Spatial search strategies of job seekers and the role of unemployment insurance*

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Abstract

Job search is a spatially oriented activity. Searching farther is costly, and working far away from home entails high costs, affecting job acceptance decisions. We build a simple theoretical framework where job seekers choose how much to search, how far to search, and what lowest wage they accept for a given commute distance. In this setup, unemployment insurance discourages broader job search through reducing the net gain from getting a job. Opposite forces encourage broader search, either through the re-entitlement effect or, under liquidity constraints, to finance costly spatial job search.

We use a unique dataset on all workers entering unemployment in Austria between 1995 to 2004 to investigate these forces. Newly unemployed workers initially find relatively more frequentely jobs in the same workplace as they used to be employed. As the unemployment spell gets longer, they both accept lower wages and progressively enlarge their radius of search, ending up with a job farther away from their previous workplace (but not necessarily farther away from their residence). Unemployment insurance reduces reservation wages at a given accepted commute distance, and encourages search outside the municipality of the previous job. Reducing potential benefit duration affects wages and commuting distance more strongly than changes in the benefit level.

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1 Introduction

Most people do not work where they live, and travel times to work are substantial. Commuters travel about 70 minutes to and from work in the US, and about 60 minutes in Germany, the UK, and France (OECD (2010)). Standard models of job search do not account for the fact that job seekers work outside their homes. Neglecting space is, perhaps, a useful simplification. But space has to matter in some decisions. The decision to accept a job will depend on commuting costs and mobility costs, not only the wage and its distribution. Job seekers who are looking for jobs will, optimally, want to use a reservation strategy involving both a reservation wage and a reservation commute distance, tied to each other. Further, even within acceptable commute distances, searching for jobs far away from one's residence may be expensive. Under liquidity constraints, job search efficiency may be seriously limited. This implies that unemployment insurance plays a role typically overlooked to improve the job search process.

The distance dimension of job search has several policy implications, beyond equilibrium unemployment, notably on the optimal design of unemployment compensation. Although explicit in many empirical and theoretical works, it is not central in most analyses. As a matter of fact, the commute time dimension is relevant in job acceptance decisions, and its impact is of the order of magnitude of the wage dimension; to illustrate, Table 1 shows that many job seekers report that the primary reason for rejecting a job offer is not for too low wages, but for too high distance. Excluding all reasons but wages and commute distance, the last column shows that 60% of job offers are rejected for too low wages, but 40% are rejected for too high commute distances. The commute distance is therefore a potentially first-order margin in job acceptance decisions. Of course, wage and distances interact: there might be a wage level making a commute distance acceptable.

In this paper, we explore these trade-offs and proceed as follows. We first derive a simple theory of job search in space that includes commute distance and optimal spatial search strategies. This will introduce the key concepts and discipline the empirical analysis in providing simple expressions for hazard rates. The three main endogenous variables are: the wage reservation strategy for a given commute distance (or equivalently the optimal

Table 1: Reasons for rejecting offers

	%	% excl. last 3	% excl. last 3 & hrs	% compared to wage rate
1. rate of pay	12.1	21.8	24.7	59.7
2. temporary/insecure job	6.65	12.0	13.6	-
3. type of work	12.9	23.3	26.4	-
4. number of working hours	6.05	11.0	-	-
5. working time (day/night time, shifts...)	6.42	11.6	12.4	-
6. working conditions / environment	3.06	5.54	6.27	-
7. **distance to job / commuting**	**8.14**	**14.7**	**16.7**	**40.3**
8. could not start the job at required time	4.82	-	-	-
9. other reasons for not accepting	20.99	-	-	-
10. not yet decided	18.93	-	-	-
Sum	100	100	100	100

Source: Rupert *et al.* (2009).

reservation distance for a given wage); the optimal radius of job search in space; and within this range, the optimal intensity of search effort. We solve for the optimal acceptance decision where the interplay of accepted wages and accepted commute distance depends on the marginal rate of substitution between the two: individuals can buy short commutes with a lower wage or seek to be compensated with a higher wage for long commutes. This has obvious implications on job search strategies: indeed, once they correctly anticipate their future decision rules, unemployed individuals looking for a job may try to enter jobs that pay a higher wage and involve a shorter commute time relative to the previous job. We explore the implications for hazard rates and the role of unemployment insurance under various assumptions on liquidity constraints. As a matter of fact, in several countries, the spatial component of the costs of job search is either partly financed by the employment agencies, or deductible from income taxes[1].

