*** (0.01)
Lowest-level tertiary	-0.19*** (0.05)	0.10*** (0.01)	-0.11*** (0.03)	0.20*** (0.01)
Higher-degree-level tertiary	-0.65*** (0.06)	0.26*** (0.01)	-0.62*** (0.03)	0.33*** (0.01)
Regional unemployment rate	-0.03** (0.02)	-0.02*** (0.00)	-0.04*** (0.01)	0.01*** (0.00)
Log(UI benefit level)	-0.34*** (0.06)	0.22*** (0.01)		
UI_0	0.07** (0.04)	0.09*** (0.01)		
UI_{60}	-1.11*** (0.10)	0.23*** (0.01)		
UI_{120}	-1.63*** (0.11)	0.15*** (0.01)		
Member of UI fund			-0.50*** (0.02)	1.23*** (0.00)
Number of unemployment days, 0-1 year ago				
0-49	0.20*** (0.04)	-0.19*** (0.01)	-0.05*** (0.02)	0.04*** (0.01)
50-99	0.08 (0.09)	0.09*** (0.01)	-0.15*** (0.05)	0.13*** (0.01)
100-149	0.09 (0.11)	-0.04*** (0.02)	-0.15*** (0.06)	0.03* (0.02)

(continued)

TABLE 5 (continued)

	Earnings-related (UI)		Labour market support (LMS)	
	II Exit rate Coeff. (s. e.)	III Sanction rate Coeff. (s. e.)	II Exit rate Coeff. (s. e.)	III Sanction rate Coeff. (s. e.)
150-199	-0.02 (0.13)	-0.14*** (0.02)	-0.02 (0.06)	-0.09*** (0.02)
200-249	0.23* (0.16)	-0.20*** (0.03)	0.10* (0.08)	-0.16*** (0.03)
250-299	0.42** (0.21)	-0.26*** (0.05)	-0.07 (0.12)	-0.17*** (0.05)
Number of unemployment days, 1-2 years ago				
0-49	-0.18** (0.10)	0.07*** (0.01)	-0.15*** (0.06)	0.19*** (0.01)
50-99	-0.01 (0.09)	0.09*** (0.01)	-0.11** (0.06)	0.20*** (0.01)
100-149	0.07 (0.10)	0.07*** (0.01)	-0.20*** (0.06)	0.14*** (0.02)
150-199	-0.08 (0.11)	-0.03** (0.02)	-0.20*** (0.06)	0.04*** (0.02)
200-249	-0.04 (0.12)	-0.06*** (0.02)	-0.10** (0.06)	-0.01 (0.02)
250-299	0.17* (0.12)	-0.07*** (0.02)	-0.09* (0.07)	-0.04** (0.02)
Occupation dummies	yes	yes	yes	yes
Place of residence (TE-centre) dummies	yes	yes	yes	yes
Calendar time dummies	yes	yes	yes	yes
v_s	-0.87 (2.39)		-0.71*** (0.24)	
v_u		-1.30*** (0.00)		-1.67*** (0.00)
p_1		0.47 (0.78)		0.49*** (0.15)
p_2		0.27 (0.94)		0.26** (0.17)
p_3		0.05 (0.78)		0.05 (0.15)
p_4		0.22 (0.94)		0.20** (0.17)
$\rho(v_u, v_s)$		0.40		0.45
Log likelihood		-1,735,135		-2,038,455
Number of individuals		198,341		266,209

Notes: To conserve space, estimates for the baseline hazard are not presented. The reference groups are as follows: 25-29 years old (age), primary level (education), 300-365 (number of unemployment days, 0-1 year ago), 300-365 (number of unemployment days, 1-2 years ago), unclassified (occupation), Uusimaa (place of residence) and 2005q1 (calendar time). The correlation between the heterogeneity terms is denoted as $\rho(v_u, v_s)$. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

The estimation results in columns I and III indicate that with respect to both types of benefits, the probability of receiving a sanction is lower for women and for Swedish-speaking citizens. The sanction rate also decreases when educational level or age increases. Unlike with LMS, immigrants receiving UI are more likely to be sanctioned (48%) than natives. In addition, the probability of receiving a sanction rises once UI benefits are exhausted, perhaps because of the increased offering of ALMPs after UI benefits are exhausted.

In the timing-of-events model, multiple unemployment spells experienced by the same individual are exploited to enhance the quality of the estimation results. Because individual-level heterogeneity can be a strong assumption, we also estimate a model for which the unobserved heterogeneity was considered at spell level. In this case, the LMS (UI) estimate for an on-going sanction was 0.59 (0.10), and the estimate for a completed sanction was 0.28 (-0.06); thus, the results are robust (the full results are available from the author).

The effect of a sanction across the population

Studies by Svarer (2011) and Van den Berg *et al.* (2004) demonstrate that reactions to sanctions differ among various unemployment groups. To examine this possibility, we allow sanction dummies to interact with some of the explanatory variables. The results are shown in Table 6. We also include indicators for the sanction type (duration) in the interaction model²².

With both types of benefits, women are less responsive to sanctions than men. According to Hasenfeld *et al.* (2004), sanctions have no incentive effects if there are personal barriers, such as a lack of work experience and child care demands. Previous studies also indicate that having children decreases the exit rate from unemployment to work for married parents and even more so for single parents (Van den Berg *et al.*, 2004). Having young children has also been observed to prolong the unemployment duration of Finnish women (see, e.g., Ollikainen, 2003; Gonzalo and Saarela, 2000). Unfortunately, information on family-related background characteristics was not available. Similarly, unemployed individuals with higher levels of education react to on-going sanctions less than their counterparts, but the reverse is true after a sanction is completed. One explanation is that there is a time lag between the moment when an unemployed individual increases his job search effort and the moment when his re-employment rate increases (Van den Berg *et al.* 2004). Thus, highly educated unemployed individuals may actually be more responsive to sanctions than those with lower education levels because of this delay.

²² The reference group includes sanctions of 30–60 days. The other category for sanctions is the exclusion of benefits until 90–150 days of work, education or ALMP programmes have been completed by the jobseeker.

TABLE 6 Results for the exit rate from unemployment to work with interaction effects

Interactions	Earnings-related (UI) Sanction		Labour market support (LMS) Sanction	
	On-going Coeff. (s. e.)	Completed Coeff. (s. e.)	On-going Coeff. (s. e.)	Completed Coeff. (s. e.)
Intercept	0.13** (0.08)	-0.02 (0.08)	0.69*** (0.03)	0.39*** (0.04)
Women	-0.11** (0.06)	-0.03 (0.06)	-0.36*** (0.02)	-0.26*** (0.04)
Non-Finn	-0.02 (0.18)	0.04 (0.15)	0.19*** (0.05)	0.39*** (0.06)
Swedish-speaking	0.00 (0.21)	0.02 (0.21)	0.04 (0.11)	-0.02 (0.16)
Age				
30-34	0.05 (0.08)	0.06 (0.08)	0.13*** (0.04)	0.08* (0.05)
35-39	0.01 (0.08)	-0.04 (0.08)	0.08** (0.04)	0.01 (0.05)
40-44	-0.01 (0.08)	-0.02 (0.08)	0.12*** (0.04)	-0.06 (0.05)
45-49	-0.02 (0.09)	-0.05 (0.08)	0.02 (0.04)	-0.10** (0.06)
Education				
Upper secondary level	0.08 (0.06)	-0.07 (0.06)	-0.16*** (0.03)	-0.07** (0.04)
Lowest-level tertiary	-0.04 (0.10)	0.07 (0.10)	-0.22*** (0.06)	-0.11* (0.08)
Higher-degree-level tertiary	0.00 (0.11)	0.04 (0.11)	-0.26*** (0.06)	0.07 (0.08)
Sanction type				
90-150 days	0.08 (0.18)	†	0.12*** (0.03)	
Log likelihood		-1,735,436		-2,038,489
Number of individuals		198,341		266,209

Notes: The full set of results is available from the author. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively. †It is not possible to complete a sanction without studying, working or participating in an ALMP measure.

One distinctive difference between the two allowance types is the sanction effect for immigrants. Immigrants receiving LMS are more responsive to sanctions, both on-going (23%) and completed (52%), than natives. The same coefficient for the UI allowance is close to zero and is statistically insignificant. This result is interesting because immigrants were expected to have longer unemployment durations than Finns regardless of the benefit received (see Table 5). It is possible that immigrants become less selective in their job seeking once they are sanctioned. Immigrants who have limited language skills and who have acquired competence abroad that is not recognised may be willing to accept jobs with low requirements (e.g., cleaning services). Furthermore, immigrants may be unaware of the sanction rules and would thus increase their

job search efforts after expiration of a sanction because of the closer monitoring and counselling provided by the PES (Hasenfeld *et al.* 2004; Van den Berg *et al.* 2004). Such a situation is especially applicable if the duration of residence in the country has been relatively short.

The strictness of a sanction

The empirical evidence relating to the severity of sanctions is scarce and inconclusive. Svarer (2011) reports that tougher sanctions (three weeks) have greater effects on the re-employment rate than milder sanctions (two to three days). Van den Berg *et al.* (2004) find that the strictness of a sanction is not important because the effects are fairly similar regardless of the magnitude of the benefit reduction (5%, 10% or 20%). In this paper, the strictness is measured by the duration of a sanction because all sanctions entail a 100% reduction in benefits.

Table 7 depicts results for different types of sanctions. We estimate two separate models for each allowance and observe the interaction of the sanction type indicator (30–60 days or 90–150 days) with the time-varying sanction dummies (on-going and completed)²³. We combine the 30-day and 60-day sanctions into one category because of the small number of observations for the 30-day sanction. The other category for sanctions is the exclusion of benefits until 90–150 days of work, education or ALMPs have been completed by the jobseeker. In this category, we estimate the effect of an on-going sanction because it is not possible to complete a sanction and receive benefits again without studying, working or participating in an ALMP programme. Most of the severe sanctions (90–150 days) in the data are imposed on the long-term unemployed (that is, unemployed individuals who have exhausted their UI benefits and received LMS thereafter or individuals who have been receiving LMS for more than 500 days). These individuals are monitored more closely, and ALMPs are offered to them more frequently. Thus, it is important to investigate whether short (30–60 days) and long (90–150 days) sanctions have similar effects for the two types of benefits considered.

According to the results, the strictness of a sanction is more marked for unemployed individuals receiving LMS. Longer sanctions increase the re-employment rate by 92%, and shorter sanctions increase the re-employment rate by 58% (Table 8). In contrast, with UI benefits, the effect of longer sanctions on re-employment (11%) is not statistically significant, most likely because of the low number of observations (see Table 4). The estimation results for brief sanctions (12%) are the same as in Table 6. Thus, for UI benefits, the sanction effect is primarily driven by the 30- to 60-day sanctions.

²³ The sanction rate is common to both sanction types because there were too few observations for the long sanctions to estimate a separate sanction rate.

TABLE 7 Results for the exit rate from unemployment to work and the effects of sanction by type

	Earnings-related (UI)		Labour market support (LMS)	
	Sanction type		Sanction type	
	30-60 days	90-150 days	30-60 days	90-150 days
	Coeff. (s. e.)	Coeff. (s. e.)	Coeff. (s. e.)	Coeff. (s. e.)
Sanction				
On-going	0.11*** (0.03)	0.10 (0.18)	0.46*** (0.02)	0.65*** (0.02)
Completed	-0.04* (0.03)	†	0.24*** (0.02)	†
Log likelihood	-1,735,427	-1,735,395	-2,039,598	-2,039,503
Number of individuals	198,341	198,341	266,209	266,209

Notes: The full set of results is available from the author. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively. †It is not possible to complete a sanction without studying, working or participating in an ALMP measure.

The effect of a sanction over time

The empirical evidence for the time-varying effects of sanctions is inconclusive. Svarer (2011) finds that the effect is strong and positive during the first two months but diminishes three months after the imposition of a sanction. Similarly, Røed and Westlie (2012) note that the effect is relatively short-lived because once the sanction is completed, the hazard of re-employment is at its previous pre-sanction level. In contrast, Van den Berg *et al.* (2004) find that most of the increase in the job-finding rate occurs after sanction expiration. Furthermore, Müller and Steiner (2008) and Van den Berg and Vikström (2009) provide supporting evidence of the long-term effects of benefit sanctions.

Next, we examine how soon the effect diminishes after the expiration of a sanction and whether the effect varies during a sanction. We estimate a model in which the effect of a sanction can change one, two, three, four and five months after the imposition of a sanction and one, two and three months after the completion of sanctioning. Because the duration of a sanction is observed to be important (Table 7), we estimate the model for 30- to 60-day sanctions and for 90- to 150-day sanctions separately for LMS. For UI receivers, we analyse only the time-varying effects for short sanctions. As in Table 7, the sanction type indicators are allowed to interact with the time-varying sanction dummies (five for on-going sanctions and three for completed sanctions).

For LMS recipients, a sanction has a large and positive effect on the job-finding rate both during and after a sanction period (Table 8). For sanctions from 30 to 60 days, the effect is greatest (60%) two months after imposition and begins to diminish three months after the expiration date. With sanctions from 90 to 150 days, the effect is greatest (169%) three months after imposition but remains positive throughout the sanction period. In contrast, for UI recipients, the sanction effect is short-lived because the re-employment rate becomes negative as soon as the sanction is completed.

There are several explanations for these results. First, some time may be needed before the adjusted job search intensity of an unemployed individual becomes effective (e.g., because of the recruiting process). Second, closer monitoring of a sanctioned unemployed individual and the individual's willingness to prevent future sanctions may affect the results.

TABLE 8 Results for the exit rate from unemployment to work and the effects of sanctions over time

Sanction effects over time	Earnings-related (UI)	Labour market support (LMS)	
	30-60 days	30-60 days	90-150 days
	Coeff. (s. e.)	Coeff. (s. e.)	Coeff. (s. e.)
On-going, time after imposition in days			
1-30	0.21*** (0.04)	0.35*** (0.02)	0.58*** (0.03)
31-60	0.00 (0.05)	0.47*** (0.03)	0.34*** (0.04)
61-90			0.99*** (0.04)
91-120			0.44*** (0.05)
121-			0.62*** (0.02)
Completed, time after expiration in days			
1-30	0.02 (0.05)	0.37*** (0.04)	†
31-60	-0.24*** (0.07)	0.46*** (0.04)	†
61-	-0.07** (0.04)	0.10*** (0.02)	†
Log-likelihood	-1,672,415	-1,983,840	-1,983,472
Number of individuals	198,341	266,209	266,209

Notes: The full set of results is available from the author. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively. †It is not possible to complete a sanction without studying, working or participating in an ALMP measure.

2.5.2 Exit rate from unemployment to various labour market outcomes

The recent work of Røed and Westlie (2012) reports that sanctions increase not only the exit rate from unemployment to work (80%) but also the exit to education (200%) and to an ALMP programme (22%). To the best of our knowledge, Røed and Westlie are the only researchers examining the effect of a sanction for different labour market transitions. The authors also find that the hazard spikes encountered at the time of UI benefit exhaustion partly result from exits from the labour force, primarily to obtain education and other benefits (SA).

We estimate separate models for various labour market outcomes to determine whether there are differences between UI and LMS recipients. Three separate outcomes are considered: exit from unemployment i) to work, ii) to an ALMP and iii) to outside of the labour force. It should be noted that the results for the exit to work are the same as in Table 5. The results concerning ALMP are of interest because unemployed individuals can receive benefits from the time

that they enter an ALMP programme even after receiving a sanction, which should encourage unemployed individuals to participate in these measures.

According to the results, the probability of participating in an ALMP after receiving a sanction increases by 11% for LMS recipients but has no effect on UI recipients (Table 9). Expired sanctions have no effect on the rate of transition to ALMPs. With both benefit types, sanctions encourage unemployed individuals to leave the labour force, but with UI recipients, the incentive is especially strong (67%)²⁴. Interestingly, unlike the results relating to exit to work, the probability of participating in an ALMP or exiting the labour force is much larger for women and immigrants than for men and natives receiving UI benefits (these results are not shown in Table 9 but are available from the author). This finding suggests that these groups of people, especially immigrants, may be less employable than others and that they need ALMPs to enhance their employment opportunities. In addition, family-related reasons may influence the decisions of women to leave the labour force. Previous studies show that having children decreases the exit rate from unemployment to work for married parents and even more so for single parents (Van den Berg *et al.*, 2004; Ollikainen, 2003). In Finland, it has also been argued that the 500-day entitlement period for UI benefits makes unemployed individuals passive and that the benefits are sometimes used for purposes other than active job searching, e.g., to support child care at home (Virjo *et al.*, 2006). Some individuals may also collect unemployment benefits while they wait for a planned education programme or job to begin. In these cases, individuals may simply move outside of the labour force and apply for other benefits (SA) when they receive a sanction.

TABLE 9 Results for various labour market outcomes

Labour market outcome	Earnings-related (UI) Sanction		Labour market support (LMS) Sanction	
	On-going Coeff. (s. e.)	Completed Coeff. (s. e.)	On-going Coeff. (s. e.)	Completed Coeff. (s. e.)
Work	0.12*** (0.03)	-0.04 (0.03)	0.59*** (0.01)	0.28*** (0.02)
ALMP	0.00 (0.05)	0.01 (0.04)	0.10*** (0.02)	0.04 (0.02)
Outside labour force	0.51*** (0.07)	-0.04 (0.07)	0.35*** (0.03)	0.12*** (0.04)

Notes: The full set of results is available from the author. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

²⁴ The results should be interpreted with caution because of the low number of observations for the exit to outside of the labour force (see Table 4).

2.6 Conclusions

This study investigated benefit sanctions and their effect on the exit rate from unemployment to work in Finland. The effect of a sanction on the exit rate was analysed using a timing-of-events model that allowed us to separate the selection and causal effects of sanctioning. We used novel register data, including information on the unemployed at PES during the 2003–2009 period. The data include not only members of unemployment insurance funds but also other unemployed individuals and their benefits, which is uncommon in the literature. Thus, we analysed the effect of sanctions separately for earnings-related allowance (UI) and flat-rate labour market support (LMS) recipients. We also estimated a separate model for various labour market outcomes.

According to the results, LMS recipients react to sanctions more strongly than UI recipients do. An on-going sanction increases the job-finding rate of UI recipients by 13% and that of LMS recipients by 80%. A completed sanction also increases the re-employment rate of LMS recipients (32%) but has no effect on UI recipients. The results are consistent with the findings of previous studies in that the effect of a sanction is much greater for LMS (SA) recipients than for UI recipients²⁵. However, relating the results to the previous literature is difficult because of the scarcity of existing evidence on this matter.

A sensitivity analysis revealed that the strictness of a sanction is more important for unemployed individuals receiving LMS than for unemployed individuals receiving UI, most likely because LMS recipients are the individuals who typically receive more severe sanctions. Moreover, a distinct difference between the two benefit groups is that immigrants are more responsive to sanctions than are natives when receiving LMS rather than UI. Immigrants may be unaware of the sanction rules and may thus increase their job search efforts after receiving a sanction because of the closer monitoring and counselling provided by the PES. The difference may also be observed because some immigrants who receive LMS have been in the Finnish labour market for only a short period (because of their brief period of residence in the country).

In this paper, we also estimated the effect of sanctions on the exit rate from unemployment to an ALMP programme and outside of the labour force. The probability of participating in an ALMP after receiving a sanction increases by 11% for LMS recipients but has no effect on UI recipients. We also found that UI recipients who receive sanctions are more than four times more likely to exit the labour force (67%) than to return to work (13%). Moreover, unlike exiting unemployment to work, the probability of participating in an ALMP or leaving the labour force is much larger for women and immigrants than for men and

²⁵ Abbring *et al.* (2005) report that the effect of sanctions is 58%–67% for Dutch men and women collecting UI benefits, whereas Van den Berg *et al.* (2004) find that sanctions increase the exit rate from social assistance to work by 148%. To our knowledge, the study by Van den Berg *et al.* (2004) is the only study related to sanctions other than UI benefit sanctions.

natives receiving UI benefits. These groups of people may need ALMPs to promote their employment opportunities. Moreover, for women, family-related reasons could influence the decision to leave the labour force.

Overall, the two benefit groups analysed differ substantially. The results may reflect that LMS recipients are more dependent on unemployment benefits than UI recipients are. Half of the LMS recipients also receive other forms of SA, whereas only 10% of UI recipients receive such assistance (Virjo *et al.*, 2006). Family-related characteristics may also be a factor because the LMS is means-tested, whereas the UI benefit is not. Previous studies report that sanctioned individuals often accept jobs with lower earnings and shorter durations than non-sanctioned individuals do (e.g., Van den Berg and Vikström, 2009; Arni *et al.*, 2012). Finnish unemployed individuals have been found to accept jobs that do not increase (and may even reduce) their household disposable income (Kyyrä, 1999). Thus, the effect of sanctions on the quality of subsequent jobs should be examined in the future.

References

- Abbring, J. and Van den Berg, G. (2003). The nonparametric identification of treatment effects in duration models. *Econometrica* 71, 1491-1517.
- Abbring, J., Van den Berg, G. and Van Ours, J. (2005). The effect of unemployment insurance sanctions on the transition rate from unemployment to employment. *The Economic Journal* 115, 602-630.
- Arni, P., Lalive, R. and Van Ours, J. (2012). How effective are unemployment benefit sanctions? Looking beyond unemployment exit. Forthcoming in *Journal of Applied Econometrics*.
- Boockmann, B., Thomsen, S.L. and Walter, T. (2009). Intensifying the use of benefit sanctions: An effective tool to shorten welfare receipt and speed up transitions to employment? IZA Discussion Papers No. 4580, Bonn.
- Boone, J., Sadrieh, A. and van Ours, J. (2009). Experiments on unemployment benefit sanctions and job search behaviour. *European Economic Review* 53, 937-951.
- Boone, J. and Van Ours, J. (2006). Modeling financial incentives to get the unemployed back to work. *Journal of Institutional and Theoretical Economics* 162, 227-252.
- Brinch, C.N. (2007). Nonparametric identification of the mixed hazards model with time-varying covariates. *Econometric Theory* 23, 349-354.
- Card, D., Chetty, R. and Weber, A. (2007). The spike at benefit exhaustion: leaving unemployment system or starting a new job? *The American Economic Review* 97, 113-118.
- Gaure, S., Røed, K. and Zhang, T. (2007). Time and causality: A Monte Carlo assessment of the timing-of-events approach. *Journal of Econometrics* 141, 1159-1195.