[1] Eg. in the US, job search expenses are partly deductible from IRS. "*To qualify for a deduction, your expenses must be spent on a job search in your current occupation. You may not deduct expenses you incur while looking for a job in a new occupation; (...) ; If you travel to look for a new job in your present occupation, you may be able to deduct travel expenses to and from the area to which you travelled. You can only deduct the travel expenses if the trip is primarily to look for a new job ; (...) ; You cannot deduct job search expenses if you are looking for a job for the first time.*" Source ; http://www.irs.gov/uac/Job-Search-Expenses-Can-be-Tax-Deductible. In France, a similar regime of tax deduction applies, complemented with direct subsidies of job search from Pôle Emploi (the employment agency): http://vosdroits.service-public.fr/particuliers/F1640.xhtml. In Austria, job search assistance covers parts of job search costs.

We use an exhaustive panel of newly unemployed workers based on an administrative dataset in Austria, covering years 1995 to 2004 and overall more than 150 000 spells of unemployment to establish a few stylized facts related to commute distance and job acceptance decisions. The choice of Austria is motivated by data availability: we know the city of residence and the city of employment and can match these informations with information about transportation time from a private company which provided a matrix of travel time based on the existing network of roads and highways in 2000, approximately in the middle of our sample. The choice of Austria is also relevant because we want to isolate the commute time decision from the residential mobility decision. For unemployed individuals, we calculate that about 6% change their residency over the turn of non-employment. It turns out that the influence of mobility on the empirical results can be negligted in a first order, which considerably simplifies the analysis

In the data,we observe fairly high dispersion in the change of commuting distance and wage which make both margins relevant for unemployed individuals. We introduce an analysis of a competing risks model and its relative hazard ratios. Newly unemployed workers seem to start the job search from the same workplace as they used to be employed and looking for high wage jobs. As the unemployment spell gets longer, they tend to accept lower wages and progressively enlarge their range of search, ending up with a job farther away from their previous workplace. We offer evidence of a reservation frontier strategy in the wage/distance plane. We then investigate the role of policy and in particular unemployment insurance, in estimating Cox Proportional Hazard models. They provide measures of the causal effects of the unemployment insurance replacement rate, the social assistance replacement rate, and benefit duration (proxied by potential benefit duration) and show that their impact varies by destination (distance winners vs. loosers, wage loosers vs. wage winners).

The empirical analysis thus offers guidance in the solution and the calibration of an enriched model of the labor market capturing in a more accurate the regularities in the data. The model is therefore enriched along several dimensions. First, we allow for different unemployment compensation regimes: newly unemployed workers are covered by unemployment insurance, but they can subsequently loose it for a reduced level of benefits, in the unemployment assistance regime. We also allow individuals to target their job search activity in space, distinguishing effort inside and outside the previous workplace. Finally, we also introduce non-separability in consumption and search costs to allow for richer reservation strategies. Once calibrated, the model reproduces the empirical fact that, over time and as unemployment benefits decrease, the unemployed progressively adjust their reservation strategies: their reservation wage goes down and in addition they start prospecting in different areas. The model predicts that individuals remaining unemployed for longer time have a higher probability to enter less paying jobs and/or jobs located farther away from the previous job. The model delivers simple expression for all hazard rates (overall exit to employment, exits towards higher wages than in the previous job, exits towards lower wages, exit towards higher commute distances and towards lower distances) and all relative hazard rates.

A very large number of classical or more recent papers have been explicit about commute distance. Crampton (1999) has a discussion of the optimal location of vacancies and their number, illustrated by the classical papers by Seater (1979), Chirinko (1982) and more recently van Ommeren *et al.* (1997). Racial differences have been analysed through the lens of distance and access to jobs in the spatial mismatch literature following Kain (1968): papers include Holzer (1986; 1987; 1988), Ihlanfeldt (1997), Zax and Kain (1996), Brueckner and Zenou (2003) and Coulson *et al.* (2001) and are summarized in Gobillon *et al.* (2007) and Zenou (2009); see also van Vuuren (mimeo) and Nenov (2015). The articulation between commuting decisions and mobility decisions has been studied by Rupert and Wasmer (2012) and applied to ethnic unemployment gaps in Gobillon *et al.* (2014) for commuting vs mobility decisions. More closely related to our work, the role of local labor markets has been investigated in Cheshire (1979), Rogerson (1982), Manning and Petrongolo (2011), Gobillon *et al.* (2011) and Marinescu and Rathelot (mimeo). The latter find in particular that job seekers's applications from a particular website, Carreer.Builder, decrease by 20% every 5 kilometers of distance between the applicant's address and the vacancy. Manning and Petrongolo (2011) also found a large decay, somewhat higher (approximately 80%), but for a different concept, the concept of job acceptance (and not of simple applications). Finally our work is connected to the large literature measuring the value of time across different transportation modes, at short and longer distances (see Brownstone and Small (2005) for road use and Hammadou and Jayet (2003) for longer transportation times). Recent papers, using experimental setups, have investigated the role of information on search strategies, including the broadness of search. See notably Altmann *et al.* (2015) and Belot *et al.* (2015).

Our paper also ties to a literature on the role of unemployment insurance for job finding and job quality. Ehrenberg and Oaxaca (1976) were the first to look at the effect of unemployment insurance on post-unemployment outcomes and find positive effects of unemployment benefits on post unemployment wages for different age groups and gender. Addison and Blackburn (2000) provide evidence for a weakly positive effect of unemployment benefits on post unemployment wages. Centeno and Novo (2006) use a quantile regression approach to analyze the relationship between the unemployment insurance system and the quality of subsequent wages and tenure over the whole support of the wage and tenure distributions. They find a positive impact of unemployment benefits on each quantile of the wage and tenure distribution. Several recent studies, based on regression discontinuity designs, find little or no effects of Potential Benefit Duration (PBD), mostly looking at wage or job stability. Card *et al.* (2007a) and Lalive (2007) find little evidence on wages and/or job stability in the Austrian context. van Ours and Vodopivec (2008) find that a reduction in the potential benefit duration has only small effects on wages, on the duration of subsequent employment and on the probability of securing a permanent rather than a temporary job. Le Barbanchon (2012) finds no effects on wages or employment. Two studies find positive effects of PBD on low wage earners or job seekers at risk of exhausting their benefits. Centeno and Novo (2009) detect a positive impact on the match quality for individuals at the bottom of the wage distribution. Caliendo *et al.* (2013) find that the unemployed who obtain a new job close to benefit exhaustion are more likely to leave subsequent employment and receive lower wages than than their counterparts with extended benefit duration. Two studies on Germany find negative effects of PBD extensions. Schmieder *et al.* (2012) analyze the long-term effects of extensions in UI durations taking into account not only the initial, but also all recurrent nonemployment spells. They find significant long-run effects of an extension in UI duration on the duration of nonemployment up to three years after the start of the initial spell. Schmieder *et al.* (2013) study the effects of PBD changes on re-employment wages in

Germany finding sharp negative effects of PBD extensions for older workers. Two studies on the Austrian context find positive effects of benefit extensions. Degen (2014) and Nekoei and Weber (2014) study the effects of PBD for job quality in Austria, exploiting a sharp increase in PBD from 30 to 39 weeks for workers aged 40 years or older. Both papers find a positive effect of prolonged PBD on wages on the order of 0.5 percentage points. Nekoei and Weber (2014) rationalize this finding in a directed job search framework and discuss the implications of this finding for policy.