- Gonzalo, M.R. and Saarela, J. (2000). Gender differences in exit rates from unemployment: Evidence from a local Finnish labour market. *Finnish Economic Papers* 13, 129-139.
- Ham, J. and Rea, S. (1987). Unemployment insurance and male unemployment duration in Canada. *Journal of Labor Economics* 5, 325-353.
- Hasenfeld, Y., Ghose, T. and Larson, K. (2004). The logic of sanctioning welfare recipients: an empirical assessment. *Social Service Review* 78, 304-319.
- Krueger, A. and Mueller, A. (2010). Job search and unemployment insurance: new evidence from time use data. *Journal of Public Economics* 94, 298-307.
- Kyyrä, T. (1999). Post-unemployment wages and economic incentives to exit from unemployment. VATT-Research Reports 56, Helsinki.
- Lalive, R., Zweimüller, J. and van Ours, J. (2005). The effect of benefit sanctions on the duration of unemployment. *Journal of the European Association* 3, 1386-1417.
- Lilja, R. (1993). Unemployment benefit system and unemployment duration in Finland. *Finnish Economic Papers* 6, 25-37.
- Meyer, B. (1990). Unemployment insurance and unemployment spells. *Econometrica* 58, 757-782.
- Moffitt, R. and Nicholson, W. (1982). The effect of unemployment insurance on unemployment: the case of federal supplement benefits. *The Review of Economics and Statistics* 64, 1-11.
- Mortensen, D. (1977). Unemployment insurance and job search decisions. *Industrial and Labor Relations Review* 30, 505-517.
- Müller, K.-U. and Steiner, V. (2008). Imposed benefit sanctions and the unemployment-to-employment transition: the German experience. IZA Discussion Papers No. 3483, Bonn.
- Ollikainen, V. (2003). The determinants of unemployment duration by gender in Finland. VATT Discussion Papers No. 316, Helsinki.
- Røed, K. and Westlie, L. (2012). Unemployment insurance in welfare states: the impacts of soft duration constraints. *Journal of the European Economic Association* 10, 518-554.
- Rosholm, M. and Svarer, M. (2008). The threat effect of active labour market programmes. *Scandinavian Journal of Economics* 110, 385-401.
- Svarer, M. (2011). The effect of sanctions on exit from unemployment: evidence from Denmark. *Economica* 78, 751-778.
- Van den Berg, G. (2001). Duration models: specification, identification and multiple durations. In Heckman, J. and Leamer, E. (eds.), *Handbook of Econometrics*, Vol. 5, Amsterdam: Elsevier.
- Van den Berg, G., van der Klaauw, B. and van Ours, J. (2004). Punitive sanctions and the transition rate from welfare to work. *Journal of Labor Economics* 22, 211-241.
- Van den Berg, G. and Vikström, J. (2009). Monitoring job offer decisions, punishments, exit to work, and job quality. IZA Discussion Papers No. 4325, Bonn.

Virjo, I., Aho, S. and Koponen, H. (2006). Passivoiko työttömyysturva? (in Finnish). *Studies in Labour Policy* 303, Ministry of Employment and the Economy, Helsinki.

CHAPTER 3

INTERNET-BASED EMPLOYER SEARCH AND VACANCY DURATION: EVIDENCE FROM FINLAND*

ABSTRACT. This study investigates the effect of the introduction of the public employment agency's Internet-based service on the duration of employer search. The analysis exploits the introduction of a web-based service by the Finnish Employment Agency in October 2002. The results, based on information on job vacancies announced via the public employment agency between 2002 and 2003, indicate that the introduction of the web service, in general, shortened the duration of employer search. However, we find that the introduction of the web-based service shortened the average duration of vacancies in some regions but not in others. In addition, employers in urban areas were more likely to benefit from the introduction of the online service.

Keywords: employer search, vacancy duration, internet, regional labour markets

JEL classification: C41, J63

* The author would like to thank Jaakko Pehkonen and anonymous referees for helpful suggestions. Financial support from the Yrjö Jahnesson Foundation (no. 6094) is gratefully acknowledged. The author also thanks Heikki Räisänen and the Ministry of Employment and the Economy Finland for kindly supplying the data used in this study. The usual disclaimer applies. The author is grateful for the hospitality enjoyed at the Government Institute for Economic Research (VATT). This paper has been published as "Nivalainen, H. (2014). Internet-based employer search and vacancy duration: evidence from Finland, *Labour* 28 (1), 112-140".

3.1 Introduction

A large body of research has used search theory to examine the duration of unemployment (e.g., Mortensen, 1986; Addison and Portugal, 2003; Fougere *et al.*, 2009). In contrast, employer search is a relatively neglected area of research in labour economics. Few studies have examined the duration of employer search (Barron *et al.*, 1987; Burdett and Cunningham, 1998; Behrenz, 2002; DeVaro, 2005), and most have examined the employers' choice of search methods (e.g., Roper, 1988; Lindeboom *et al.*, 1994; Henkens *et al.*, 2005) and other measures of intensive or extensive search (e.g., Barron and Bishop, 1985; Barron *et al.*, 1997; Russo *et al.*, 2000)¹. Some papers have examined the link between employers' use of search methods and vacancy duration (e.g., Gorter *et al.*, 1996; DeVaro, 2005).

Another under-researched area is the role of the Internet in recruiting. Among the few studies on online employer search, Brencic and Norris (2009, 2010) found that employers who have to fill vacancies immediately specify fewer job requirements, provide more information about the job and are quicker to remove vacancy announcements from recruitment websites. Additionally, most employers do not modify the salary or job requirements posted in their online advertisements despite the high costs of continuing their search.

Thus, further research is necessary to understand the effect of new technologies on employer search. Finland offers an excellent setting to deepen the existing knowledge on the relationship between the introduction of new technologies and employer search. In October 2002, the Finnish public employment service (PES) introduced an Internet-based recruitment service for employers. Employers registered with the PES can use the system to post announcements about new vacancies, modify information about existing vacancies, change the status of positions when they are filled and cancel announcements. Through this web service, job advertisements are posted immediately to the PES website, where jobseekers can search for suitable jobs. This labour market policy reform was the first of its kind that targeted employers².

The main difference between the web service and the traditional PES (i.e., employment offices) is that the web service does not require the assistance of employment officials. Furthermore, the web service is available 21 hours a day

¹ Intensive search is the hours spent on screening and interviewing applicants per applicant. Extensive search is the average number of applicants screened and interviewed per employment offer (see e.g., Barron and Bishop, 1985).

² The web service was a part of the Second Wave of Policy Reforms implemented since 2002. The reform consisted of two main components: the development of job search centres and the labour force service centres. The main role of these centres is to address the needs of clients who are not easily placed and need special help to get back into the labour market. They also enable both employers and jobseekers to access information more efficiently through various means such as online services (see e.g., Räsänen, 2004).

and 7 days a week, whereas employment offices are open only during regular business hours³. Therefore, the web service is a flexible alternative accessible at various times and from different locations.

This study investigates how the introduction of the PES web service has affected employer search in the first few months after its implementation. Micro-level data that include information on vacancies announced via the PES between 2002 and 2003 is utilized. The observed vacancy durations are used as a proxy for employer search and a flexible parametric hazard function is used to analyse vacancy durations before and after the implementation of the web service. We also examine how the web service has affected the filling of vacancies across different regions. The regional focus is motivated by the persistent differences in local labour market conditions, population densities and age structures across Finland as well as regional differences in the Internet access across households⁴. There is also evidence that matching is more efficient in high-population density areas due to agglomeration externalities (e.g., Hynninen and Lahtonen, 2007; Rosenthal and Strange, 2004).

The results of this paper show that the introduction of the PES's Internet-based service shortened the duration of employer search. The probability of filling a vacancy was 14% larger after the web service was introduced to employers. However, we find that the web-based service shortened the average duration of vacancies only in certain regions, namely in the provinces of Western Finland, Oulu and Lapland, and that employers in urban areas were more likely to benefit from the introduction of the online service.

In addition to Internet-based employer search, the results of this study are informative of the effects of an active labour market policy reform oriented towards employers. To our knowledge, there are no existing studies of the effects of a new labour market policy on employer search. Most of the previous studies have concentrated on unemployment and unemployed. For example, Hägglund (2006) evaluated the impact of an Internet-based job-search assistance programme offered at the Swedish public employment offices on employment outcomes. The voluntary program was not successful because it had no significant effect on subsequent job transitions. Moreover, some papers exist where the effect of policy reform on unemployment durations is examined at the regional level (McVicar and Podivinsky, 2009).

The paper is organised as follows. The second section (3.2) briefly introduces the theoretical framework for employer search. The data and the econometric methods used are presented in Section 3.3. Empirical findings are presented in Section 3.4, and Section 3.5 concludes the study.

³ The web service is open from 3 a.m. to 12 p.m. every day and the employment offices are open from approximately 9 a.m. to 4 p.m. on business days (Mon.-Fri.).

⁴ The regional unemployment spread in Finland is the widest among the Nordic countries, and very large within the EU context, too (Hanell *et al.*, 2002).

3.2 Recruitment channels and employer search

The employer search theory states that the search of a suitable worker is costly in time and money (Lippman and McCall, 1976; Burdett and Cunningham, 1998). Employers want to maximise their profits and therefore consider the trade-off between the benefits of hiring an applicant and the costs of continuing their search. In the standard (sequential-search) model, employers select applicants based on specific qualifications (e.g., education and experience) and consider them on a case-by-case basis after they apply. The search resumes until the employer finds an applicant whose expected productivity exceeds the minimum required productivity, that is, the reservation productivity. In the standard model, the probability of filling a vacancy, $\lambda(t)$, can be broken into two components: the arrival rate of applicants, $\delta(t)$, and the probability that an applicant is acceptable (i.e., the probability that the applicant's productivity exceeds the reservation level of productivity), $P(t)$. The basic idea of this model is captured in the following equation

$$\lambda(t)dt = \delta(t)P(t)dt \quad (1)$$

To estimate this model, it is necessary to specify a hazard function, $\lambda(t)$, which we discuss in Section 3.3⁵.

The choice of the optimal recruitment channel can be introduced into the employer search model by assuming that employers have different search channels at their disposal which differ in terms of search and screening costs, applicant arrival rate and productivity (Gorter *et al.*, 1996). The model assumes that employers use recruiting channels sequentially, that is, recruitment channels are not opened simultaneously. Employers start searching for applicants by activating a recruitment channel (c) which has the highest difference between the expected benefits and costs. Unlike in the standard (sequential) employer search model, applicants arriving through the recruitment channel chosen are selected non-sequentially⁶. Instead of considering applicants a case-by-case basis, employers form a pool of applicants and pick the best applicant from the pool. If the expected productivity of the selected candidate exceeds the minimum required productivity (i.e., the reservation productivity), the candidate is hired. Otherwise, the employers continue their search by activating an additional recruitment channel or by re-activating the current recruitment channel. The basic idea of the employer

⁵ The data do not contain information about the applicant arrival rate or the screening and selection process. Therefore, a reduced-form employer search model, $\lambda(t)dt = \lambda(t, X)$, is estimated, where X contains vacancy, employer and regional characteristics.

⁶ Some studies have argued that employers actually use a non-sequential search strategy instead of sequential search strategy (e.g. van Ours and Ridder, 1993; Abbring and van Ours, 1994). In our analysis, we assume that employers use sequential search strategy or, in the case of a non-sequential search, that the optimal size of the applicant pool is equal to one.

search model incorporating the choice of the recruitment channel is similar to equation (1) with additional sub-index c describing the recruitment channel chosen

$$\lambda_c(t)dt = \delta_c(t)P_c(t)dt \quad (2)$$

Recruitment channels can be divided into two broad categories: informal (e.g., friends, relatives and former and present employees) and formal (e.g., advertisements and public and private employment agencies) (Russo *et al.*, 2000). Employers often prefer informal recruitment channels because they provide good initial screening and give potential applicants more information about the job, which may improve potential matches (van Ours, 1994; Lindeboom *et al.*, 1994). Although there are no direct costs associated with the use of informal channels, employers sometimes complain about the low number of applicants they attract (Mencken and Winfield, 1998). Thus, many employers also use formal recruitment channels despite their disadvantages. For instance, employers often use advertisements despite the direct costs of placing them and the indirect costs of screening the numerous applicants who responded to job ads. The use of PES have no direct costs, but employers sometimes complain that the applicants through this channel are less likely to accept jobs, which creates higher screening costs per vacancy (Barron and Mellow, 1982).

Studies have shown that unemployed jobseekers who use PES tend to experience longer spells of unemployment than their peers who use other search methods (e.g., Thomas, 1997). Similar observations have been made with regard to employer search; informal contacts and advertising are more common and effective recruitment channels than other formal channels (e.g., Gorter and van Ommeren, 1999; Gorter *et al.*, 1996). Thomas (1997) suggested that many jobseekers who approach PES have already tried other search methods unsuccessfully. Similarly, employers who announce their vacancies using PES may have had little or no success with other channels in the past.

According to the model (1), a change in technology affects the probability of filling a vacancy both through the arrival rate of applicants and the probability that an applicant is acceptable. The Internet is expected to affect the hazard rate, $\lambda(t)$, through its effect on the arrival rate of applicants, $\delta(t)$, due to the following reasons. For instance, the Internet breaks down geographic barriers so that a jobseeker from a distant area may apply for a job and succeed against less qualified local candidates (Freeman, 2002). The Internet also reduces application costs, which should increase the pool of applicants and, in turn, make better matches and increase the productivity and wages of employers and jobseekers⁷. However, online search can also have negative

⁷ Bagues and Labini (2009) have examined the impact of online labour market intermediaries on the university-to-work transition and found that online intermediaries have a positive effect on matching quality with increased wages (by 3%) of university graduates.

effects. Due to the increased numbers of applicants, employers may spend significant time screening and interviewing candidates, which increases the average duration of vacancies and the employer's search costs (Autor, 2001). Moreover, while better job matches may reduce incentives for workers to switch jobs, the Internet also makes it easier for the employed to look for new jobs (Nakamura *et al.*, 2009).

The Internet is also expected to affect the filling of vacancies, $\lambda(t)$, through its effect on the acceptance rate, $P(t)$. For example, employers may assume that candidates who search for jobs using the Internet are more likely to have desirable characteristics, such as technical skills and education (Fountain, 2005)⁸. On the other hand, the reduction in search-related costs may invite applications from candidates who are relatively less qualified (Fountain, 2005; Hadass, 2004). Nevertheless, the benefits a firm gains from Internet recruiting may still outweigh its costs; even though the workers hired online are on average less qualified, they are also less costly to replace.

There is scarce evidence on Internet use in employer search, although some studies have evaluated online job search. Stevenson (2009) showed that the vast majority of people who use the Internet to search for jobs are employed and that workers who use the Internet are more likely to leave their current jobs. In general, lower search costs should reduce unemployment, but there is no consistent evidence to support that Internet use shortens periods of unemployment (e.g., Kuhn and Skuterud, 2004; Kuhn and Mansour, 2011).

Hadass (2004) studied how the reduced application costs of Internet recruiting affects the matching process of workers and firms. Job tenure in a firm was used as a proxy for match quality; i.e., the longer the recruited worker stayed with the firm the better the match. Hadass found that workers who are hired online have shorter tenure than those who are hired through informal contacts but similar tenure to those who are hired through print advertisement. Thus, there is no consistent evidence that online recruiting leads to lower quality matches.

Brencic and Norris (2009, 2010) are among the few researchers to have studied online employer search, and they found that most employers do not modify salary offerings or job requirements in the advertisements they post on online job boards. Employers who need to fill their vacancies immediately tend to specify fewer job requirements, provide more information about the job and remove vacancies more quickly from the job boards.

⁸ Prior studies indicate that individuals seeking work via the Internet tend to be well educated on average (Stevenson, 2009).

3.3 Empirical model and data

In this section, we present the empirical model for employer search based on the theoretical model described in Section 3.2. The discussion of the vacancy duration model is followed by a description of the vacancy data.

3.3.1 The duration model

We used a piecewise constant proportional hazard model to estimate vacancy durations. The piecewise constant hazard is a flexible model that allows the baseline hazard to vary between different, pre-specified survival time intervals (Burdett and Cunningham, 1998; Addison and Portugal, 2003). Specifically, the hazard rate is constant within each interval but may differ between them. By adopting the proportional hazard model, we assumed that the hazard rate varies across time periods but that the effects of the covariates on hazard remain the same throughout the duration of search. The proportional hazard model is standard in the duration literature (e.g., Van den Berg, 2001).

The proportional hazard model can be written as

$$h(t|x_t, v) = \lambda(t) \exp(x_t' \beta) v, \quad (3)$$

where $\lambda(t)$ is the baseline hazard function, $\exp(\cdot)$ is the exponential function, x_t is a vector of explanatory variables and v is a function of unobserved characteristics. The baseline hazard is constant within each predefined survival time interval and the survival times are assumed to follow the exponential distribution. Because the average vacancy duration in the sample is less than one month (see Table 2), we used intervals of one day (1,2,3,...,30+). The intercept is omitted because the use of interval dummy variables and a constant in the estimation model would have resulted in perfect collinearity between the regressors (e.g., Jenkins, 1997).

Prior studies have shown that it is important to account for unobserved heterogeneity in duration models (e.g., Van Ours and Ridder, 1992; Hougaard, 1984). We assume that the unobserved heterogeneity follows a discrete distribution with two mass-points⁹. One of the mass-points in each marginal distribution is normalized to zero, which is required due to the piecewise-constant baseline specification (Van den Berg, 2001; Heckman and Singer, 1984). The associated probabilities for the mass points are denoted as

$$p_i = \Pr(v = v_i) \text{ for } i = 1, 2 \quad (4)$$

where $0 \leq p_i \leq 1$ and $\sum_{i=1}^2 p_i = 1$.

⁹ We also estimated a model where the unobserved heterogeneity was assumed to follow a gamma distribution, which is the most popular way of modeling unobservables in the hazard models. The results did not change.

The discrete distribution is a flexible distribution for unobserved heterogeneity (e.g., van den Berg, 2001; Heckman and Singer, 1984). When the number of points of support increases, the discrete distribution can approximate any true underlying distribution well. In practice, it is often difficult to find more than a few different mass-points.

3.3.2 The vacancy data

The data in this study were based on the vacancy announcements of the Finnish PES between 2002 and 2003. Each vacancy announcement comprises an observation unit and includes one or more vacancies that an employer aimed to fill. The micro-level data include information on over 90,000 vacancies. Vacancy and employer characteristics that we observe include job duration, job type, working time, employer size, employer sector and industry. Moreover, the data provide information on the employment office that announced each vacancy and the regional classification of each office¹⁰. We also extracted information on the annual and monthly average numbers of open vacancies processed and unemployed jobseekers served by each employment office from the Employment Service Statistics of the Ministry of Employment and the Economy and included it in the original data¹¹. From the same register, we also gathered monthly information of the labour market matches made in each employment office during the previous years. In addition, we use monthly information on the trend of the national output to control for the effect of business cycles¹². However, during the observation period there was neither a major economic crisis nor an upswing in the Finnish economy.

Vacancy duration refers to the period between the start and end date of a vacancy posting at PES. Vacancy duration is used as a proxy for the duration of employer search for two reasons. First, the exact starting point of an employer search is not necessarily known because employers may use other methods before registering their vacancies with PES (see e.g., Gorter and van Ommeren, 1999). Second, there is a risk of measurement error with regard to the end of an employer search because employers may continue their search process after withdrawing a vacancy from the employment service (e.g., in the case of screening). For our analysis to be reliable, we need to assume that the measurement error is not correlated with the introduction of the online service. We will return to the measurement issue at the end of our analysis in Section 3.4.3, and show that changing the measurement for the duration of employer search does not affect the main results.

¹⁰ Information from 159 employment offices are included in the data. See Appendix 1 for a more detailed description of the regional classification used in the study.

¹¹ The Employment Service Statistics (*Työvoimatoimistojen kokonaisuaineisto 2002-2008*) is distributed by the Finnish Social Science Data Archive, Tampere.

¹² The monthly business cycle indicator ("trend indicator of output") is from the Statistics Finland and it describes the development of the national economy (available at: http://tilastokeskus.fi/til/ktkk/meta_en.html (accessed 6 January 2013)).

Most of the existing studies on vacancy duration rely on surveys but we use register-based data. Moreover, the measurement of duration in our study is similar to the method of Brencic and Norris (2010) but differs from the measurement in DeVaro (2005). In Brencic and Norris (2010), vacancy duration is measured as the difference between the date on which a vacancy was posted on an online job board and the date on which it was withdrawn from the job board. Instead, in DeVaro (2005), vacancy duration is measured as the number of weeks it took to fill a vacancy according to employers.

Although our data only cover one method of search by employers, it is an important one. The market share of PES has been over 60% (of formal channels) since 1994, and in 2003 the share was 62%¹³. According to a recent survey study, employers find that the PES is the most significant filling channel and informal contacts the second significant filling channel in Finland (Räisänen, 2011)¹⁴. The study also indicates that informal and formal recruiting channels are often used as alternatives for each other. Moreover, during the observation period, there has not been any contemporaneous introduction of web-based technologies by other labour market intermediaries. For instance, the usage of firm's own Internet pages as a recruiting channel has been relatively constant during the years 2002 and 2003 (Appendix 1).

In the dataset, vacancies can be filled by jobseekers at the PES, withdrawn from the employment service registry before being filled (i.e., cancelled) or result in some other outcome¹⁵. Vacancies are filled either through employment offices or through the web service. A vacancy posting, that is, an open vacancy announced through the PES, may include one or several vacancies that an employer wants to fill. In such cases, we could only observe the duration of the longest of the vacancies because we only had information on the vacancy that was filled last. The share of multiple vacancies in the dataset is approximately 20%; they were excluded from the data to correct for the possible vacancy duration bias. Furthermore, a small group of the vacancies specified an educational requirement (3%). Therefore, educational requirement was not included as an explanatory variable in the estimations.

By analysing the vacancy durations six months before and after the introduction of the web service in October 2002, we examined the influence of a change in the matching technology on employer search. Thus, the observation period used is from April 2002 to March 2003. For the effect of technology we introduced a dummy variable *post* that is assigned a value of 1 after the

¹³ The information is based on a survey of employers by the Finnish Ministry of Employment and the Economy. When calculating the market share, direct contacts to present and former employees are excluded. When informal contacts are included, the market share of PES is 40% (in 2002).

¹⁴ The study is based on micro level sample data which is representative at the level of all Finnish establishments.

¹⁵ 'Other' outcomes include the cases in which vacancies are filled by job assignments or by other means, and cases in which vacancies have enough applicants to support the removal of the posting. Job assignment is a policy measure that requires an unemployed jobseeker to contact an employer recommended by the public employment service or to risk a benefit sanction.

introduction of the web service and 0 otherwise. Furthermore, we treated the post-implementation vacancies that remained open at the end of our observation period (March 2003) as right-censored. In what follows, we provide a descriptive analysis of the whole dataset and then describe the data specific to the pre- and post-web periods.

Table 1 shows the number and percentage of open vacancies grouped by outcome during the observation period. In total, almost 100,000 open vacancies were announced between April 2002 and March 2003. Over 40% of the vacant jobs were filled of which 1% was filled through the web service. However, the proportion of vacant jobs filled through the web service has increased from 1% to 2% one month after the introduction of the new technology, that is, after October 2002. Approximately one of every twenty vacancies was cancelled, and every other vacancy had an outcome other than being filled or cancelled (e.g., filled by a job assignment).

Figure 1 describes the mean duration of vacancies between April 2002 and March 2003. It should be noted that the statistics are related to each time period according to the year and month in which the vacancies were posted to the PES¹⁶. The average duration of all the vacancies was 16 days but the duration varied depending on the type of search method employers used. For instance, for vacancies with other outcome and with cancelled vacancies the average duration varied between 9-13 days and 20-32 days, respectively. In addition, the mean durations for web-based filling was quite long in the first few months (37 days in October 2002) but soon began to decrease, reaching 21 days in March 2003. The observed pattern seems reasonable given the time it takes for a new service to operate normally. The empirical filling hazard confirms that there are not many differences between pre- and post-web periods (Figure 2). The figure also shows that the probability of filling a vacancy is highest during the first 16 days and decreases thereafter.

¹⁶ It is worth mentioning that the employers did not have the opportunity to update the vacancy after the web-based service became available; only new vacancies were possible to announce through the web service. Nonetheless, it is unlikely that an employer decided to withdraw a vacancy from the PES and, soon after the web service was implemented, to re-post the same vacancy to the PES in order to utilize the benefits of the new technology. This kind of behavior would be observable from the data.

TABLE 1 Number and percentage of vacancies by outcome, April 2002-March 2003

Outcome	Apr02	May02	Jun02	Jul02	Aug02	Sep02	Oct02	Nov02	Dec02	Jan03	Feb03	Mar03	Total
Filled	3,841	4,039	2,983	2,865	4,035	3,647	3,230	2,940	2,350	3,508	3,283	3,620	40,341
through employment office	(40.5%)	(37.8%)	(37.2%)	(37.9%)	(40.7%)	(42.3%)	(43.3%)	(44.7%)	(41.0%)	(39.0%)	(43.1%)	(43.8%)	(40.8%)
through web service	3,841	4,039	2,983	2,865	4,035	3,647	3,142	2,801	2,236	3,318	3,112	3,450	39,469
	(40.5%)	(37.8%)	(37.2%)	(37.9%)	(40.7%)	(42.3%)	(42.6%)	(43.5%)	(39.8%)	(36.9%)	(40.8%)	(41.8%)	(40.1%)
Withdrawn (cancelled)	570	609	476	489	529	512	88	139	114	190	171	170	872
	(6.0%)	(5.7%)	(5.9%)	(6.5%)	(5.3%)	(5.9%)	(1.2%)	(2.2%)	(2.0%)	(2.1%)	(2.2%)	(2.1%)	(0.9%)
Other	5,062	6,043	4,550	4,198	5,351	4,460	3,649	3,051	2,954	4,743	3,858	4,146	52,065
	(53.4%)	(56.5%)	(56.8%)	(55.6%)	(54.0%)	(51.7%)	(49.5%)	(47.4%)	(52.6%)	(52.7%)	(50.6%)	(50.2%)	(52.8%)
All vacancies	9,473	10,691	8,009	7,552	9,915	8,619	7,368	6,432	5,613	8,997	7,621	8,256	98,546
	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)

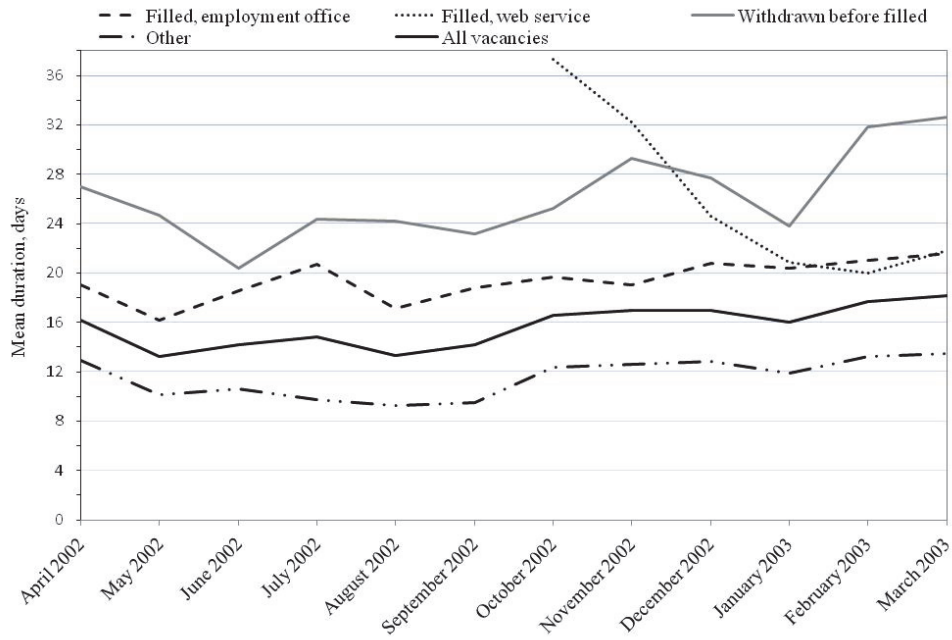


FIGURE 1 The mean durations of vacancies (days) by outcome, April 2002-March 2003.

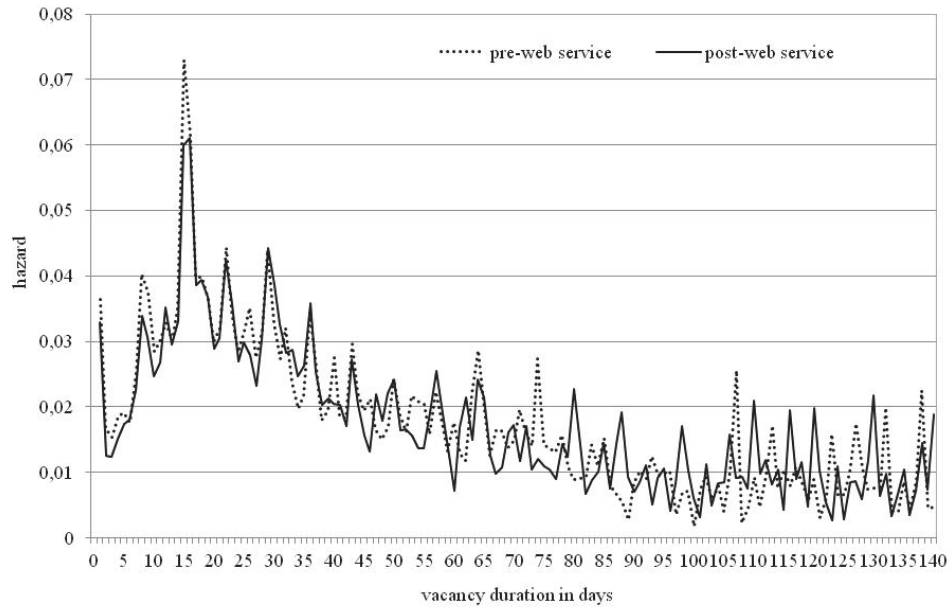


FIGURE 2 Empirical filling hazard, pre- and post-introduction of the web service.

Table 2 illustrates the characteristics of filled vacancies as well as the characteristics of filled vacancies six months before and after the

implementation of the web. Of the relatively few differences between the two periods (columns II and III), the most significant relate to job duration, employer sector and regional characteristics. A comparison of the data before and after the implementation of the web service shows that the percentage of temporary jobs (i.e., a job duration below three months) decreased from 38% to 29%. This finding can be attributed to seasonal variation (e.g., the availability of summer jobs for students from May to July). Similarly, the share of vacancies in private sector decreased from 70% to 66%. Instead, the average number of unemployed jobseekers (U) and the average number of vacancies (V) was observed to be higher after the web service. Finally, public employers in Finland have a legal duty to report open vacancies to the PES which is reflected by the high share of vacancies in public services (48%). A more detailed description of the main variables can be found in Appendix 2.

TABLE 2 Mean characteristics of all vacancies as well as before and after the introduction of the web service

Variables	All vacancies I	Pre-web service II	Post-web service III
Post (after web service=1)	0.45 (0.49)	0	1
<i>Vacancy characteristics</i>			
Working time (other than full-time day work=1)	0.27 (0.44)	0.26 (0.44)	0.28 (0.45)
Job duration (below three months=1)	0.34 (0.47)	0.38 (0.48)	0.29 (0.45)
Job type (other than wage work=1)	0.16 (0.37)	0.16 (0.36)	0.17 (0.37)
<i>Employer characteristics</i>			
Number of personnel (200 or more=1)	0.51 (0.50)	0.51 (0.50)	0.52 (0.50)
Employer sector (private=1)	0.68 (0.47)	0.70 (0.45)	0.66 (0.47)
<i>Regional characteristics</i>			
Area (urban=1)	0.71 (0.45)	0.70 (0.46)	0.74 (0.44)
Unemployed jobseekers ^a (log U)	7,876 (7,696)	7,631 (7,591)	8,177 (7,831)
Open vacancies ^a (log V)	780 (1,084)	735 (1,064)	834 (1,105)
Population density (high density=1)	0.65 (0.48)	0.63 (0.48)	0.67 (0.47)

(continued)

TABLE 2 (continued)

Variables	All vacancies I	Pre-web service II	Post-web service III
<i>Industries</i>			
Agriculture and fishing	0.03 (0.18)	0.04 (0.19)	0.03 (0.16)
Manufacturing	0.11 (0.32)	0.12 (0.32)	0.11 (0.31)
Construction	0.03 (0.18)	0.04 (0.19)	0.03 (0.16)
Wholesale and retail trade	0.11 (0.31)	0.11 (0.31)	0.11 (0.31)
Transportation and storage	0.04 (0.19)	0.04 (0.19)	0.04 (0.19)
Accommodation and food services	0.05 (0.22)	0.05 (0.22)	0.05 (0.21)
Information and business services	0.02 (0.15)	0.02 (0.14)	0.03 (0.16)
Real estate	0.04 (0.19)	0.04 (0.18)	0.04 (0.20)
Public services	0.48 (0.50)	0.46 (0.50)	0.49 (0.50)
Other services	0.09 (0.29)	0.09 (0.29)	0.09 (0.28)
Business cycle ^b	104.2 (3.98)	104.7 (2.26)	103.7 (5.34)
Monthly labour market matches, one year ago (log M1) ^{ab}	319 (342)	353 (357)	269 (311)
Monthly labour market matches, two years ago (log M2) ^{ab}	328 (353)	347 (368)	299 (327)

Notes:^a For continuous variables, the arithmetic mean is for the variable prior to taking the logarithm. ^b Time-varying variables are measured at the beginning of a vacancy period. Standard deviations are provided in parentheses. The business cycle indicator (trend indicator of output) is from the Statistics Finland (year 2000=100).

3.4 Internet-based employer search and vacancy duration

In this section (3.4.1), we analyse the impact of the PES web service on employer search in the first few months after the introduction of the service. According to search theory, the effects of Internet on search outcomes are not obvious - they can be positive or negative (see Section 3.2). In section 3.4.2, we also examine how the web service affected the filling of vacancies across regions.

3.4.1 The web service and vacancy duration

Vacancies can be filled via two channels: the public employment offices or the PES's website. We examined whether the web service of the PES had a positive effect on employer search and defined a positive effect as a statistically significant positive change in hazard after the introduction of the web service. To analyse the influence of the new technology, we assumed that the vacancies listed before and after the implementation of the web service exhibit similar

characteristics. In Section 3.3, we compared the observed characteristics of filled vacancies pre- and post-implementation of web service and found only a few differences between them (see Table 2). In addition, all of the models include industry-specific dummies, a monthly business cycle indicator and monthly indicators for the labour market matches made in each employment office one and two years ago. Thus, the set of control variables that we include in the model should disentangle time trends from the effect of the policy reform. To save space, the baseline hazards are not reported but graphical presentation is given in Appendix 3.

Table 3 presents the estimation results for the filled vacancies with (Column II) and without (Column I) the unobserved heterogeneity. The withdrawn vacancies as well as those with other outcomes were treated as censored cases. The results for the two models (I and II) are fairly similar, thus, we will focus on the results in Column II. The most interesting finding is that the web service has had a positive effect on filling vacancies since the estimate of variable *post* is positive. The probability of filling a vacancy was $(1 - \exp(-0.13))$ 14% larger after the web service was introduced to employers. Of the vacancy characteristics considered, temporary vacancies (i.e., a job duration below three months) were 48% more likely to be filled, and vacancies for something other than wage work (e.g., a commission job) were 69% less likely to be filled¹⁷. Employer characteristics, such as size and sector, seem to have no effect on vacancy duration. All industries except for 'manufacturing', 'construction' and 'accommodation and food services' have positive effect on vacancy duration, although, the effect is not always statistically significant. The probability of filling a vacancy is highest in 'wholesale and retail trade' (27%) as well as in 'transportation and storage' (21%).

Of the regional characteristics considered, jobs in urban areas appeared to be filled almost 40% more likely. High population density (5%) and the number of unemployed jobseekers at an employment office (7%) had a positive effect on vacancy duration, and number of vacancies (-4%) had a negative effect on vacancy duration¹⁸. One way to explain these patterns is that the web service attracts applicants from regions outside the one where the vacancy was announced. Previous studies have shown that spillover effects, especially from jobseekers in neighbouring regions, tend to affect the efficiency of job-applicant matching in densely populated areas (Hynninen, 2005).

¹⁷ Gorter *et al.* (1996) have also found that the PES is likely to be used by employers when recruiting for temporary positions.

¹⁸ Andrews *et al.* (2008) have also found a weak but significant effect of population density on filled vacancies.

TABLE 3 Piecewise constant hazard model for filled vacancies with (II) and without (I) unobserved heterogeneity

Dependent variable: vacancy duration	Filled vacancies	
	I	II
Independent variables	Coeff. (s.e.)	Coeff. (s.e.)
<i>Effect of the web service</i>		
Post (after web service=1)	0.13*** (0.02)	0.13*** (0.01)
<i>Vacancy characteristics</i>		
Working time (other than full-time=1)	0.08*** (0.02)	0.09*** (0.02)
Job duration (below three months=1)	0.36*** (0.02)	0.39*** (0.02)
Job type (other than wage work=1)	-1.10*** (0.03)	-1.17*** (0.04)
<i>Employer characteristics</i>		
Number of personnel (200 or more=1)	0.00 (0.01)	-0.01 (0.02)
Employer sector (private=1)	0.01 (0.02)	0.00 (0.02)
<i>Regional characteristics</i>		
Area (urban=1)	0.34*** (0.02)	0.34*** (0.02)
Unemployed jobseekers (log U)	0.07*** (0.02)	0.07*** (0.02)
Open vacancies (log V)	-0.04** (0.02)	-0.04** (0.02)
Population density (high density=1)	0.04** (0.02)	0.05*** (0.02)
<i>Industries</i>		
Manufacturing	-0.01 (0.04)	-0.02 (0.04)
Construction	-0.02 (0.05)	-0.04 (0.05)
Wholesale and retail trade	0.24*** (0.04)	0.24*** (0.04)
Transportation and storage	0.20*** (0.05)	0.19*** (0.05)
Accommodation and food services	0.00 (0.04)	-0.01 (0.05)
Information and business services	0.07 (0.06)	0.08 (0.06)
Real estate	0.13*** (0.04)	0.10** (0.05)
Public services	0.15*** (0.04)	0.12*** (0.04)
Other services	0.08* (0.04)	0.06 (0.04)

(continued)

TABLE 3 (continued)

Dependent variable: vacancy duration	Filled vacancies	
	I	II
Independent variables	Coeff. (s.e.)	Coeff. (s.e.)
<i>Time effects</i>		
Business cycle	0.00 (0.00)	0.00 (0.00)
Monthly labour market matches, one year ago (log M1)	0.22*** (0.02)	0.23*** (0.02)
Monthly labour market matches, two years ago (log M2)	0.08*** (0.02)	0.08*** (0.02)
Number of vacancies	98,546	98,546
Number of filled vacancies	41,341	41,341
Log L	-102,699	-102,640
Unobserved heterogeneity	no	yes
ν_1		-1.94*** (0.36)
p_1		0.92*** (0.02)
p_2		0.08*** (0.02)

Notes: The constant term is omitted for identification purposes. The business cycle (trend indicator of output) is from the Statistics Finland. Monthly labour market matches are from the Employment Service Statistics of the Ministry of Employment and the Economy Finland. The reference group for industries is 'agriculture and fishing'. To save space, baseline hazards are not reported. 'Post' is a binary dummy for the introduction of the web service, which takes a value of 1 after the web service (October 2002) and 0 otherwise. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

As a robustness check, we estimate a model where the policy change has been advanced by one, two and three months (Table 4). We expect that the effect of the policy change is weakened when the months in which the actual policy change did not yet take place are considered as starting dates, that is, if the policy change has had positive effects on probability of filling vacancies.

Advancing the policy change by one month, that is, using September 2002 as a reform date slightly increases the policy (*post*) coefficient (0.15). Similarly, using August 2002 or July 2002 as a reform date also increases the policy estimate (0.19 and 0.14, respectively). Thus, the results suggest that the introduction of web-based service has not increased the probability of filling vacancies because the pseudo coefficients are statistically significant and at the same level or even larger than the true "*post*" coefficient.

There are several explanations for our results. First, the online service attracts many applicants, which allows employers to be more selective and spend more time screening and interviewing applicants. Second, vacancies that take longer to fill may be matched with better quality workers. Third, it is possible that the employers who post job openings on the website of the PES are not in a hurry and, due to the low costs involved, post a job announcement in case an interesting candidate applies. Finally, employers can leave their advertisements on the online job board to recruit the same types of workers on

a regular basis (i.e., for occupations with high labour turnover rates). Unfortunately, there was no information available to control for the costs of keeping a vacancy unfilled or to measure the quality of a match. Employer selection on the basis of the costs of keeping a vacancy unfilled and the quality of a match could, at least partly, explain the main findings of this paper: the absence of increase in the filling hazard after the web service was introduced.

TABLE 4 Robustness checks for the timing of the policy change, piecewise constant hazard model for filled vacancies with unobserved heterogeneity

Dependent variable: vacancy duration Effect of the web service	Filled vacancies Coeff. (s.e.)
Post (t) (from October 2002 onward=1) <i>Advanced policy change</i>	0.13*** (0.01)
Post (t-1) (from September 2002 onward=1)	0.15*** (0.01)
Post (t-2) (from August 2002 onward=1)	0.19*** (0.02)
Post (t-3) (from July 2002 onward=1)	0.14*** (0.02)

Notes: The full set of results is available from the author. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

3.4.2 The web service and vacancy durations across regions

The sensitivity analysis suggested that there is some uncertainty in the results at the aggregate level (see Table 4). It could be that the policy estimate is affected by seasonal and regional variation, and thus, the results should be interpreted with caution. This also leaves room for regional analysis.

In this section, we discuss our analysis of the impact of the web service on filled vacancies at the regional level. We expected the web service to have a differential impact on vacancy duration across regions because Finland is a large, sparsely populated country with an ageing population¹⁹. Businesses and jobs as well as the population have increasingly aggregated in the southern parts of the country, in larger cities with universities and in other regional centres. This agglomeration of the population and jobs has created differences across regional labour markets. The observable and unobservable differences across regions may have caused the web service to have a different impact

¹⁹ In 2002, the average population density in Finland was 17.5 (population/km²). In 2010, children (≤ 14 years) and the elderly (≥ 65 years) made up the same proportion (17 %) of the total Finnish population. The proportion of the elderly is expected to reach 25% by 2025 (Statistics Finland, Population projection 2009-2060, available at: http://www.stat.fi/til/vaenn/2009/vaenn_2009_2009-09-30_en.pdf (accessed 6 June 2012)).

across Finland. Hence, even if the web service is a national one, there is some flexibility in its local use.