Our paper extends and complements this rich literature in several respects. We build a simple theoretical search model where spatial decisions matter and make job acceptance depend on both wages and commute distance. Although several papers have done similar exercises, the model is flexible enough to provide functional forms that accurately match empirical concepts, such as hazards, sub-hazards and relative hazards ratios with respect to both commute distance and wage changes across jobs. We discuss whether and how much job seekers trade these two dimensions off. We use a rich framework and study how liquity constraints may impede job search and how a subsidy might improve efficiency. The empirical exercise adds to the unterstanding of how unemployment benefits impact post-unemployment outcomes. This paper adds to this literature in assessing systematically not only how wages but also commuting distance is affected by the unemployment insurance system by estimating the effects on both outcomes simulatenously. This sheds light on how individuals not only decide for wages *or* distance but also for wages *and* distance. The estimation by means of the competing risk approach together with non-linearities in the determination of unemployment insurance parameters allows for a credible estimation of the impact of these parameters on both, distance and wages. Overall, policy plays a crucial but complex role on job acceptance decisions and in turn on job search processes.

The paper is organized as follows. **Section 2** introduces the key concepts behind the spatial analysis of job search. **Section 3** provides various and hopefully exhaustive evidence of the role of space in job search and the spatial dispersion of commute distances, based on our rich data set of unemployment spells in Austria. In **Section 4**, we extend the model in order to provide a realistic calibration. In **Section 5** we calibrate the model based on relative hazard ratios in the data and draw lessons for policy. **Section** 6 concludes.

2 A simple theory of search in space

The goal of this section is to provide the basic trade-offs of spatial search and comute and draw some implications of the theory. The model derives the reservation strategy defined here as *the minimum acceptable wage for a given commute distance. Commute distance* implies some costs and effort. Reciprocally, there is a maximum acceptable commute distance at a given wage. The agents, knowing their future strategy of job acceptance, optimally calculate the range of search, that is the maximum distance within which to prospect; finally, they determine the optimal intensity of search effort, captured by the arrival rate of job offers within the range of search.

2.1 Setup

2.1.1 Notations

Time is continuous. Individuals and firms discount the future at rate r. The level of benefits is b. Searching for a job is more costly in more remote area. Let D be the radius of search, and $2\pi\lambda$ be the rate of arrival of search offers (where 2π is a simple proportionality factor coming from the integration of search in a circle around the individuals' location). Job seekers control both the intensity of search effort λ and the range of search at a cost $C(D, \lambda)$. At this stage we do not specify the nature of the search costs but they may be both pecuniary and non-pecuniary. We also assume perfect separability between search costs and consumption. Denote by $U(D, \lambda)$ the value of job search and by $W(w, \rho)$ the value of being employed at a wage w and at a commute distance ρ. The employed workers pay a commute cost $c(\tau\rho)$ which depends on commute time ρ and the cost of transportation τ. We also assume perfect separability in consumption and commute costs.

2.1.2 Unemployment and Employment values

Each job offer consists in a random draw of wage and distance from a given two-dimensional distribution. We do not restrict the draws (w, ρ) to be independent. With notations $F_\rho(w)$ and $G(\rho)$ for the associated cumulated distributions of each variable separately, we can go one step furher. In this case, the Bellman equations for job search are:

$$rU(D,\lambda) = b - C(D,\lambda) + 2\pi\lambda \int_0^D \left(\int_w Max[W(w,\rho) - U; 0] dF_\rho(w) \right) dG(\rho) \qquad (1)$$

The value function for employment is:

$$rW(w,\rho) = w - c(\tau\rho) + s(U - W(w,\rho)) \qquad (2)$$

2.2 Interior solutions and strategies

The surplus from employment can be easily calculated, given the linearity in income. Noticing that $\frac{\partial W}{\partial w}(w,\rho) = \frac{1}{r+s}$; and denoting by $R(\rho)$ the reservation wage associated with distance ρ, defined as $W(R(\rho),\rho) = U(D^*,\lambda^*) = U^*$, we can rewrite the value of employment as a linear function of w:

$$W(w,\rho) - U^* = \frac{w - R(\rho)}{r+s} = S(w,\rho) \qquad (3)$$

where the notation $S(w,\rho)$ is the surplus value of holding a job paid w at a commute distance ρ.