The raw data indicate that employers in urban, densely populated areas use the web service more often than those in rural, sparsely populated areas (see Appendix 4). Additionally, the web service is more common in Employment and Economic Development (TE) centres and in provinces that include large university cities. This basic pattern indicates the need for a regional analysis. We attempted to account for the differences in the regional labour markets by introducing a variable describing the degree of urbanisation (and, simultaneously, the density of population) in an area. Previous studies have shown that population density determines the matching rates in labour markets (Coles and Smith, 1996). High-density areas tend to be more efficient in matching jobseekers with vacancies than other areas do, despite the greater heterogeneity among jobseekers (Hynninen and Lahtonen, 2007).

We accounted for the regional flexibility in web service use by adding interactions between several different regional classifications and the variable describing the introduction of web service (*post*) in the model. The data provide information on the location of the employment office where each vacancy was announced. Because the employment offices are administrative units whose coverage is not based on regional classifications, we aggregated the data to follow our regional classification as closely as possible. We used three regional categories: provinces, TE-centres and municipality type (i.e., urban, semi-urban or rural), which describes the degree of urbanisation (see Appendix 5 and 6).

Table 5 presents the estimation results for the filled vacancies across regions. We estimated the effect of the web service in different provinces (Column I) and in different TE-centres (Column II). The regional variables for the degree of urbanisation are included in both estimations. The estimates for the other control variables, such as vacancy, employer and regional characteristics, are not presented because they are approximately the same as in the previous estimations (see Table 3).

We found that the interaction between the post-web service and the corresponding provinces is positive and statistically significant in Oulu, Lapland and urban areas (Table 5, Column I). Western Finland has also experienced weak positive effects from the introduction of the online service. Across the provinces, the probability of filling a vacancy is 2% to 42% higher after the PES web service was introduced to employers (with the exception of Eastern Finland, where it has a negative effect on the likelihood of vacancy filling). In addition, in urban areas, the probability of finding a suitable worker for an open vacancy was 24% higher after the introduction of the web service. In contrast, the estimate for rural areas is close to zero and not statistically significant, which implies that the web service did not affect vacancy duration in these areas. These results suggest that the web service only has positive effects on hazard in urban and densely populated areas. All of the provinces in Finland have large university cities, but their extensive rural areas often exhibit different, depressed labour market conditions in comparison to

urban areas. Therefore, we also estimated a model that uses a more detailed regional classification (TE-centres) to account for regional variations.

The interaction between the post-web service and TE-centres is positive and statistically significant only in Varsinais-Suomi, Northern Ostrobothnia, Lapland and urban areas (Table 5, Column II). In these regions, the probability of filling a vacancy is 7% to 31% higher after the web service was implemented. These results support the existing results in Column I because Northern Ostrobothnia and Varsinais-Suomi are part of the provinces of Oulu and Western Finland, respectively, which were observed to experience positive effects from the web-based service. Similar conclusions apply to Lapland. Nonetheless, the results should be interpreted with some caution because employers used the web service relatively rarely in these TE-centres (Appendix 4). The share of vacancies filled through the web service was less than 1% in Northern Ostrobothnia, 1% in Varsinais-Suomi and 2% in Lapland. Thus, we have reason to believe that there might be some other underlying factors that influence the results. It may be that vacancies in Oulu and Western Finland differ from the vacancies in the rest of the Finland, for example, due to different economic structure. In Western Finland and Oulu (Lapland) there are relatively more people working in manufacturing (public services) compared to rest of Finland (Appendix 7). In contrast, agriculture is more common source of livelihood in Eastern Finland compared to other regions. It is possible that web service have enabled the labour markets to become more integrated.

The search theory predicts that introduction of Internet-based technology has the potential of increasing geographic mobility. The anecdotal evidence suggests that the introduction of Internet-based service has not increased the geographical mobility in Finland because internal migration has been relatively constant during the 20th century; approximately 5% of the Finns move across municipal borders annually, and half of them move also across borders of provinces (Appendix 8). Also, despite the strong concentrating trend towards large towns in southern Finland, all individuals do not move to urban areas and growth centres. There is a constant inflow of migrants also to peripheral and rural regions (Nivalainen, 2010).

Our findings indicate that the web service has had positive effects on vacancy duration in all the provinces of Finland except in Eastern Finland (see Table 5), where Internet access is also lower compared to all the other parts of Finland (Appendix 9). For example, in 2006, 55% of households in Eastern Finland had Internet access, whereas the equivalent share was between 65% to 67% in all the other major regions.¹⁹ Thus, there is some evidence that the differences in the impact of employers' online search may be attributed to the regional differences in Internet access across households and to regional differences in economic structure. Nonetheless, our main conclusion is that the

¹⁹ Information prior to year 2006 was not available. The regional classification used (major regions) is not the same as the one used in the estimations (provinces). However, major regions and provinces in Finland are relatively close to each other. See Appendix 4 for more information about the classifications of these regions.

web service has decreased the vacancy duration, at least in certain regions, and that employers in urban areas tend to benefit most from the web service provided by the PES.

TABLE 5 Piecewise constant hazard model for filled vacancies across provinces (I) and across TE-centres (II)

Dependent variable: vacancy duration	Filled vacancies	
	I	II
Independent variables	Coeff. (s.e.)	Coeff. (s.e.)
<i>Interactions:</i>		
<i>Type of municipality</i>		
Post × Urban	0.22*** (0.04)	0.18*** (0.04)
Post × Rural	0.00 (0.05)	0.02 (0.05)
<i>Province</i>		
Post × Western Finland	0.02 (0.03)	
Post × Eastern Finland	-0.13*** (0.05)	
Post × Oulu	0.35*** (0.04)	
Post × Lapland	0.34*** (0.07)	
<i>TE-centre^a</i>		
Post × Southeastern Finland (Southern Finland)		-0.19*** (0.05)
Post × Häme (Southern Finland)		-0.14*** (0.04)
Post × Varsinais-Suomi (Western Finland)		0.07** (0.04)
Post × Pirkanmaa (Western Finland)		-0.54*** (0.05)
Post × Central Finland (Western Finland)		-0.14** (0.06)
Post × Satakunta (Western Finland)		-0.30*** (0.06)
Post × South Ostrobothnia (Western Finland)		-0.02 (0.06)
Post × South Savo (Eastern Finland)		-0.22*** (0.08)
Post × North Savo (Eastern Finland)		-0.18*** (0.06)
Post × North Karelia (Eastern Finland)		-0.59*** (0.10)
Post × Kainuu (Oulu)		0.06 (0.09)

(continued)

TABLE 5 (continued)

Dependent variable: vacancy duration	Filled vacancies	
	I	II
Independent variables	Coeff. (s.e.)	Coeff. (s.e.)
Post × Northern Ostrobothnia (Oulu)		0.27*** (0.05)
Post × Lapland (Lapland)		0.18** (0.08)
Industries	yes	yes
Time effects	yes	yes
Number of vacancies	98,546	98,546
Number of filled vacancies	41,341	41,341
Log L	-102,659	-102,545
v_1	-1.92*** (0.28)	-1.73*** (0.30)
p_1	0.92*** (0.02)	0.92*** (0.02)
p_2	0.08*** (0.02)	0.08*** (0.02)

Notes: The constant term is omitted for identification purposes. Time effects include business cycle indicator (trend indicator of output) and monthly indicators for the number of labour market matches made in each employment office one and two years ago. The reference group for industries is 'agriculture and fishing'. To save space, baseline hazards and estimates related to other than interactions between 'post' and regions are not reported. 'Post' is a binary dummy for the introduction of the web service, which takes a value of 1 after the web service (October 2002) and 0 otherwise. In Column I, two binary dummies describing the interaction between the post-web service (post ×) and Southern Finland and between the post-web service and semi-urban areas are omitted due to collinearity. In Column II, three dummies describing the interaction between the post-web service (post ×) and Uusimaa, Swedish Ostrobothnia and semi-urban areas are omitted due to collinearity. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively. ^a The corresponding provinces of each TE-centre are shown in parentheses.

3.4.3 Sensitivity analysis

As a sensitivity analysis, we estimate a model for public employers who have notified the starting date of a job in their job ad. By this approach, we hope to minimize the possible measurement error in the data (see Section 3.3.2). In Finland, public employers have legal duty to report open vacancies to the PES, whereas for private employers this is optional. Thus, for public employers there should not be measurement error at the start of the search. Furthermore, some employers in the data have announced the starting date of the job. Thus, for these vacancies there should not be measurement error at the end of the search. Moreover, for these vacancies we are able to calculate the proxy for recruiting duration instead of vacancy duration. The recruiting duration refers to the period between the starting date of a vacancy posting at PES and the starting date of a job, notified by employer, on condition that the starting date of a job is

later than the ending date of a vacancy posting at PES. Combining these two restrictions, we are left with a subsample that comprises 5% of the original sample.

The estimation results in Table 6 are fairly similar to the ones in Table 5. The web service has decreased the government's recruiting time in all the provinces of Finland, except in Eastern Finland (Column I). However, the estimates for Western Finland and Lapland are not statistically significant. Similarly, the interaction between the post-web service and TE-centres is positive and statistically significant only in Varsinais-Suomi, Satakunta, Northern Ostrobothnia and urban areas (Column II). Overall, the results are robust.

TABLE 6 Government recruiting: piecewise constant hazard model for filled vacancies across provinces (I) and across TE-centres (II)

Dependent variable: recruiting time	Government, filled vacancies	
	I	II
Independent variables	Coeff. (s.e.)	Coeff. (s.e.)
<i>Interactions:</i>		
<i>Type of municipality</i>		
Post × Urban	0.41* (0.27)	0.35* (0.28)
Post × Rural	-1.17** (0.54)	-0.81* (0.55)
<i>Province</i>		
Post × Western Finland	0.26 (0.16)	
Post × Eastern Finland	-0.34 (0.29)	
Post × Oulu	0.77*** (0.21)	
Post × Lapland	0.13 (0.75)	
<i>TE-centre ^a</i>		
Post × Southeastern Finland (Southern Finland)		-0.18 (0.31)
Post × Häme (Southern Finland)		0.03 (0.26)
Post × Varsinais-Suomi (Western Finland)		0.27* (0.20)
Post × Pirkanmaa (Western Finland)		-0.61** (0.26)
Post × Satakunta (Western Finland)		0.83*** (0.30)
Post × Central Finland (Western Finland)		-0.42 (0.38)

(continued)

TABLE 6 (continued)

Dependent variable: recruiting time	Government, filled vacancies	
	I	II
Independent variables	Coeff. (s.e.)	Coeff. (s.e.)
Post × South Ostrobothnia (Western Finland)		0.07 (0.49)
Post × South Savo (Eastern Finland)		-0.99 (1.02)
Post × North Savo (Eastern Finland)		-0.37 (0.33)
Post × North Karelia (Eastern Finland)		-0.82 (0.76)
Post × Northern Ostrobothnia (Oulu)		0.66*** (0.25)
Post × Lapland (Lapland)		-0.03 (0.75)
Industry dummies	yes	yes
Time effects	yes	yes
Number of vacancies	5,251	5,251
Number of filled vacancies	2,472	2,472
Log L	-5,008	-4,991
v_1	-2.42*** (0.39)	-2.38*** (0.39)
p_1	0.90*** (0.03)	0.91*** (0.03)
p_2	0.10*** (0.03)	0.09*** (0.03)

Notes: The constant term is omitted for identification purposes. Time effects include business cycle indicator (trend indicator of output) and monthly indicators for the number of labour market matches made in each employment office one and two years ago. To save space, baseline hazards and estimates for industries are not reported. 'Post' is a binary dummy for the introduction of the web service, which takes a value of 1 after the web service (October 2002) and 0 otherwise. In Column II, two binary dummies describing the interaction between the post-web service (Post ×) and Southern Finland and between the post-web service and semi-urban areas are omitted due to collinearity. In Column III, three dummies describing the interaction between the post-web service (Post ×) and Uusimaa, Swedish Ostrobothnia, Kainuu and semi-urban areas are omitted due to collinearity. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively. ^a The corresponding provinces of each TE-centre are shown in parentheses.

3.5 Conclusions

This paper investigated the factors affecting employer search and examined whether the Finnish PES' implementation of a web service (in October 2002) had positive effects on employer search. According to search theory, the effects of Internet on search outcomes are not obvious - they can be positive or

negative. The vacancy data in this study include information on vacancies announced through the Finnish PES between April 2002 and March 2003. The results are of interest because they contribute evidence to two under-researched areas: employer search and online employer search. Our findings also reflect the effects of Finland's active labour market policy reform, which targeted employers.

The estimation results indicate that the web service shortened the average duration of vacancies because the probability of filling a vacancy was larger after the web service was introduced to employers (14%). However, the sensitivity analysis reveals that the effect of the policy reform might be affected by seasonal and regional variation. Thus, the results should be interpreted with caution.

We found some differences in the web-based vacancy filling at the regional level. Our results suggest that employers in urban areas benefit from the use of the web service provided by the PES. Furthermore, the use of the online service decreased the vacancy duration in few provinces (and TE-centres), namely in Western Finland (Varsinais-Suomi), Oulu (Northern Ostrobothnia) and Lapland (Lapland). The anecdotal evidence suggested that the improvements in employers' online search may be attributable to regional differences in Internet access across households and to regional differences in economic structure.

The results of this paper indicate that Finland's policy reform had a modest effect on vacancy durations and that the reform was successful only in certain regions. It seems that the web service offers an alternative recruiting method for the employers of which especially urban employers exploit. Follow-up studies are needed to evaluate the long term effects of the Internet-based employer services. Moreover, the introduction of the online service may have affected the unobserved quality of matches. Unfortunately, no information was available to account for these effects. In the future, studies might examine whether the migration patterns of workers in Finland changed with the introduction of PES online services, and whether the labour market became more integrated.

References

- Abbring, J.H. and Van Ours, J. (1994). Sequential or non-sequential employers' search? *Economic Letters* 44, 323-328.
- Addison, J. and Portugal, P. (2003). Unemployment duration, competing and defective risks. *Journal of Human Resources* 38, 156-191.
- Andrews, M., Bradley, S., Stott, D. and Upward, R. (2008). Successful employer search? An empirical analysis of vacancy duration using micro data. *Economica* 75, 455-480.

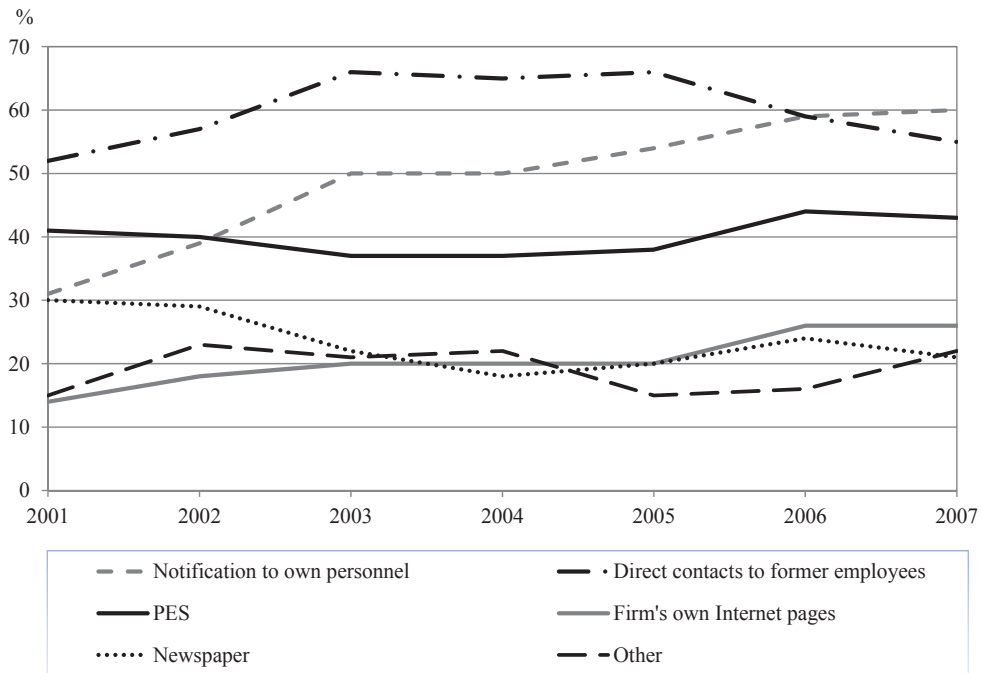
- Autor, D. (2001). Writing the labor market. *Journal of Economic Perspectives* 15, 25-40.
- Bagues, M. and Labini, M. (2009). Do online labor market intermediaries matter? The impact of AlmaLaurea on the university-to-work transition. In Autor, D. (ed.), *Studies of labor market intermediation*, Chicago: The University of Chicago Press.
- Barron, J. and Bishop, J. (1985). Extensive search, intensive search, and hiring costs: new evidence on employer hiring activity. *Economic Inquiry* 23, 363-382.
- Barron, J., Berger, M. and Black, D.A. (1997). Employer search, training and vacancy duration. *Economic Inquiry* 35, 167-192.
- Barron, J., Black, D.A. and Loewenstein, M.A. (1987). Employer size: the implications for search, training, capital investment, starting wages and wage growth. *Journal of Labor Economics* 5, 76-89.
- Barron, J. and Mellow, M. (1982). Labor contract formation, search requirements, and the use of a public employment service. *Economic Inquiry* 20, 381-387.
- Behrenz, L. (2002). The employment service and vacancy durations. *Evaluation Review* 26, 602-617.
- Brencic, V. and Norris, J. (2010). Do employers change job offers in their online job ads to facilitate search? *Economic Letters* 108, 46-48.
- Brencic, V. and Norris, J. (2009). Employer's online search: an empirical analysis. *Industrial Relations* 48, 684-709.
- Burdett, K. and Cunningham, E. (1998). Towards the theory of vacancies. *Journal of Labor Economics* 16, 445-478.
- Coles, M. and Smith, E. (1996). Cross-section estimation of the matching function: evidence from England and Wales. *Economica* 63, 589-597.
- DeVaro, J. (2005). Employer recruitment strategies and the labor market outcomes of new hires. *Economic Inquiry* 43, 263-282.
- Fougere, D., Pradel, J. and Roger, M. (2009). Does the public employment service affect search effort and outcomes? *European Economic Review* 53, 846-869.
- Fountain, C. (2005). Finding a job in the Internet age. *Social Forces* 83, 1235-1262.
- Freeman, R. (2002). The labour market in the new information economy. *Oxford Review of Economic Policy* 18, 288-305.
- Gorter, C., Nijkamp, P. and Rietveld, P. (1996). Employers' recruitment behaviour and vacancy duration: an empirical analysis for the Dutch labour market. *Applied Economics* 28, 1463-1474.
- Gorter, C. and Van Ommeren, J. (1999). Sequencing, timing and filling rates of recruitment channels. *Applied Economics* 31, 1149-1160.
- Hadass, Y. (2004). The Effect of Internet Recruiting on Matching of Workers and Employers. Available at: http://econ.tau.ac.il/papers/applied/Hadass_paper.pdf (accessed 6 June 2012).
- Hanell, T., Aalbu, H. and Neubauer, J. (2002). Regional Development in the Nordic Countries 2002. Nordregio Report 2002:2, Nordregio.

- Heckman, J. and Singer, B. (1984). A method for minimizing the impact of distributional assumptions in econometric models for duration data. *Econometrica* 52, 271-320.
- Henkens, K., Remery, C. and Schippers, J. (2005). Recruiting personnel in a tight labour market: an analysis of employers' behaviour. *International Journal of Manpower* 26, 421-433.
- Hougaard, P. (1984). Life table methods for heterogeneous populations: distributions describing the heterogeneity. *Biometrika* 71, 75-83.
- Hynninen, S.-M. (2005). Matching across space: evidence from Finland. *Labour* 19, 749-765.
- Hynninen, S.-M. and Lahtonen, J. (2007). Does the population density matter in the process of matching heterogeneous job seekers and vacancies? *Empirica* 34, 397-410.
- Hägglund, P. (2006). Job-search assistance using the internet: experiences from a Swedish randomised experiment. *International Journal of Manpower* 27, 434-451.
- Jenkins, S. (1997). Discrete time proportional hazards regression. *Stata Technical Bulletin* 39, 22-32.
- Kuhn, P. and Mansour, H. (2011). Is Internet job search still ineffective? Discussion Paper No. 5955, Institute for the Study of Labor (IZA), Bonn.
- Kuhn, P. and Skuterud, M. (2004). Internet job search and unemployment durations. *The American Economic Review* 94, 218-232.
- Lindeboom, M., Van Ours, J. and Renes, G. (1994). Matching employers and workers: an empirical analysis on the effectiveness of search. *Oxford Economic Papers* 46, 45-67.
- Lippman, S. and McCall, J. (1976). The economics of job search: a survey. *Economic Inquiry* 14, 347-368.
- Mcvicar, D. and Podivinsky, J. (2009). How well has the New Deal for Young People worked in the UK regions? *Scottish Journal of Political Economy* 56, 167-195.
- Mencken, F. and Winfield, I. (1998). In search of the right stuff: the advantages and disadvantages of informal recruiting practices in external labor markets. *American Journal of Economics and Sociology* 57, 135-153.
- Mortensen, D. (1986). Job search and labor market analysis. In Ashenfelter, O. and Layard, R. (eds.), *Handbook of Labor Economics*, Vol. 2, Amsterdam : Elsevier.
- Nakamura, A., Shaw, K., Freeman, R., Nakamura, E. and Pyman, A. (2009). Jobs online. In Autor, D. (ed.), *Studies of Labor Market Intermediation*, Chicago: The University of Chicago Press.
- Nivalainen, S. (2010). Essays on family migration and geographical mobility in Finland. PTT publications 21, Pellervo Economic Research, Helsinki.
- Roper, S. (1988). Recruitment methods and vacancy duration. *Scottish Journal of Political Economy* 35, 51-64.

- Rosenthal, S. and Strange, W. (2004). Evidence on the nature and sources of agglomeration economies. In Henderson, V. and Thisse, J.F. (eds.), *Handbook of Urban and Regional Economics*, Vol. 4, Amsterdam: Elsevier.
- Russo, G., Rietveld, P., Nijkamp, P. and Gorter, G. (2000). Recruitment channel use and applicant arrival: an empirical analysis. *Empirical Economics* 25, 673-697.
- Räisänen, H. (2011). Rekrytoinnin mustan laatikon avaaminen: rekrytoinnin syyt, rekrytointiongelmät ja hakukanavat Suomessa v.2010 (in Finnish). TEM-analyyseja 38/2011, Ministry of Employment and the Economy, Helsinki.
- Räisänen, H. (2004). The Active Labour Market Policy Reform – The Second Wave. Available at: http://www.mutual-learning-employment.net/uploads/ModuleXtender/PeerReviews/17/HCO_FIN04.pdf (accessed 25 November 2011).
- Statistics Finland (2008). Municipalities and regional divisions based on municipalities. Official Statistics of Finland, Handbooks 28.
- Stevenson, B. (2009). The Internet and job search. In Autor, D. (ed.), *Studies of Labor Market Intermediation*, Chicago: The University of Chicago Press.
- Thomas, J. (1997). Public employment agencies and unemployment spells: reconciling the experimental and nonexperimental evidence. *Industrial and Labor Relations Review* 50, 667-683.
- Van den Berg, G. (2001). Duration models: specification, identification and multiple durations. In Heckman, J. and Leamer, E. (Eds), *Handbook of Econometrics*, Vol.5, Amsterdam: Elsevier.
- Van Ours, J. (1994). Matching unemployed and vacancies at the public employment office. *Empirical Economics* 19, 37-54.
- Van Ours, J. and Ridder, G. (1992). Vacancies and the recruitment of new employees. *Journal of Labor Economics* 10, 138-155.
- Van Ours, J. and Ridder, G. (1993). Vacancy durations: search or selection? *Oxford Bulletin of Economics and Statistics* 55, 187-198.

APPENDICES

Appendix 1 Market share (% of all recruits) of different recruiting channels in Finland, 2001-2007.



Notes: Employers may have used several channels simultaneously. 'Other' includes staff leasing services and job-broking services of educational institutions.

Source: Employer survey, Ministry of Employment and the Economy Finland

Appendix 2 The main variables

Variable	Description
Post before web service (=0) after web service (=1)	Post is a binary dummy for the introduction of the web service, which takes a value of 1 after the web service (October 2002) and 0 otherwise
<i>Vacancy characteristics</i> Number of vacancies in an announcement one (=0), more than one (=1)	The announcement may include one or several vacancies that the employer wants to fill. The variable has a value of 1 if the announcement includes more than one vacancy and has a value of 0 if it includes only one vacancy.
Educational requirements not specified (=0), specified (=1)	The variable has a value of 1 if the vacancy announcement includes educational requirements indicated by the employer and value 0 otherwise.
Working time full-time day work (=0), other than full-time day work (=1)	The variable has a value 1 if the working time of the vacancy is other than full-time day work and a value of 0 if it is full-time day work. Jobs that are not considered to be full time can be, for example, part-time work, shift work, or evening or night work.
Job duration three months or more (=0), below three months (=1)	The variable has a value of 1 if the duration of the job (job contract) is shorter than three months and value of 0 if the duration is three months or longer. For example, summer jobs have a duration of less than three months.
Job type Wage work (=0), other than wage work (=1)	The variable has a value of 1 if the type of job is other than wage work and a value of 0 if it is a wage type of work. Wage work means that the worker gets paid a fixed amount, regardless of the number of hours worked. Other than wage work can be, for example, a commission job (e.g., phone sales, real estate sales) or entrepreneurship.
<i>Employer characteristics</i> Number of personnel less than 200 (=0), 200 or more (=1)	The variable has a value of 1 if the recruiting employer has 200 or more employees and a value of 0 for fewer than 200 employees.
Employer sector public (=0), private (=1)	The variable has a value of 1 if the recruiting employer is in the private sector and a value of 0 if it is in the public sector. Private employers can be firms, private organisations and private persons or households, and public employers can be the government, municipalities or joint committees.

(continued)

Appendix 2 (continued)

Variable	Description
<i>Regional characteristics</i>	
Area semi-urban or rural (=0), urban (=1)	The variable has a value of 1 if the employment office is located in an urban area and a value of 0 if it is located in a semi-urban or rural area. The regional classification is the same as with the interactions variable 'Web × Type of municipality' below, and it is intended to describe the degree of urbanisation of the municipality where the employment office is located.
Open vacancies (log V)	Yearly averages are calculated from the total number of vacancies at each employment office at the end of the month; V=open vacancies.
Unemployed jobseekers (log U)	Yearly averages are calculated from the monthly number of unemployed jobseekers at each employment office; U=unemployed jobseekers.
Population density high density (=1), low density (=0)	The variable has a value of 1 if the population density of an area is above average (>17.1) and a value of 0 if it is below average (<17.1). The information regarding the population density is based on the statistics in 2004.
<i>Other characteristics</i>	
Industry dummies (10)	Agriculture and fishing (as reference), Manufacturing, Construction, Wholesale and retail trade, Transportation and storage, Accommodation and food services, Information and business services, Real estate, Public services, Other services.
Business cycle	The monthly business cycle indicator ("trend indicator of output") is from the Statistics Finland and it describes the development of the national economy (year 2000=100). Available at: http://tilastokeskus.fi/til/ktkk/meta_en.html (accessed 6 January 2013).
Monthly labour market matches, one year ago (log M1)	Number of labour market matches made each month in each employment office, one year ago. Information is from the Employment Service Statistics of the Ministry of Employment and the Economy.

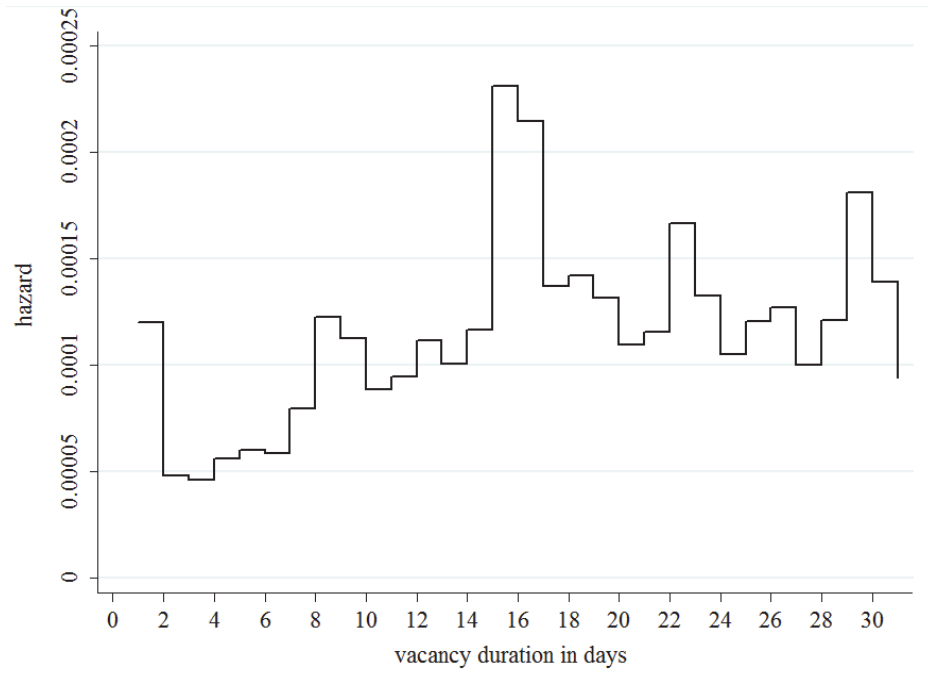
(continued)

Appendix 2 (continued)

Variable	Description
Monthly labour market matches, two years ago (log M2)	Number of labour market matches made each month in each employment office, two years ago. Information is from the Employment Service Statistics of the Ministry of Employment and the Economy.
<i>Interactions</i>	
Post × Employment and Economic Development (TE) centre†	Interaction variable between the introduction of web service and 15 TE-centres. Classification is based on municipalities where the employment offices are located. See Appendix 5.
Post × Province†	Interaction variable between the introduction of web service and 5 provinces: Southern Finland, Western Finland, Eastern Finland, Oulu and Lapland. Classification is based on municipalities where the employment offices are located. See Appendix 5.
Post × Type of municipality†	Interaction variable between the introduction of web service and urban, semi-urban, or rural area. The regional classifications are based on the statistical grouping of Finnish municipalities, where the municipalities are divided into three groups (urban, semi-urban and rural) according to the proportion of the population living in urban settlements and the population of the largest urban settlement. More specifically, rural municipalities are those in which less than 60% of the population lives in urban settlements and the population of the largest urban settlement is less than 15 000, or where at least 60% but less than 90% of the population lives in urban settlements and the population of the largest urban settlement is less than 4 000. In 2008, there were 67 urban, 74 semi-urban and 274 rural municipalities in Finland. See Appendix 6.

Source: †Statistics Finland (2008)

Appendix 3 Baseline hazard in piecewise constant hazard model for filled vacancies

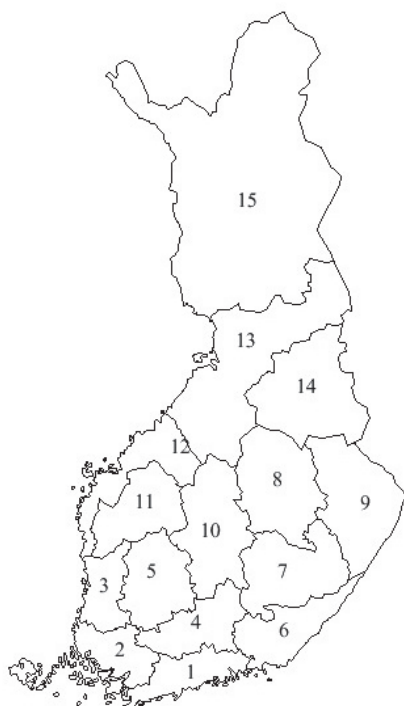


Appendix 4 The use of web service vs. employment offices across regions, post-introduction of the web service, % of filled vacancies

Region	Vacancies filled through	
	web service (%)	employment office (%)
<i>Type of municipality</i>		
urban	4.6	95.4
semi-urban	0.7	99.3
rural	0.5	99.5
<i>Employment and Economic Development (TE) Centre</i>		
Uusimaa	7.4	92.6
Varsinais-Suomi	1.0	99.0
Pirkanmaa	10.5	89.5
Southeastern Finland	1.1	98.9
South Savo	1.2	98.8
Swedish Ostrobothnia	0.0	100.0
Central Finland	3.4	96.6
North Savo	0.2	99.8
North Karelia	1.8	98.2
Kainuu	1.9	98.1
Northern Ostrobothnia	0.5	99.5
Lapland	1.8	98.2
Satakunta	1.3	98.7
Häme	0.7	99.3
South Ostrobothnia	0.5	99.5
<i>Province</i>		
Southern Finland	5.8	94.2
Western Finland	2.8	97.2
Eastern Finland	0.7	99.3
Oulu	0.7	99.3
Lapland	1.8	98.2

Appendix 5 Employment and Economic Development (TE) Centres in Finland (a) and regional classification into provinces (b) and into major (NUTS2) regions (c)

a)



b)

Province				
Southern Finland	Western Finland	Eastern Finland	Oulu	Lapland
1 Uusimaa	2 Varsinais-Suomi	7 South Savo	13 Northern Ostrobothnia	15 Lapland
4 Häme	3 Satakunta	8 North Savo	14 Kainuu	
6 Southeastern Finland	5 Pirkanmaa	9 North Karelia		
	10 Central Finland			
	11 South Ostrobothnia			
	12 Swedish Ostrobothnia			

Source: Statistics Finland (2008)

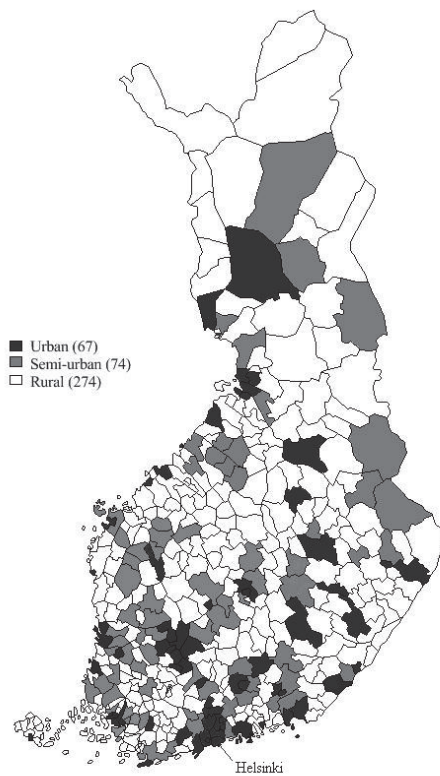
Appendix 5 (continued)

c)

Major region			
Southern Finland	Western Finland	Eastern Finland	Northern Finland
1 Uusimaa	3 Satakunta	7 South Savo	13 Northern Ostrobothnia
4 Häme	5 Pirkanmaa	8 North Savo	15 Lapland
6 Southeastern Finland	10 Central Finland	9 North Karelia	12 northern part of Swedish Ostrobothnia
2 Varsinais-Suomi	11 South Ostrobothnia 12 southern part of Swedish Ostrobothnia	14 Kainuu	

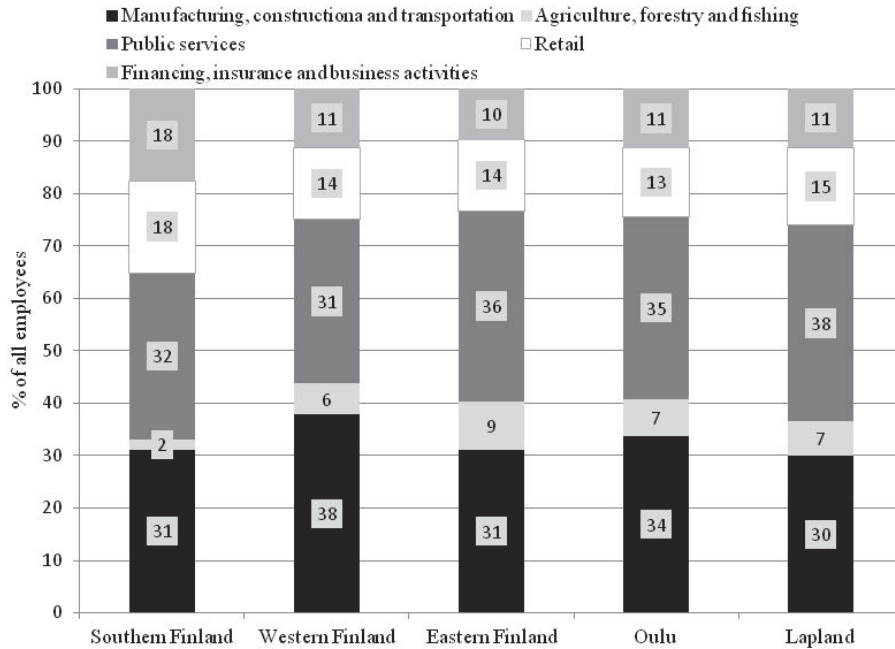
Source: Statistics Finland (2008)

Appendix 6 Urban, semi-urban and rural areas in Finland



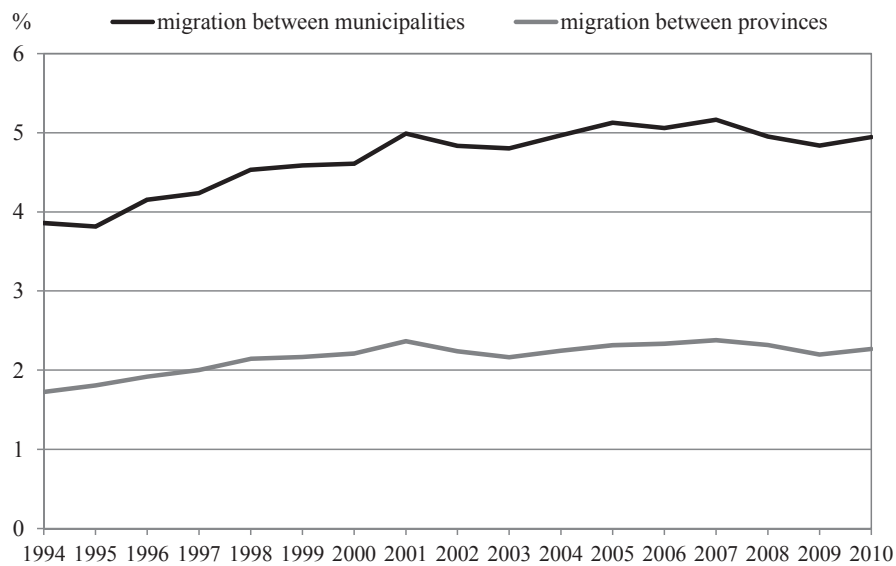
Source: Statistics Finland (2008)

Appendix 7 Economic structure in Finland by industries and provinces, year 2002



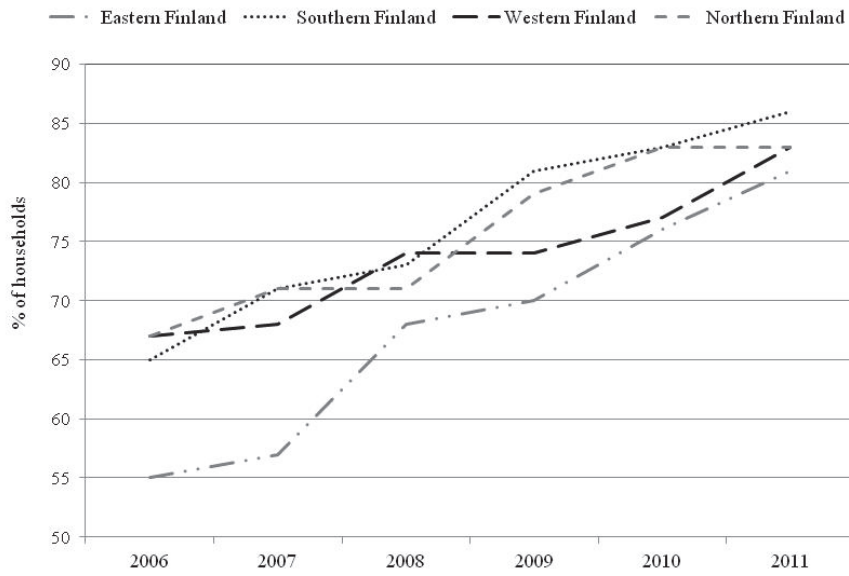
Source: Statistics Finland, Employment statistics

Appendix 8 Internal migration propensities (% of population) in Finland, 1994-2010



Source: Statistics Finland, Population statistics

Appendix 9 Level of Internet access of households (%), major regions in Finland, 2006-2011



Source: Eurostat

CHAPTER 4

IS THERE A LINK BETWEEN TECHNOLOGY AND UNSUCCESSFUL EMPLOYER SEARCH?*

ABSTRACT. This paper investigates cancelled vacancies, that is, the duration until an employer chooses to withdraw a vacancy from the labour market. By employing difference-in-differences, we investigate whether the introduction of the Finnish public employment agency's web-based service, in October 2002, has influenced the speed of cancelling vacancies. The results suggest that, in the short run, the online service did not have an impact on the employer's decision to withdraw vacancies from the labour market. In the long run, vacancies are withdrawn from the labour market more slowly through the online service of the public employment agency than they would be by contacting an employment office.

Keywords: employer search, vacancy duration, internet

JEL classification: C41, J63

4.1 Introduction

The evidence on the use of new technologies in recruiting is scarce. Brencic and Norris (2009, 2010) are among the few researchers studying online employer search. They find that employers who need to fill their vacancies immediately

* Financial support from the Yrjö Jahnesson Foundation (no.6094) and Alfred Kordelin Foundation is gratefully acknowledged. The author would like to thank Jaakko Pehkonen, Kaisa Kotakorpi and the anonymous referee for helpful comments and discussion. Thanks also to Heikki Räisänen and the Ministry of Employment and the Economy for kindly supplying the data. The usual disclaimer applies.

tend to specify fewer job requirements, provide more information about the job and remove vacancies more quickly from the online job boards. Most of the employers do not change the offered wage or job requirements while their ads are posted on the job board, not even when the costs of continuing with the search are high. Further research is necessary to understand the effect of new technologies on employer search.

The search theory states that lowering the cost of job search raises productivity (Pissarides, 2000). Therefore, online search should increase the efficiency of matching because more meetings between potential employees and workers are possible, and also, because more (up-to-date) information is available to both parties (Bagues and Labini, 2009; Autor, 2001). The use of new technology causes workers' and employers' reservation match quality to increase, which in turn raises workers' earnings and employers' profits¹. The lower costs of online hiring have been widely discussed in the literature (e.g., Fister, 1999; Cober *et al.*, 2000; Verhoeven and Williams, 2008).

The online search may also have negative effects. While better job matches should reduce workers' incentive to change a job, the new technology (the Internet) makes it easier for workers to look for a new job while employed (Nakamura *et al.*, 2009). Additionally, lowering the cost of search may encourage jobseekers to simultaneously apply to many vacancies, thus, creating an overwhelming number of (unqualified) applications (Autor 2001; Galanaki 2002; Verhoeven and Williams 2008). However, no consistent evidence exists that online recruiting induces lower quality of matches than other formal recruitment channels (e.g. advertisement and employment agencies). Using job tenure as a proxy for match quality, Hadass (2004) discovers that recruiting via online or via print advertising produce similar job tenures.

Recently, Nivalainen (2014) has investigated how the introduction of the Finnish public employment agency's web-based service has affected employer search in the first few months after its implementation. She finds that the web service, implemented in October 2002, had only a modest (positive) effect on the duration of filled vacancies. However, the results suggest that the introduction of the web-based service shortened the average duration of vacancies in certain regions, and that employers in urban areas were more likely to benefit from the use of the online service.

The purpose of this paper is to examine unsuccessful employer search, that is, situations where employers decide to withdraw vacancies from the labour market.² Unsuccessful employer search is a subject that has been ignored in the literature, even though evidence exists to support it³. According to

¹ Bagues and Labini (2009) find that in the context of university-to-work transition, online labour market intermediaries have a positive effect on matching quality: the wages of university graduates increased by 3%.

² These situations are similar to the one where jobseekers decide to leave the labour market (see e.g., Frijters and van der Klaauw, 2006).

³ In this paper, we use the term 'unsuccessful employer search', although, it may not always be the case. In certain situations, firms can voluntarily cancel the search process. For instance, changes in the business activity of the firm, such as a cancellation

Andrews *et al.* (2008), every third vacancy in the United Kingdom is withdrawn from the labour market, and the primary reason for this is skill shortages, especially in non-manual occupations. Similarly, Beaumont (1978) discovers that one third of all vacancies notified to the British PES are withdrawn from the market. He finds that low wage levels, bad working conditions and undesirable location of the firm are reasons behind cancelled vacancies. A recent German study by Rebien *et al.* (2014) also shows that 10% to 15% of the recruiting establishments had to cancel a vacancy due to unsuccessful search during the years 2008 to 2012. According to their results, the lack of potential applicants and high skill requirements increase the probability of cancelling a vacancy.

In this study, we are not trying to identify the reasons behind unsuccessful employer search but rather to explore whether technology has an effect on it. By applying a difference-in-differences approach, we analyse the causal effect of the introduction of the Finnish public employment agency's (PES) web-based service on the duration of cancelled vacancies. We focus on vacancies that are posted to the PES by employers with similar background characteristics with the only (observable) difference being in their use of the web-based service.

The paper is organised as follows. Section 4.2 offers theoretical framework for unsuccessful employer search. In Section 4.3, we discuss the institutional background, that is, the role of Finnish PES in recruiting. In the same section, we describe the vacancy data, which contains information on over one million job vacancies. Since October 2002, employers registered with the PES have been able to use an Internet-based service to post announcements about new vacancies, modify information about existing vacancies and cancel them. Through this service, job advertisements are posted immediately to the website of the PES, where jobseekers can search for suitable jobs. By using the register-based data from the PES, we are able to study the role of technology in (unsuccessful) recruiting. After discussing the econometric methods in Section 4.4, we give descriptive statistics for the selected sample and present the estimation results of the difference-in-differences model. In section 4.5, we examine the long-term effect of the web service on the duration of unsuccessful employer search. Finally, Section 4.6 offers some concluding remarks.

4.2 A theory for unsuccessful employer search

In the standard employer search model (Lippman and McCall 1976; Burdett and Cunningham 1998), the probability of filling a vacancy, $\lambda(t)$, during a short period of time $(t, t + dt)$, given that it has been open until t , can be broken into two components: the arrival rate of applicants, $\delta(t)$, and the probability that an

of a large order, can result in withdrawing an open vacancy from the labour market (see section 4.2. for more discussion).

applicant is acceptable, $P(t)$ (i.e. the probability that the applicant's productivity is greater than the reservation level of productivity⁴):

$$\lambda(t)dt = \delta(t)P(t)dt. \quad (1)$$

Our data do not contain information about arrival rates and other variables that would allow us to identify the two components, $\delta(t)$ and $P(t)$, in equation (1). Thus, we will estimate a reduced-form employer search model:

$$\lambda(t) = \lambda(t, X), \quad (2)$$

where X is a vector of vacancy, employer and regional characteristics.

In this study, the framework by Frijters and van der Klaauw (2006) is applied. They consider a non-stationary job search model, where jobseekers have the option of leaving the labour force⁵. In our case, we have an employer search model where employers can choose to withdraw a vacancy from the labour market. The probability of cancelling a vacancy is expected to depend on the same variables as the probability of filling a vacancy (see equation 1). The idea is that the applicant arrival rate and the productivity distribution of applicants may change with the elapsed duration of search, which in turn affects the employer's reservation productivity level and expected revenues (see, e.g., Andrews *et al.*, 2008). If the applicant arrival rate or the productivity distribution of applicants falls at some point in time, employers may choose to cancel a vacancy because it is more profitable to continue producing with an unfilled vacancy than it is to continue searching⁶. In these situations, employers may want to withdraw a vacancy posting as soon as possible in order to avoid the costs of another period of search (e.g., advertising and screening costs).

In practice, there are many reasons why firms may want to cancel the search process. Thomson (1966) states that firms sometimes experience difficulties in forecasting their labour demand. Vacancies are cancelled when firms realise that they have exaggerated their needs for labour. Another reason why firms may want to cancel a vacancy is that if no suitable candidates are found, firms may try to solve their staffing problems by other means, for instance, by re-organising tasks within the firm and then (after some time) recruiting for job tasks that are easier to fill (Rebien *et al.*, 2014; Farm, 2009). Moreover, changes in the business activity of the firm, such as the cancellation of a large order (e.g., the shipping industry), can sometimes result in

⁴ The probability that an employer finds an applicant acceptable can be characterized by a reservation productivity level z^* : $P(t) = [1 - F(z^*)]$.

⁵ In the empirical literature that considers nonparticipation, the usual approach has been to assume that transitions into nonparticipation are only possible at stochastically determined moments (e.g. Burdett *et al.*, 1984). In these stationary models, we would not observe an employer choosing to search and then changing its behavior, i.e. cancelling a vacancy.

⁶ For example, if "high-skill" vacancies have a very small pool of potential applicants and this pool is quickly exhausted, these vacancies are withdrawn from the labour market more quickly (Andrews *et al.* 2008).

withdrawing an open vacancy from the labour market because additional labour force is no longer required.

Figure 1 depicts the empirical hazards for filling and cancelling vacancies up to 24 weeks (6 months)⁷. We observe a declining hazard for the filled vacancies and an inclining hazard for the cancelled vacancies. In other words, the probability of filling a vacancy is highest at the beginning of search and decreases thereafter. Instead, the probability of cancelling a vacancy increases with the elapsed duration. Thus, the shapes of the hazards are in line with the theory; as the search duration increases, the benefit of searching declines until the vacancy is withdrawn from the labour market.

Are the cancelled vacancies in the data truly withdrawn from the labour market? We cannot be certain that this is the case, but if the cancelled vacancies were being filled by other channels, the hazard would most likely be downward-sloping (see, e.g., Andrews *et al.*, 2008). Additionally, we can observe from the data whether the vacancy was i) filled by a PES jobseeker, ii) filled by other means, or iii) had enough applicants to remove from the PES. Thus, most vacancies in the data do not seem to be simply mistakes.

The web-based service of the Finnish PES is a fast and convenient method to fill and cancel vacancies. It has the potential of not only to improve the filling of vacancies but also to enable faster cancelling of vacancies. It is interesting to explore whether employers, in a situation where they choose to cancel a vacancy, are willing to employ the advantages of the web-based service. The answer to this question is not obvious because online search may have positive or negative effects (see Section 4.1), and because the evidence on the use of new technologies in recruiting is scarce. One of the few existing studies on online employer search reports that employers who need to fill their vacancies immediately tend to remove vacancies more quickly from the online job boards compared with employers who do not need to fill their vacancies immediately (Brencic and Norris, 2009). In addition, most of the employers do not change the offered wage or job requirements while their ads are posted on the job boards, not even when the costs of continuing with the search are high (Brencic and Norris, 2010). A recent study of Brensic and Norris (2012) also shows that not all employers use online search tools when posting their vacancies on online job boards (Monster.com), regardless of that the tools offered are free and intended to facilitate the search.

⁷ The number of vacancies that are still open after 24 weeks is very small (less than 1%), and therefore, they are not very representative.

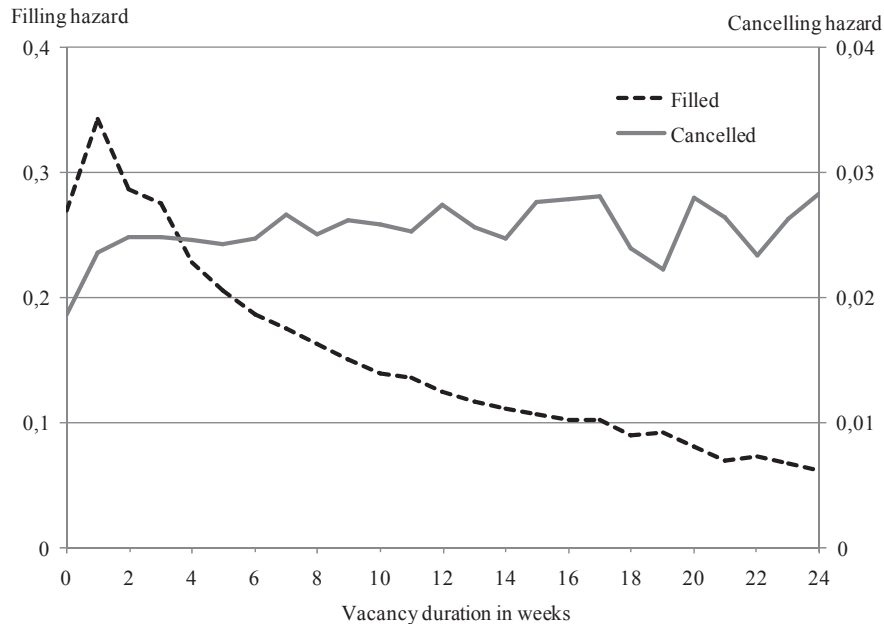


FIGURE 1 Empirical hazards for filling and cancelling vacancies (up to 24 weeks).

Note: Notice the different y-scales.

4.3 Vacancies in Finland

4.3.1 Institutional background

In this study, we examine the duration of employer search by employing the registers of the Finnish PES. Although our data covers only one method of search by employers, it is an important one. The market share of the PES is over 60%, and has been since 1994 (Hämäläinen, 2007)⁸. Unlike public employers, private employers do not have a legal duty to report open vacancies to the public job-broking⁹. Nonetheless, private sector covers over 70% of the vacancies notified to the PES¹⁰.

The use of the Finnish PES varies between regions and industries. In 2007, the market share of the PES was over 80% in Southeastern Finland, North Karelia and Lapland but under 60% in Uusimaa and Northern Ostrobothnia

⁸ The market share does not include informal channels, such as, direct contacts to former employees. When informal channels are included in the analysis, the market share of the PES is approximately 40% (e.g., 43% in 2007).

⁹ However, there are no sanctions for public employers for not reporting an open vacancy to the public job-broking.

¹⁰ Unfortunately, we do not have information on the actual share of private sector vacancies posted (and filled) at the PES.

(Tuomaala, 2008). Moreover, industries with highly educated workers use the service less than others. For example, in 2006, the market share of the PES in 'agriculture and forestry' was almost 80%, whereas it was less than 60% in the industries of 'business services' (Hämäläinen, 2007). Also, employers in 'manufacturing' and 'health and social services' often use the PES to search for suitable workers.

The reason for the common use of the PES is its ability to reduce the employer's recruitment costs. The benefit of using free public services is highest for small firms and when recruiting for occupations with high labour turnover. It has been argued that the public job-broking reaches low-productivity applicants, which may influence the employer's decision to employ the free service (Russo *et al.*, 2000). The more selective the PES (pre-screening activities on e.g., motivation, ability and work-experience), the more it is exploited by employers (Windolf, 1986). In Finland, the main role of the PES is to publicise job openings and give support in the recruiting process. For instance, the PES can search for suitable candidates from its registers and present them to the recruiting employer. However, it is up to the employer if he wants to employ the screening services of the PES. Moreover, the employers themselves can search for (and contact) applicants through the web-based CV service, which contains information on the unemployed jobseekers registered at the PES and their Curriculum Vitae (CV)¹¹.

4.3.2 The data

The data used in this study are the register data on open vacancies submitted by employers to the Finnish PES during 2002-2008. The observation unit in the dataset is a vacancy notification which may include one or several vacancies that the employer wants to fill¹². The share of notifications with multiple vacancies in the data is 20%. It should be noted that we can only observe the duration of the longest of these multiple vacancies; that is, we only have information on the vacancy that was filled (cancelled) last. This means that the duration and the probability of filling (cancelling) are not observed for all of the vacancies. Therefore, multiple vacancies are excluded from the data.

The micro data include information on 100,000 jobs each year, totalling over 800,000 observations. Various vacancy and employer characteristics are available, including job duration, job type, working time, employer sector and employer size. In addition, the PES office where the vacancy is announced and the regional classification of each office are also available¹³. From the Employment Service Statistics, variables describing labour market tightness,

¹¹ The information on whether employers used the CV service is not visible from the data.

¹² The same notification may be used to post several vacancies at once if the job characteristics are the same.

¹³ There are 159 employment offices in the data. Åland, which is an autonomous island, is excluded from the data due to its exceptional labour market conditions. For more information of the regional classification see Appendix 1.

that is, the monthly stock of open vacancies and unemployed jobseekers of each PES office, are also included to the original data¹⁴.

The vacancy duration concept used in this paper is the difference between the ending and starting date of a vacancy¹⁵. The vacancy duration is a proxy for the employer search for two reasons. First, the actual start of the employer search is not necessarily observed because employers might have used other methods prior to registering their vacancies with the PES (see e.g., Gorter and van Ommeren, 1999). Second, there might be some measurement error at the end of the employer search. It is possible that employers continue their search process after pulling the vacancy from the PES (e.g., screening job applications)¹⁶.

Employer search does not always result in filling a vacancy. In the data, some vacancies are withdrawn, cancelled, from the PES. Cancelling a vacancy can be performed via two methods: through the PES office or through the PES's website (since October 2002). The main difference between these two methods is that the Internet-based cancelling method does not require the assistance of employment officials¹⁷. Moreover, the web service is a flexible alternative that is accessible across various times and locations.

The vacancies in the data can (i) be filled by jobseekers from the PES or (ii) be withdrawn from the PES (cancelled) either (a) through the PES office or (b) through the web service. There are also vacancies that are filled by other search channels¹⁸. However, our main focus is on filled and cancelled vacancies via the PES. Table 1 represents the number and share of open vacancies as well as their mean duration, as measured by outcome, from the years selected. In total, there were almost 800,000 open vacancies during the years 2002-2008. Approximately 80% of the vacant jobs were filled by the PES. Importantly, the share of jobs cancelled was approximately 8%, of which 7% were cancelled through the PES offices and 2% through the web service.

¹⁴ The Employment Service Statistics (*Työvoimatoimistojen kokonaisaineisto 2002-2008*) is distributed by the Finnish Social Science Data Archive, Tampere.

¹⁵ Vacancy durations are censored from 365 days onward because it is not likely that a vacancy is open more than a year. The number of these vacancies is approximately 700 (0.1%).

¹⁶ Measurement errors are common with register-based data (see e.g. Brencic and Norris (2009) and Andrews et al. (2008) for similar problems). However, it is very unusual that information about vacancies is kept in data registers. Most of the previous studies on vacancy duration have been based on surveys. For example, the measurement of duration in our study is similar to the method of Brencic and Norris (2010) but differs from the measurement in DeVaro (2005).

¹⁷ The PES has developed a web service that allows the employer to use a technical platform for recruiting operations. The employer can log into the system and add new vacancies, change the status of open vacancies when they are filled or cancel them. The web service is available 21 hours per day and 7 days per week, whereas the PES offices are open only during regular business hours.

¹⁸ In the data, there are vacancies where the employer has considered having enough applicants to support removal from the PES. These vacancies have been most likely filled but because we are not certain of the actual outcome and duration of these vacancies, they are excluded from the data. The share of vacancies with enough applicants is 4% of all vacancies.

The annual number of open vacancies increased from 100,000 to 140,000 vacancies during the 2002-2008 period. While the number of vacancies increased during the observation period, the changes in the proportions varied. The share of job openings filled by the PES declined from 83% to 81% during the years 2002-2008. At the same time, the share of cancelled vacancies increased from 6% to 10% and the share of vacancies cancelled through the web service increased from 0% to 3%. The most interesting finding is that the growth in the use of web-based cancelling method has been huge; from the year 2002 to year 2004 the growth has been 7-fold, from 2004 to 2006 4-fold and even during the last two observation years the growth has been 2-fold.

TABLE 1 Number, share and mean duration of vacancies by outcome, 2002-2008

Outcome	2002	2004	2006	2008	Total	Mean duration ^a
Filled	80,700 (83%)	73,600 (80%)	88,700 (79%)	113,000 (82%)	633,900 (81%)	16.4 (23.9)
Withdrawn (cancelled)	6,000 (6%)	6,300 (7%)	9,400 (8%)	13,700 (10%)	43,700 (8%)	28.4 (44.3)
through PES office	6,300 (6%)	6,200 (6%)	8,100 (7%)	10,900 (7%)	54,400 (7%)	29.7 (46.3)
through web service	100 (0.1%)	700 (0.5%)	2,600 (2%)	4,500 (3%)	13,200 (2%)	22.2 (32.9)
Other ^b	10,800 (11%)	11,800 (13%)	14,000 (12%)	14,200 (8%)	86,200 (11%)	27.5 (34.2)
All vacancies	97,200 (100%)	91,500 (100%)	111,900 (100%)	138,100 (100%)	780,046 (100%)	18.6 (27.7)

Notes: ^aStandard deviations for mean durations (in days) are shown in parentheses. ^b'Other' outcome include vacancies filled by other search channels than the PES.

The average duration of all vacancies is 19 days but the duration varies depending on the outcome. The average durations are two days shorter than the general average for jobs filled by the PES. The longest average duration, 29 days, is for cancelled vacancies. This seems logical if we consider that employers are willing to wait for a certain period, which is longer than the average time needed to fill a job, before they decide to withdraw a vacancy from the labour market. However, the durations are different when we distinguish between the two types of methods for cancelling vacancies. The average duration is 30 days for vacancies cancelled via PES offices but only 22 days for vacancies cancelled via the web. This implies that vacancies are withdrawn from the PES faster through the web service than through the PES offices. The standard deviations in each outcome group are quite large,

implying that there is a large amount of heterogeneity between the vacancies and the PES offices.

Table 2 represents the characteristics of vacancies, employers and regions for filled and cancelled vacancies. Most of the recruiting employers in the data were small-sized private-sector firms. The recruiting employer was from the public sector in 18% of the cases where the job openings were cancelled through the PES, but in only 6% of cases where vacancies were cancelled through the web service. The corresponding share for vacancies filled by the PES was 30%. In the case of cancelled vacancies, the share of large employers was smaller (8%) compared to filled vacancies (15%). The three most common industries in the data are public services (32%), social and health care (19%) and manufacturing (11%). A notable share of vacancies cancelled via the web service are from the public services (74%)¹⁹.

Most of the vacancies in the data were full-time wage work with a job duration of three months or more. Moreover, most of the vacancies in the data were located in urban areas for all outcome groups considered, but the share was highest for vacancies cancelled through web service (96%). In addition to the area type of each PES office, the two basic variables in search models, that is, the monthly stock of open vacancies and the monthly stock of unemployed jobseekers, were also included. There are relatively more unemployed jobseekers and open vacancies in the offices where the vacancy has been posted but then cancelled via the web service. This indicates that the Internet-based service might be more commonly used in large regions and densely populated areas, such as cities, and less in more rural areas where the density of population is also lower. Previous studies have shown that high-density areas tend to be more efficient in matching jobseekers with vacancies than other areas, despite the greater heterogeneity among jobseekers (Hynninen and Lahtonen, 2007). Therefore, a variable describing the population density will be added as explanatory variable in the estimations. Previous studies have observed that if all PES offices would match jobseekers and vacancies as effectively as the best one, the aggregate unemployment in Finland would decline by over 2 percentage points (Hynninen *et al.*, 2009).

A detailed description of the variables used can be found in Appendix 1.

¹⁹ In Finland, public employers have a legal duty to report open vacancies to the PES. However, misbehavior is not sanctioned.

TABLE 2 Vacancy, employer and regional characteristics by outcome, means

Variables	Filled	Withdrawn	Withdrawn through	
			PES office	web service
<i>Vacancy characteristics</i>				
Working time (other than full-time day work=1)	0.27	0.26	0.26	0.25
Job duration (less than three months=1)	0.30	0.20	0.22	0.12
Job type (other than wage work=1)	0.16	0.10	0.11	0.04
<i>Employer characteristics</i>				
Number of personnel				
Less than 50	0.72	0.82	0.85	0.81
50 to 199	0.13	0.09	0.07	0.10
200 or more	0.15	0.08	0.08	0.09
Employer sector (private=1)	0.70	0.84	0.82	0.94
Industries				
Agriculture and fishing	0.02	0.03	0.03	0.00
Manufacturing	0.11	0.11	0.13	0.01
Construction	0.03	0.04	0.05	0.00
Wholesale and retail trade	0.10	0.08	0.10	0.03
Transportation and storage	0.04	0.04	0.04	0.03
Accommodation and food services	0.04	0.06	0.07	0.02
Information and business services	0.02	0.01	0.02	0.00
Real estate	0.04	0.04	0.03	0.04
Social and health care	0.19	0.13	0.15	0.05
Public services	0.32	0.33	0.25	0.74
Other services	0.09	0.12	0.14	0.06
<i>Regional characteristics</i>				
Area (urban=1)	0.76	0.76	0.71	0.96
Population density† (log D)	60.1	61.9	53.2	102.8
Unemployed jobseekers† (log U)	7,722	6,915	5,798	12,179
Open vacancies† (log V)	1,605	1,493	942	4,089

Notes: Bold coefficients indicate that the t-test for the equality of the means between filled (withdrawn through PES office) and withdrawn (withdrawn through web service) vacancies is statistically significant at least at the 5% level. †For continuous variables, the mean is for the variable prior to taking the logarithm.

4.4 The web service and the duration of cancelled vacancies

4.4.1 The econometric approach

We use a difference-in-differences (DID) model to investigate the causal effect of the introduction of the web service, in October 2002, on the duration of cancelled vacancies (e.g., Card and Krueger, 1994). We compare the duration of cancelled vacancies nine months before and after the web service. Thus, the observation period used is from January 2002 to June 2003. Moreover, we focus on vacancies that are posted to the PES by employers with similar background characteristics; the only difference between these employers is in their use of the web service. Thus, the control group comprises employers who did not use the web service, whereas the treatment group comprises employers who did employ the service. By this approach, we hope to isolate the causal effect of introduction of the online service from the unobservable changes around the time of the introduction of the online service.

The DID model is written as follows

$$T_i = \beta_0 + \beta_1 Treat_i + \beta_2 Post_i + \beta_3 Treat_i * Post_i + \beta_4 X_i' + \varepsilon_i, \quad (3)$$

where T_i is the duration of a vacancy i and $Treat_i$ indicates whether the recruiting employer belongs to the treatment group (=1) or to the control group (=0). Moreover, variable $Post_i$ describes the introduction of the web service (October 2002), that is, it gets a value of one after the treatment and zero before the treatment. Thus, parameter β_3 of the interaction term, $Treat_i * Post_i$, is our primary interest because it measures the DID estimate of the treatment effect. Furthermore, X_i is a function of vacancy and regional specific covariates, and the unobserved heterogeneity is captured by the error term, ε_i .

In literature, it has been argued that the treatment in the DID model is not always random (see, e.g., Meyer, 1995). For instance, if the employers in our model are somehow selected into using the web service, this can create upward or downward bias in the results. To reduce the impact of selection bias, we use matching approach to generate a comparison group of employers that have the same (observable) characteristics as the treated employers. First, we estimate a logit model that explains the use of web service as a cancelling method (treatment) with the employer characteristics (industry, sector and size), vacancy characteristics (working time, job duration and job type) and two regional variables (area and population density) included in the model, and generate propensity scores that measure the probability of treatment group membership. Second, we use nearest neighbour matching on propensity scores with replacement to select a control group of observations that are most comparable to the treatment group (see e.g., Rosenbaum and Rubin, 1983;

1985)²⁰. Third, we follow Crump *et al.* (2009) and trim the data by keeping only observations with propensity scores between 0.1 and 0.9. As a final step, we estimate a DID model using the matched sample (in section 4.4.1).

After we performed matching on the propensity score, the t-tests for the equality of means of the covariates in the treatment and control group are no longer significant. The difference in the means, i.e., the standardised bias, is also substantially lower (close to zero). This implies that the matching has been successful. The covariate balance table is given in Appendix 2.

Table 3 represents the number, share and mean duration of vacancies in the matched sample. The same statistics are also given separately for cancelled vacancies. Moreover, the information is divided into the pre-web and post-web periods as well as into treatment and control groups. The share of vacancies in the treatment group varies between 24% to 27% depending on the time period. It seems that, regardless of the group, the average duration of vacancies is shorter for the pre-web service period than for the post-web service period. With cancelled vacancies, the treatment groups comprises 19% (pre-web) to 29% (post-web) of the vacancies. In the treatment group, the average duration of cancelled vacancies is shorter for the pre-web service period than for the post-web service period; the opposite holds for the comparison group.

TABLE 3 Number, share and mean duration of vacancies in the matched sample, before and after the introduction of the web service, treatment group vs. control group

Group	Pre-web service (Jan2002-Sep2002)	Post-web service (Oct2002-Jun2003)
<i>All vacancies</i>		
Treatment ^a	5,468 (24%) 14.3 (20.6)	5,820 (27%) 16.7 (23.9)
Control ^b	17,541 (76%) 16.4 (22.9)	15,531 (73%) 17.4 (24.6)
<i>Cancelled vacancies</i>		
Treatment ^a	216 (19%) 19.6 (34.4)	352 (29%) 22.1 (37.8)
Control ^b	942 (81%) 24.1 (37.4)	862 (71%) 21.7 (37.1)

Notes: Standard deviations for mean durations (in days) are shown in parentheses. ^a Employers who used the web service after its introduction. ^b Employers who did not use the web service.

²⁰ The matching is performed with Stata program 'psmatch2' written by Leuven and Sianesi (2003). We apply caliper matching (0.1) because it improves the quality of the match (Austin, 2011). Moreover, we use nearest neighbour matching with replacement because otherwise we would have too few observations in the matched sample.

4.4.2 Estimation results

In this section, we investigate whether the introduction of the PES's web service has influenced the speed of cancelling vacancies. It is hard to predict the effect of the web-based service on the duration of unsuccessful employer search. The Internet-based service may have positive or negative effects on the average duration of vacancies (see discussion in Sections 4.1 and 4.2). In a situation, where the employer decides to end the search process, the employer may want to withdraw a vacancy posting as soon as possible to avoid the costs of another period of search (e.g., screening costs). It could be that cancelling a vacancy is faster via the Internet because the web-based service is a convenient service that is accessible across various times (21 hours a day for 7 days a week) and locations. However, it could also be that there are no incentives for the employer to cancel a vacancy any faster via online because the services provided by the PES are free; at least, there are no direct costs²¹.

Table 4 represents the estimation results for the DID analysis of cancelled vacancies. Model 1 is a baseline OLS model with no additional control variables. We also estimate several other specifications where the vacancy and regional characteristics (Model 2), industry dummies (Model 3) as well as province dummies (Model 4) are included as a control variable. The vacancy and regional characteristics used are listed in Appendix 1. All of the models include cluster-robust standard errors at the employer level because the observations from the same employer might be correlated²².

The estimated treatment effect of the web service (Treat*Post) in the baseline model is 4.88, which means that the average duration of vacancies that were cancelled through the online service is almost 5 days longer than vacancies cancelled through the PES offices. The estimated treatment effect is relatively robust to the model specification (1-4). However, the treatment effect is not statistically significant in any of the model specifications; perhaps due to small number of observations for the treated (see Table 3)²³. Thus, the estimation results suggest that in general, the introduction of the online service has not influenced the employers' decision to withdraw a vacancy from the labour market.

²¹ It is in the interest of the PES to fill and cancel vacancies as soon as possible. Therefore, vacancy notifications are monitored by the PES. However, to our knowledge, there exist no maximum duration after which a vacancy is automatically cancelled by the PES.

²² The clustered standard errors are larger than the standard errors from the regular OLS model, which supports this view.

²³ We also estimated OLS models where the dependent variable was the natural logarithm of the duration of cancelled vacancies. The log-duration is less sensitive to the influence of a few large observations in the sample. According to the results, the effect of the web service is between 0.36-0.42 depending on the model specification (1-4). The estimates are statistically significant at the 10% level. The results are available from the author.

TABLE 4 Estimation results for the difference-in-differences OLS model

Dependent variable: duration of cancelled vacancies	Model 1 Coeff. (s.e)	Model 2 Coeff. (s.e)	Model 3 Coeff. (s.e)	Model 4 Coeff. (s.e)
<i>Treatment effect</i>				
Treat*Post	4.88 (4.6)	4.65 (4.1)	5.04 (4.2)	4.82 (4.2)
<i>Control variables</i>				
Intercept	24.10 (3.1)***	21.34 (18.7)	29.96 (22.6)	30.20 (23.1)
Treat	-4.53 (4.0)	-1.42 (3.1)	-0.91 (3.1)	-0.91 (3.2)
Post	-2.38 (3.4)	-1.23 (2.3)	-1.15 (2.3)	-0.89 (2.3)
Vacancy characteristics	no	yes	yes	yes
Regional characteristics	no	yes	yes	yes
Industries	no	no	yes	yes
Provinces	no	no	no	yes
Number of observations	2372	2372	2372	2372
F-test	0.5	2.6***	3.1***	3.7***
R ²	0.00	0.06	0.06	0.07

Notes: Cluster-robust standard errors at the employer level are in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

As a robustness check, we estimate models where the introduction of the web-based service has been both advanced and postponed by two months (Table 5); otherwise the models and their covariates are the same as in Table 4 (Model 1-Model 4). We report only the estimates regarding the treatment effect of the web service (Treat*Post). The results support our main findings that the introduction of web-based service has not affected the speed of cancelling vacancies. The pseudo treatment estimates are not statistically significant, and they are also relatively robust to the choice of the control variables.

TABLE 5 Sensitivity analysis for the timing of the web service, difference-in-differences OLS model

Dependent variable: duration of cancelled vacancies	Model 1 Coeff. (s.e)	Model 2 Coeff. (s.e)	Model 3 Coeff. (s.e)	Model 4 Coeff. (s.e)
<i>Treatment effect</i>				
Treat*Post (t)	4.88 (4.6)	4.65 (4.1)	5.04 (4.2)	4.82 (4.2)
<i>Advanced treatment</i>				
Treat*Post (t-2) (from August 2002 onward)	4.11 (4.7)	3.38 (4.07)	3.72 (4.1)	3.94 (4.1)
<i>Postponed treatment</i>				
Treat*Post (t+2) (from December 2002 onward)	2.32 (3.8)	1.96 (3.1)	2.43 (3.8)	2.89 (3.8)

Notes: Cluster-robust standard errors at the employer level are in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

4.5 The long-term effect of technology on the duration of unsuccessful employer search

In this section, we examine the long-term effect of the web service on the duration of cancelled vacancies via an accelerated failure time (AFT) model. We perform this analysis because it may take some time before employers become aware of the new service and start employing it. This is suggested by the small number of observation for the treatment group around the time of the imposition of the online service. Thus, it should be noted that the observation period in the DID analysis was limited to the years 2002 and 2003, whereas the AFT analysis covers the years from 2002 to 2008.

4.5.1 The duration model

We use accelerated failure time (AFT) model to analyse the determinants of unsuccessful employer search, that is, the duration of cancelled vacancies. According to statistical and graphical tests, the proportional hazards (PH) assumption does not hold, thus, the commonly used PH models are discarded (Appendix 3, Table 1). More detailed descriptions of the testing of the PH assumption as well as the selection of the survival distribution are given in Appendix 3.

In the AFT model, the logarithm of the survival time is expressed as a linear function of the covariates. The model is written as

$$\log(T_{ij}) = \beta' X_{ij} + \varphi \varepsilon_{ij} \quad (4)$$

where T_{ij} is the survival time of the j th vacancy in the i th group and φ is a scale parameter. The error term ε_{ij} is assumed to have a particular distribution that determines the distribution of the survival time, that is, determines the regression model (Cox and Oakes, 1984). Based on the Akaike (1974) information criterion (AIC) test, we assume that the durations of vacancies follow the Weibull distribution (Appendix 3, Table 2).

Studies have shown that the unobserved heterogeneity is important in explaining variations in duration (e.g. Van Ours and Ridder, 1992; Hougaard, 1984). The unobserved heterogeneity is taken into account via employer-specific random effects. A common and convenient assumption is that the random effects are gamma distributed with mean 1 and variance θ , where the variance is estimated from the data (e.g., Pan, 2001; Hougaard, 1984; Vaupel *et al.*, 1979). Moreover, many studies have shown that AFT models are more robust to omitted covariates and less sensitive to the choice of probability distribution of the unobserved heterogeneity terms than conventional PH models (e.g., Keiding *et al.*, 1997; Lambert *et al.*, 2004).

In this section, we examine the open vacancies with multiple outcomes where the vacancy durations can end in two different ways: filled or cancelled. Each vacancy has only one outcome and there is no (right) censoring. The duration times between different outcomes are assumed to be independent; that is, we assume independent competing risks²⁴. We identify a continuous time duration model where the maximum likelihoods are calculated for each type of outcome, and each of them is obtained by treating all other outcomes as censored cases (Kalbfleisch and Prentice, 2002).

The likelihood function for the AFT model is

$$L = \prod_{i=1}^g \int_0^{\infty} \left\{ \prod_{j=1}^{n_i} \lambda(t_{ij}|x_{ij})^{d_{ij}} S(t_{ij}|x_{ij}) \right\} dG(\alpha_i), \quad (5)$$

where the hazard function (5') and survivor functions (5'') are assumed to be of the forms

$$\lambda(t_{ij}|x_{ij}) = \frac{1}{\varphi_{ij}} \lambda_0\left(\frac{t}{\varphi_{ij}}\right) \text{ and} \quad (5')$$

$$S(t_{ij}|x_{ij}) = S_0\left(\frac{t_{ij}}{\varphi_{ij}}\right), \text{ respectively,} \quad (5'')$$

where $\varphi_{ij} = \varphi_{ij}(x_{ij}, \alpha_i) = \exp(\omega_i + \beta' x_{ij})$ and where $\alpha_i = \exp(\omega_i)$ describes the random effects. The duration and the vector of covariates for the j th vacancy ($j = 1, 2, \dots, n_i$) in the i th group ($i = 1, 2, \dots, g$) are denoted by t_{ij} and x_{ij} , respectively. The event indicator is denoted by d_{ij} , so that it equals 1 if an outcome is observed and 0 otherwise. $G(\alpha_i)$ is the gamma distribution of the random effects (Lambert *et al.*, 2004; Pan, 2001).

4.5.2 Estimation results for the long-term effects of the web-based service

Table 6 represents the competing risks estimation results for the two outcomes under investigation: filling and cancelling of vacancies. The observation period covers the year 2002 to 2008. We use time ratios ($\exp(\beta)$) instead of coefficients when reporting estimation results. A time ratio above one for the covariate implies that this prolongs the time to the event, whereas a time ratio below one indicates that an earlier event is more likely. It should be noted that we are not trying to identify the reasons behind unsuccessful employer search but rather to explore whether technology has an effect on it.

Overall, the major differences between vacancies cancelled through PES offices (column I) and vacancies cancelled through the web service (column II) concern regional characteristics. For the web service, urban location decreases the vacancy duration, whereas this variable increases the vacancy duration for the traditional PES service. Similarly, high population density decreases the vacancy duration when vacancies are cancelled online but increases the

²⁴ See Gorter *et al.* (1996) and Gorter and Van Ommeren (1999) for a similar approach.

duration when vacancies are cancelled through an employment office. The opposite effect of the covariate describing regional differences could indicate that the vacancy duration is less dependent on local market conditions for the web service. It also suggests that the web service might be more common in urban, densely populated areas. Of the vacancy characteristics, the type of the job seems to be more important for the web service.

TABLE 6 Estimation results for the competing risks AFT model: PES office vs. web service

Dependent variable: duration of cancelled vacancies	Withdrawn through	
	PES office I	web service II
<i>Vacancy characteristics</i>		
Working time (other than full-time day work=1)	1.18 (0.01)***	1.15 (0.03)***
Job duration (less than three months=1)	0.82 (0.01)***	1.01 (0.03)
Job type (other than wage work=1)	1.04 (0.02)**	1.75 (0.09)***
<i>Employer characteristics</i>		
Number of personnel (ref. 200 or more)		
Less than 50	0.75 (0.01)***	0.69 (0.03)***
50 to 199	0.91 (0.02)***	0.86 (0.04)***
Employer sector (private=1)	1.01 (0.02)	0.20 (0.01)***
<i>Regional characteristics</i>		
Area (urban=1)	1.24 (0.02)***	0.68 (0.04)***
Population density (log D)	1.10 (0.01)***	0.43 (0.01)***
Unemployed jobseekers (log U)	0.78 (0.01)***	0.60 (0.03)***
Open vacancies (log V)	1.38 (0.02)***	1.08 (0.04)**
Industries	yes	yes
Provinces	yes	yes
Number of observations	780,046	780,046
Number of failures	50,380	10,721
Log L	-209,812	-50,572
LR Chi ²	7,098***	23,755***
ρ (shape parameter)	0.92 (0.00)***	0.98 (0.01)**
θ (frailty parameter)	0.00 (0.00)	0.27 (0.11)***
ML estimate of mean duration, days	5.2 (0.42)	8.4 (2.03)
Difference between the mean durations		3.2 (2.25)***

Notes: Time ratios of the AFT Weibull model with gamma-distributed random effects. Yearly (6), monthly (11), industry (11) and province (4) dummies are included in the models. Standard errors are in parentheses. Likelihood ratio test for $H_0: \theta = 0$ and $H_0: \rho = 0$. Standard deviations for ML estimates of mean duration are in parentheses. T-test for H_0 : difference between the mean durations is zero. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

The estimation results indicate that there are some differences in the determinants of unsuccessful employer search when the two cancelling methods are compared. However, the most interesting finding is reported at the bottom of Table 6. The estimated vacancy duration indicates that, on average, vacancies are cancelled 3 days faster via PES offices than via the website of the PES. The performed t-test indicates that the difference between the mean durations is statistically significant. Thus, the estimation results suggest that, in the long run, technology has influenced the employers' decision to withdraw a vacancy from the labour market by prolonging the duration of cancelled vacancies.

4.6 Conclusions

This paper has investigated employer search by examining vacancy durations. The main purpose of this study was to examine unfilled vacancies to determine whether technology influences the duration of unsuccessful employer search. To be more precise, is there a positive link between the use of the PES's web-based service and the speed of cancelling vacancies? This is the case if the average duration of cancelled vacancies has decreased after the introduction of the PES' online service in October 2002. The results of this study are of interest because they provide evidence in two under-researched areas: online employer search and unsuccessful employer search.

The estimation results of the difference-in-differences model suggest that, in general, the introduction of the online service has not influenced the employers' decision to withdraw a vacancy from the labour market. The estimated treatment effect is 4.88 (days) but not statistically significant. The treatment effect remains approximately the same as we include control variables in the model. Thus, the web service has not significantly influenced the duration of cancelled vacancies.

We also examined the long-term effects of the web service by estimating a competing risks AFT model for vacancies cancelled through the PES offices or through the web-based service of the PES during the years 2002-2008. The results indicate that, in the long run, vacancies are removed from the PES (3 days) more quickly by using the basic service methods, that is, by contacting the PES office than using the web-based service of the PES.

The results of this paper show that technology does not affect the speed of cancelling vacancies, at least, it does not reduce the average duration of cancelled vacancies. One explanation for the findings is that because the services provided by the PES are free, cancelling a vacancy later has no direct costs for the employer. Thus, there are no incentives for the employers to cancel vacancies any faster via online than via a PES office. It could be that the web-based service of the PES is merely a flexible recruiting alternative for the employers; a service that is accessible across various times and locations.

References

- Akaike, H. (1974). A new look at the statistical model identification. *IEEE Transactions on Automatic Control* 19, 716-723.
- Andrews, M., Bradley, S., Stott, D., and Upward, R. (2008). Successful employer search? An empirical analysis of vacancy duration using micro data. *Economica* 75, 455-480.
- Austin, P. (2011). Optimal caliper widths for propensity-score matching when estimating differences in means and differences in proportions in observational studies. *Pharmaceutical Statistics* 10, 150-161.
- Autor, D. (2001). Writing the labor market. *Journal of Economic Perspectives* 15, 25-40.
- Bagues, M. and Labini, M. (2009). Do online labor market intermediaries matter? The impact of AlmaLaurea on the university-to-work transition. In Autor, D. (ed.), *Studies of labor market intermediation*, Chicago: The University of Chicago Press.
- Brencic, V. and Norris, J. (2012). Employers on-line recruitment and screening practises. *Economic Inquiry* 50, 94-111.
- Brencic, V. and Norris, J. (2010). Do employers change job offers in their online job ads to facilitate search? *Economic Letters* 108, 46-48.
- Brencic, V. and Norris, J. (2009). Employer's online search: an empirical analysis. *Industrial Relations* 48, 684-709.
- Burdett, K. And Cunningham, E. (1998). Towards a theory of vacancies. *Journal of Labor Economics* 16, 445-478.
- Burdett, K., Kiefer, N., Mortensen, D. and Neumann, G. (1984). Earnings, unemployment, and the allocation of time over time. *Review of Economic Studies* 51, 559-578.
- Card, D. And Krieger, A. (1994). Minimum wages and employment: a case study of fast-food industry in New Jersey and Pennsylvania. *The American Economic Review* 84, 772-793.
- Cober, R., Brown, D., Blumental, A., Doverspike, D. and Levy, P. (2000). The quest for the qualified job surfer: it's time the public sector catches the wave. *Public Personnel Management* 29, 479-496.
- Cox, D. (1972). Regression models and life tables. *Journal of the Royal Statistical Society* 34, 187-202.
- Cox, D. and Oakes, D. (1984). *Analysis of survival data*, London: Chapman and Hall.
- Crump, R., Hotz, V., Imbens, G. and Mitnik, O. (2009). Dealing with limited overlap in estimation of average treatment effects. *Biometrika* 96, 187-199.
- Devaro, J. (2005). Employer recruitment strategies and the labor market outcomes of new hires. *Economic Inquiry* 43, 263-282.
- Farm, A. (2009). Unemployment and vacancies. Working paper 8/2009, Swedish Institute for Social Research (SOFI), Stockholm University.
- Fister, S. (1999). Online recruiting: good, fast and cheap? *Training* 36, 26-28.

- Frijters, P. and Van der Klaauw, B. (2006). Job search with non-participation. *The Economic Journal* 116, 45-83.
- Galanaki, E. (2002). The decision to recruit online: a descriptive study. *Career Development International* 7, 243-251.
- Gorter, C., Nijkamp, P. and Rietveld, P. (1996). Employers' recruitment behaviour and vacancy duration: an empirical analysis for the Dutch labour market. *Applied Economics* 28, 1463-1474.
- Gorter, C. and Van Ommeren, J. (1999). Sequencing, timing and filling rates of recruitment channels. *Applied Economics* 31, 1149-1160.
- Hadass, Y. (2004). The Effect of Internet Recruiting on Matching of Workers and Employers. Available at: http://econ.tau.ac.il/papers/applied/Hadass_paper.pdf (Accessed 30 July 2012).
- Hougaard, P. (1984). Life table methods for heterogeneous populations: distributions describing the heterogeneity. *Biometrika* 71, 75-83.
- Hynninen S.-M., Kangasharju, A. and Pehkonen, J. (2009). Matching inefficiencies, regional disparities, and unemployment. *Labour* 23, 481-506.
- Hynninen, S.-M. and Lahtonen, J. (2007). Does the population density matter in the process of matching heterogeneous job seekers and vacancies? *Empirica* 34, 397-410.
- Hämäläinen, H. (2007). Työvoiman rekrytointi toimipaikoissa vuonna 2006 (in Finnish). <http://www.mol.fi/mol/fi/99_pdf/fi/06_tyoministerio/06_julkaisut/10_muut/rekrytointi2006.pdf> (Accessed 21 August 2013).
- Kalbfleisch, J. and Prentice, R. (2002). *The statistical analysis of failure time data*, New York: John Wiley & Sons.
- Keiding, N., Andersen, P. and Klein, J. (1997). The role of frailty models and accelerated failure time models in describing heterogeneity due to omitted variables. *Statistics in Medicine* 16, 215-224.
- Lambert, P., Collett, D., Kimber, A. and Johnson, R. (2004). Parametric accelerated failure time models with random effects and an application to kidney transplant survival. *Statistics in Medicine* 23, 3177-3192.
- Leuven, E. and Sianesi, B. (2003). Psmatch2: Stata module to perform full Mahalanobis and propensity score matching, common support graphing, and covariate imbalance testing. Statistical Software Components, Boston College Department of Economics.
- Lippman, S. and McCall, J. (1976). The economics of job search: a survey. *Economic Inquiry* 14, 347-368.
- Meyer, B. (1995). Natural and quasi-experiments in economics. *Journal of Business and Economic Statistics* 13, 151-161.
- Nakamura, A., Shaw, K., Freeman, R., Nakamura, E. and Pyman, A. (2009). Jobs online. In Autor, D. (ed.), *Studies of labor market intermediation*, Chicago: The University of Chicago Press.
- Nivalainen, H. (2014). Internet-based employer search and vacancy duration: evidence from Finland. *Labour* 28, 112-140.
- Pan, W. (2001). Using frailties in the accelerated failure time model. *Lifetime Data Analysis* 7, 55-64.

- Pissarides, C. (2000). *Equilibrium unemployment theory*, Cambridge: MIT Press.
- Rebien, M., Kubis, A. and Müller, A. (2014). Success and failure in the operational recruitment process: contrasting the outcomes of search. IAB Discussion Paper 7/2014, Institute for Employment Research (IAB), Nürnberg.
- Schoenfeld, D. (1982). Partial residuals for the proportional hazards regression model. *Biometrika* 69, 239-241.
- Thomson, W. (1966). Collection and use of job vacancy data in Canada. In National Bureau of Economic Research (ed.), *The measurement and interpretations of job vacancies*, New York: Columbia University Press.
- Tuomaala, M. (2008). Työvoiman hankinta toimipaikoissa vuonna 2007 (in Finnish). TEM analyses 5/2008, Ministry of Employment and the Economy Finland.
- Van Ours, J. and Ridder, G. (1992). Vacancies and the recruitment of new employees. *Journal of Labor Economics* 10, 138-155.
- Vaupel, J., Manton, K. and Stallard, E. (1979). The impact of heterogeneity in individual frailty on the dynamics of mortality. *Demography* 16, 439-454.
- Verhoeven, H. and Williams, S. (2008). Advantages and disadvantages of Internet recruitment: a UK study into employers' perceptions. *International Review of Business Research Papers* 4, 364-373.
- Windolf, P. (1986). Recruitment, selection and internal labour markets in Britain and Germany. *Organization Studies* 7, 235-254.

APPENDICES

Appendix 1 The main variables

Variable	Description
<i>Vacancy characteristics</i>	
Number of vacancies in a posting one (=0), more than one (=1)	The notification may include one or several vacancies that the employer wants to fill. The variable has a value of 1 if the notification includes more than one vacancy and has a value of 0 if it includes only one vacancy.
Working time full-time day work (=0), other than full-time day work (=1)	The variable has a value 1 if the working time of the vacancy is other than full-time day work and a value of 0 if it is full-time day work. Jobs that are not considered to be full-time can be, for example, part-time work, shift work, or evening or night work.
Job duration three months or more (=0), less than three months (=1)	The variable has a value of 1 if the duration of the job (job contract) is less than three months and value of 0 if the duration is three months or longer. For example, summer jobs have a duration of less than three months.
Job type Wage work (=0), other than wage work (=1)	The variable has a value of 1 if the type of job is other than wage work and a value of 0 if it is a wage type of work. Wage work means that the worker gets paid a fixed amount, regardless of the number of hours worked. Other than wage work can be, for example, a commission job (e.g. phone sales, real estate sales) or entrepreneurship.
<i>Employer characteristics</i>	
Number of personnel Less than 50, 50-199, 200 or more	Three categories. The variable has a value of 1 if the recruiting employer has i) less than 50, ii) 50-199, iii) 200 or more personnel, and a value of 0 otherwise.
Employer sector public (=0), private (=1)	The variable has a value of 1 if the recruiting employer is in the private sector and a value of 0 if it is in the public sector. Private employers can be firms, private organizations and private persons or households, and public employers can be the government, municipalities or joint committees.
Industries (10 dummies)	Agriculture and fishing (as reference), Manufacturing, Construction, Wholesale and retail trade, Transportation and storage, Accommodation and food services, Information and business services, Real estate, Public services, Other services.

(continued)

Appendix 1 (continued)

<i>Variable</i>	<i>Description</i>
<i>Regional characteristics</i>	
Area† semi-urban or rural (=0), urban (=1)	The variable has a value of 1 if the PES office is located in an urban area and a value of 0 if it is located in a semi-urban or rural area. The regional classifications of the PES offices are based on the statistical grouping of Finnish municipalities (2008), where the municipalities are divided into three groups (urban, semi-urban and rural) according to the proportion of the population living in urban settlements and the population of the largest urban settlement.
Population density† (log D)	The variable describes the population density of an area (=D). The information regarding the population density is based on the statistics in 2008. The average density of population was 17.4 (population/km ²).
Unemployed jobseekers (log U)	Yearly averages are calculated from the monthly stock of unemployed jobseekers of each PES office; U=unemployed jobseekers.
Open vacancies (log V)	Yearly averages are calculated from the stock of open vacancies of each PES office at the end of the month; V=open vacancies.

Notes: †Source: Statistics Finland.

Appendix 2 Covariate balance table

Variable	Matching	Treated	Control	Stand. bias	$p > t $
<i>Vacancy characteristics</i>					
Working time	Before	0.36	0.30	12.6	0.000
	After	0.36	0.36	0.5	0.688
Job duration	Before	0.34	0.31	6.3	0.001
	After	0.34	0.34	0.2	0.855
Job type	Before	0.09	0.11	-7.5	0.000
	After	0.09	0.09	0.0	0.981
<i>Employer characteristics</i>					
Number of personnel					
Less than 50	Before	0.65	0.69	-6.9	0.000
	After	0.65	0.66	-0.6	0.654
50 to 199	Before	0.11	0.10	1.6	0.153
	After	0.11	0.11	0.6	0.653
200 or more	Before	0.24	0.21	6.6	0.011
	After	0.24	0.24	0.2	0.863
Employer sector	Before	0.66	0.70	-8.4	0.000
	After	0.66	0.66	0.7	0.623
Industries					
Manufacturing	Before	0.01	0.03	-15.5	0.000
	After	0.01	0.01	0.7	0.414
Wholesale and retail trade	Before	0.02	0.05	-14.9	0.006
	After	0.02	0.02	0.1	0.923
Transportation and storage	Before	0.04	0.04	-2.7	0.015
	After	0.04	0.04	-0.1	0.918
Accommodation and food services	Before	0.02	0.03	-6.0	0.000
	After	0.02	0.02	0.3	0.777
Information and business services	Before	0.01	0.01	-3.3	0.004
	After	0.01	0.01	-0.4	0.735
Real estate	Before	0.11	0.06	20.7	0.000
	After	0.11	0.11	1.0	0.501
Social and health care	Before	0.09	0.14	-16.4	0.000
	After	0.09	0.08	0.4	0.756
Public services	Before	0.70	0.64	14.2	0.000
	After	0.70	0.71	-1.0	0.447
Other services	Before	0.00	0.01	-9.8	0.000
	After	0.00	0.00	-0.6	0.492
<i>Regional characteristics</i>					
Area	Before	0.94	0.88	22.3	0.000
	After	0.94	0.94	-0.6	0.587
Population density†	Before	98	89	14.2	0.000
	After	98	98	0.1	0.914
Unemployed jobseekers†	Before	14247	9959	46.8	0.000
	After	14247	10642	39.3	0.000
Open vacancies†	Before	1657	1116	39.1	0.000
	After	1657	1230	30.9	0.000

Notes: In the matched sample, there are no observations for the following industries: 'construction' and 'agriculture and fishing'. † For continuous variables, the mean is for the variable prior to taking the logarithm.

Appendix 3 Testing the proportional hazards assumption and selecting the distribution of the survival time

The Cox (1972) model has become very popular in survival analysis. A crucial assumption in the Cox model is that the hazards are proportional and this can be tested, for example, by using Schoenfeld (1982) residuals. The statistical test assesses the correlation between the Schoenfeld residuals and the rank order of times. If the proportional hazards (PH) assumption holds for a particular covariate, the Schoenfeld residuals for that covariate will not be related to the survival time. The test results in Table 1 indicate that the PH assumption is violated and that the hazards of the Cox model are not proportional.

TABLE 1 Test of PH assumption in the Cox model based on Schoenfeld residuals

Time: Rank(t)	Withdrawn through	
	PES office	web service
<i>Vacancy characteristics</i>		
Working time	0.015*** (10.7)	0.017* (3.1)
Job duration	0.069*** (244.2)	0.003 (0.1)
Job type	0.081*** (335.3)	0.029*** (8.9)
<i>Employer characteristics</i>		
Number of personnel (ref. 200 or more)	0.034*** (57.7)	-0.045*** (20.9)
Less than 50	0.018*** (15.9)	0.064*** (43.1)
50 to 199	0.053*** (138.9)	-0.003 (0.1)
Employer sector		
Industries (ref. other services)		
Agriculture and fishing	0.006 (1.9)	0.018* (3.3)
Manufacturing	0.025*** (30.7)	0.005 (0.3)
Construction	0.037*** (68.3)	0.013 (1.9)
Wholesale and retail trade	0.001 (0.0)	-0.029*** (9.3)
Transportation and storage	0.020*** (20.9)	0.037*** (14.4)
Accommodation and food services	0.020*** (20.5)	0.008 (0.7)
Information and business services	-0.014*** (10.4)	0.012 (1.6)

(continued)

TABLE 1 (continued)

Time: Rank(t)	Withdrawn through	
	PES office	web service
Real estate	0.027*** (36.7)	0.019** (3.9)
Social and health care	0.012* (7.3)	0.029*** (8.2)
Public services	0.008* (3.4)	-0.016** (2.8)
<i>Regional characteristics</i>		
Area	0.002 (5.9)	0.012 (1.4)
Population density	-0.031*** (5.9)	0.059*** (38.2)
Unemployed jobseekers	-0.002 (0.1)	-0.059*** (36.2)
Open vacancies	0.003 (0.3)	0.063*** (41.1)
Global test	1556.9***	455.6***

Notes: For PH assumption: $H_0: \tau = 0$, i.e. there is no correlation between the Schoenfeld residuals and rank order of times. In the test for individual covariates, the value of τ is reported and the value of chi-squared with one degree of freedom is given in parentheses. In the global test, the value of chi-squared with 41 degrees of freedom is reported. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

Statistical criteria can be used to compare the AFT models and to assess the need for inclusion of frailties. The nested models (e.g. Weibull, exponential and lognormal) can be compared using the likelihood ratio (LR) test. However, the LR test does not work with non-nested models (e.g. log-logistic). One method for selecting between non-nested models is the Akaike information criterion test: $AIC = -2L + 2(k + c + 1)$, where k is the number of covariates and c is the number of model-specific distributional (shape) parameters (Akaike 1974).

We fit the AIC test for the AFT model with different distributions for the survival time as well as with and without the gamma distributed random effects. The values of the AIC test from each model are summarised in Table 2. The Weibull distribution for the survival times appears to be the best fit (with the smallest AIC score) for the both outcomes considered, although, there are not much difference between the Weibull and the exponential model. We will use Weibull model with gamma-distributed random effects when estimating the vacancy durations.

TABLE 2 Values of AIC test for the AFT models considered with and without gamma-distributed random effects

Distribution of random effects		
<i>None</i>		
AFT model	Withdrawn through PES office	Withdrawn through web service
Weibull	419,709 (-209,812 ^{***})	101,236 (-50,575 ^{***})
Exponential	420,348 (-210,132 ^{***})	101,256 (-50,587 ^{***})
Lognormal	424,504 (-212,209 ^{***})	101,332 (-51,123 ^{***})
Log-logistic	420,718 (-210,316 ^{***})	101,259 (-50,586 ^{***})
<i>Gamma</i>		
AFT model	Withdrawn through PES office	Withdrawn through web service
Weibull	419,709 (-209,812 ^{***})	101,232 (-50,572 ^{***})
Exponential	420,292 (-210,103 ^{***})	101,234 (-50,574 ^{***})
Lognormal	424,506 (-212,209 ^{***})	102,332 (-51,123 ^{***})
Log-logistic	420,720 (-210,316 ^{***})	101,261 (-50,586 ^{***})

Notes: The AFT models include (10) selected covariates (see Table 1) together with (6) yearly, (11) monthly and (4) province dummies. The smallest AIC score is marked in bold. Values of log likelihoods are in parentheses. In the likelihood ratio test, ^{***} indicate significance at the 0.1% level.

SUMMARY IN FINNISH (YHTEENVETO)

Tutkimuksia teknologian ja sanktioiden vaikutuksesta työn ja työntekijöiden etsintään Suomen työmarkkinoilla

Väitöskirja koostuu kolmesta empiirisestä artikkelista, jotka käsittelevät sekä työnantajien että työntekijöiden etsintäkäyttäytymistä Suomen työmarkkinoilla. Väitöskirjan tavoitteena on arvioida työttömyysturvaetuuksiin liittyvien sanktioiden toimivuutta sekä selvittää informaatioteknologian vaikutusta rekrytointiin ja rekrytoinnin alueellisiin eroihin Suomessa. Tutkimusartikkeleita edeltää johdantokappale, joka esittelee lyhyesti väitöskirjan teoreettisen taustan sekä antaa taustatietoa työttömyysetuuden sanktioista, rekrytoinnista ja etsintäteknologian kehityksestä Suomen työmarkkinoilla viimeisen vuosikymmenen aikana. Samaisessa luvussa tehdään myös katsaus aikaisempaan kirjallisuuteen sekä väitöskirjan tutkimusmenetelmiin, -aineistoihin ja -tuloksiin.

Luvussa 2 analysoidaan työnetsintää työttömien näkökulmasta. Tutkimuksessa tarkastellaan työttömyysturvaetuuteen liittyviä sanktioita Suomessa sekä niiden vaikutusta työllistymiseen. Tarkemmin sanottuna, onko työllistymisen todennäköisyys suurempi niillä työttömillä, jotka ovat saaneet sanktion verrattuna niihin työttömiin, jotka eivät ole sanktiota saaneet? Työtön henkilö voi menettää oikeutensa työttömyysturvaetuuteen määrääjäksi eli saada sanktion, jos hän esimerkiksi kieltäytyy itselleen sopivasta työstä tai työvoimapoliittisesta toimenpiteestä.

Tutkimuksessa hyödynnetään julkisen työnvälityksen rekisteriaineistoa työttömistä työnhakijoista vuosilta 2003-2009, yhdistäen siihen Finanssivalvonnan ja Kansaneläkelaitoksen tilastoja maksetuista työttömyysturvaetuuksista. 'Timing-of-events' -mallin tulokset osoittavat, että sanktiot kannustavat työttömiä työllistymään, mutta vaikutus on huomattavasti suurempi työmarkkinatukea saavilla verrattuna ansiosidonnaista työttömyyspäivärahaa nauttiviin henkilöihin. Tuloksia selittää osaltaan se, että sanktioita annetaan huomattavasti enemmän työmarkkinatukea nostaville henkilöille. Osallistumistodennäköisyys työvoimapoliittisiin toimenpiteisiin näyttäisi kasvavan sanktioiden myötä, mutta jälleen kerran merkitsevästi vain työmarkkinatuen piirissä olevilla.

Luvussa 3 selvitetään työnantajan etsintäkäyttäytymistä Suomen työmarkkinoilla tarkastelemalla julkiseen työnvälitykseen vuosina 2002-2003 ilmoitettujen työpaikkojen kestoja niiden täyttämiseen saakka. Erityishuomiota tutkimuksessa kiinnitetään informaatioteknologiaan ja sen rooliin rekrytoinnissa. Onko työpaikkojen täyttö tehostunut verkkopalvelun käyttöönoton jälkeen (lokakuu 2002)? Verkkopalvelulla tarkoitetaan julkisen työnvälityksen Internet-pohjaista palvelua, jossa työnantaja voi tunnuksilla sisään kirjautuessaan ilmoittaa uusia työpaikkoja, ilmoittaa paikkoja täytetyksi sekä peruuttaa niitä. Tutkimuksessa pyritään tuomaan esille myös alueellista näkökulmaa, mikä on tärkeä lähestymistapa Suomen kaltaisessa maassa, jossa eri alueiden työmarkkinaolosuhteet poikkeavat suuresti toisistaan, ja työpaikat ja väestö keskittyvät yhä enemmässä

määrin muutamille kasvukeskusalueille. Artikkelissa analysoidaan, onko verkkopalvelulla erilainen vaikutus eri alueilla avointen työpaikkojen täyttymiseen?

'Mixed proportional hazard' -menetelmän tulosten perusteella julkisen työnvälityksen verkkopalvelun käyttöönotolla on ollut positiivisia vaikutuksia avointen työpaikkojen täyttymiseen. Työpaikkojen täytön todennäköisyys on keskimäärin hieman noussut (14%) palvelun käyttöönoton jälkeen. Palvelun käytössä ja työpaikkojen täytössä on kuitenkin alueellisia eroja. Verkkopalvelulla näyttäisi olevan positiivisia vaikutuksia rekrytointiin vain kaupunkialueilla ja muutamissa TE-keskuksissa, joissa avointen työpaikkojen keskimääräinen täyttöaika on lyhentynyt.

Luovussa 4 tarkastellaan työnantajan etsintäkäyttäytymistä hieman toisenlaisesta näkökulmasta. Erityishuomion kohteena tutkimuksessa ovat peruutetut työpaikat eli paikat, jotka on vedetty pois työmarkkinoilta ennen kuin ne on täytetty. Tutkimuksessa selvitetään teknologian vaikutusta työpaikkojen peruuttamiseen sekä lyhyellä että pitkällä aikavälillä julkisen työnvälityksen rekisteriaineistoa hyödyntäen. Ensinnäkin, onko työpaikkoja peruutettu nopeammin kuin aikaisemmin (heti) julkisen työnvälityksen verkkopalvelun käyttöönoton jälkeen (2002-2003)? Toiseksi, onko verkkopalvelulla ollut vaikutusta työpaikkojen peruuttamiseen pidemmällä aikavälillä tarkasteltuna (2002-2008)? Mallinnuksessa käytetään hyväksi sekä 'difference-in-differences' - lähestymistapaa että 'accelerated failure time' -mallia.

Tulosten mukaan julkisen työnvälityksen verkkopalvelun käyttöönotolla ei ole ollut merkittävää vaikutusta työpaikkojen peruuttamiseen, sillä avointen työpaikkojen keskimääräinen peruuttamisaika ei ole lyhentynyt. Sekä lyhyen että pitkän aikavälin tarkastelut osoittavat, että työpaikkoja poistetaan hitaammin verkkopalvelun kuin työvoimatoimistojen kautta. On mahdollista, että työnantajat kokevat verkkopalvelun vain täydentäväksi rekrytointivaihtoehdoksi perinteisille työvoimatoimiston palveluille. Voi myös olla, että peruuttamisajankohta on työnantajalle kustannusmielessä yhdenentekevä, koska julkisen verkkopalvelun käyttö on ilmaista.