We can now derive the reservation wage: it turns out to depend on commute costs and on the equity value of being unemployed under the optimal job search strategy. We have:

Lemma 1. *The reservation wage is linearly increasing in commute costs and in the unemployment value:*

$$R(\rho) = c(\tau\rho) + rU^*$$

It is convex or concave in the commute distance, depending on the convexity or concavity of commute costs. Convexity would result from disutility from time spent in commute, while concavity may result from optimization of transportation modes.

The interior optimal search strategies also follow immediately.Let $w^{\max}$ be the upper support of the wage distribution. Then, combining eq. 1 and 3 we have

$$rU(D,\lambda) = b - C(D,\lambda) + 2\pi\lambda \int_0^D \int_{R(\rho)}^{w^{\max}} S(w,\rho) dF_\rho(w) dG(\rho) \tag{4}$$

The first order condition on the radius is obtained by deriving eq. 4:

$$\begin{aligned} C'_D(D^*,\lambda^*) &= 2\pi\lambda \left(\int_{R(D^*)}^{w_{\max}} S(w,D^*) f_\rho(w) dw \right) g(D^*) \\ &= 2\pi\lambda g(D^*) \mathbb{E}_w S(w,D^*) \end{aligned} \tag{5}$$

so that $U(D,\lambda)$ is maximised with respect to the search strategy D when the marginal cost of searching at one more unit of distance is equal to the marginal gain. The marginal gain depends first on the direct impact on the flow of offers (first term of the right handside) and second on the change of the surplus among acceptable offers (second term of the right handside). The first order condition on optimal search effort affecting the arrival rate of offers λ reads as follows:

$$\begin{aligned} C'_\lambda(D^*,\lambda^*) &= 2\pi \int_0^D \int_{R(\rho)}^{w^{\max}} S(w,\rho) dF_\rho(w) dG(\rho) \\ &= 2\pi \mathbb{E}_{w,\rho} S(w,\rho) \end{aligned} \tag{6}$$

Both expressions show that the marginal cost has to equal the marginal gain of search, either with respect to extending the range of search by one marginal unit D, or by increasing the intensity of effort within the range. In both expressions, the marginal return on search involves the expected surplus value of holding a job.

Lemma 2. *Under separability of the cost function $C(D,\lambda)$, equation (5) implies that a higher arrival rate of offers λ is associated with a higher return on the range of search D, implying a complementarity of the two dimensions of search.*

Lemma 2 is not general, and under complementarity in the cost function $C(D,\lambda)$, the two search variables may be more substitute to each other: a higher λ raising the marginal cost of enlarging the range of search may in turn reduce the optimal radius D^*. The dominance of each mechanism is an empirical matter and we leave the question unanswered here.

2.3 Hazard rates, odds ratios and rejection rate

The unemployment exit hazard is shaped by search intensity, search radius, and reservation wage as follows:

$$haz = 2\pi\lambda \left[\int_0^D \int_{R(\rho)}^{w^{\max}} dF_\rho(w) dG(\rho) \right]$$

The unemployment exit hazard depends on search intensity λ, search radius D, and on the reservation wage $R(\rho)$. Job seekers who search hard, or have a large search radius, or have a low reservation wage, will leave unemployment for a regular job faster. The unemployment exit hazard contains information on all three endogenous variables.

To anticipate the empirical part, we will decompose the total exit hazard into sub-hazard rates that reflect the quality of jobs the unemployed might find: paying better or worse, or being farther or closer to home than the previous job, like in a competing-risks framework. More precisely, w_{-1} is the wage, and d_{-1} is the commuting distance in the job prior to entering unemployment. w^+ refers to a wage increase, d^+ means an increase in commute distance relative to the previous job. Equivalently, w^- refers to a wage decrease, d^- means a decrease in commute distance relative to the previous job. The sub-hazard rate $haz(w^+, d^+)$, refers to job seekers accepting a new job with wage increase ($w > w_{-1}$) at the cost of commuting longer to this new job ($\rho > d_{-1}$). The sub-hazard of finding a better paying job located closer to home is defined as $haz(w^+, d^-)$, the sub-hazard of finding a worse paying job, located farther away from home is defined as $haz(w^-, d^+)$, and the sub-hazard rate of finding a worse paying job located closer to home is defined as $haz(w^-, d^-)$. We now express these sub-hazards in terms of the primitives of the model. Under the assumption that determinants of job search have not varied since the previous episode of job search, the search radius includes the previous distance, and the reservation wage is below the wage earned in the previous job : job seekers would accept the previous job if offered again to them. The four sub-hazard rates are then easy to write as:

$$sub - haz(w^+, d^+) = 2\pi\lambda \int_{d_{-1}}^{D} \int_{w_{-1}}^{w^{\max}} dF_\rho(w) dG(\rho) = 2\pi\lambda[1 - F(w_{-1})][G(D) - G(d_{-1})]$$
$$sub - haz(w^+, d^-) = 2\pi\lambda \int_{0}^{d_{-1}} \int_{w_{-1}}^{w^{\max}} dF_\rho(w) dG(\rho) = 2\pi\lambda[1 - F(w_{-1})]G(d_{-1})$$
$$sub - haz(w^-, d^+) = 2\pi\lambda \int_{d_{-1}}^{D} \int_{R(\rho)}^{w_{-1}} dF_\rho(w) dG(\rho) = 2\pi\lambda \int_{d_{-1}}^{D} [F_\rho(w_{-1}) - F(R(\rho))] dG(\rho)$$
$$sub - haz(w^-, d^-) = 2\pi\lambda \int_{0}^{d_{-1}} \int_{R(\rho)}^{w_{-1}} dF_\rho(w) dG(\rho) = 2\pi\lambda \int_{0}^{d_{-1}} [F_\rho(w_{-1}) - F_\rho(R(\rho))] dG(\rho)$$

As visible from the second equation, the first sub-hazard $sub - haz(w^+, d^-)$ does not depend on the endogenous variable D and on function R, which itself depends on the value of unemployment U; while the first one, $sub - haz(w^+, d^+)$, depends only on search radius, D, but not on the researvation wage. The last one, $sub - haz(w^-, d^-)$, depends on the reservation wage, $R(\rho)$, but not on the search radius. Finally, the third one, $sub - haz(w^-, d^+)$, depends on both search radius, and reservation wage. All sub-hazards depend on search intensity to the same extent, a result of our assumption that job seekers can not engage in directed search.

Under the simplifying assumption that F is not indexed by ρ in the expressions above, that is when the two distributions F and G are independent of each other, the relative hazards – the odds ratios – with respect to $sub - haz(w^+, d^-)$ can therefore be calculated as follows:

$$relhaz = \frac{sub - haz(w^+, d^+)}{sub - haz(w^+, d^-)} = \frac{[G(D) - G(d_{-1})]}{G(d_{-1})}$$
$$relhaz^2 = \frac{sub - haz(w^-, d^+)}{sub - haz(w^+, d^-)} = \frac{\int_{d_{-1}}^{D} [F(w_{-1}) - F(R(\rho))] dG(\rho)}{[1 - F(w_{-1})]G(d_{-1})}$$
$$relhaz^3 = \frac{sub - haz(w^-, d^-)}{sub - haz(w^+, d^-)} = \frac{\int_{0}^{d_{-1}} [F(w_{-1}) - F(R(\rho))] dG(\rho)}{[1 - F(w_{-1})]G(d_{-1})}$$

The first ratio of sub-hazards, $relhaz$, compares the chances of finding a better paying job farther away from home with the chances of finding a better paying job closer to home. This ratio should in principle depend on both the wage and distance in the previous job, but wage terms actually cancel each other out and the ratio only depends on the previous distance and the search radius. The last ratio $relhaz^3$ represents the relative probability of accepting a job with a wage cut compared to a better paying job, where both jobs are closer to home than the previous job. This odds ratio provides information on the reservation wage only, as both jobs are within the search radius. The ratio $relhaz^2$ represents the relative probability of accepting a job with a wage cut farther away from home relative to a better paying jobs closer to home. Since the "bad" jobs in the numerator are worse in both dimensions, the ratio $relhaz^2$ reflects the joint evolution of reservation wages and search radius. Odds ratios do not contain search intensity since it affects all sub-hazards to the same extent.

The job rejection rate is, in the general case:

$$reject = \int_0^D F_\rho(R(\rho))dG(\rho)$$

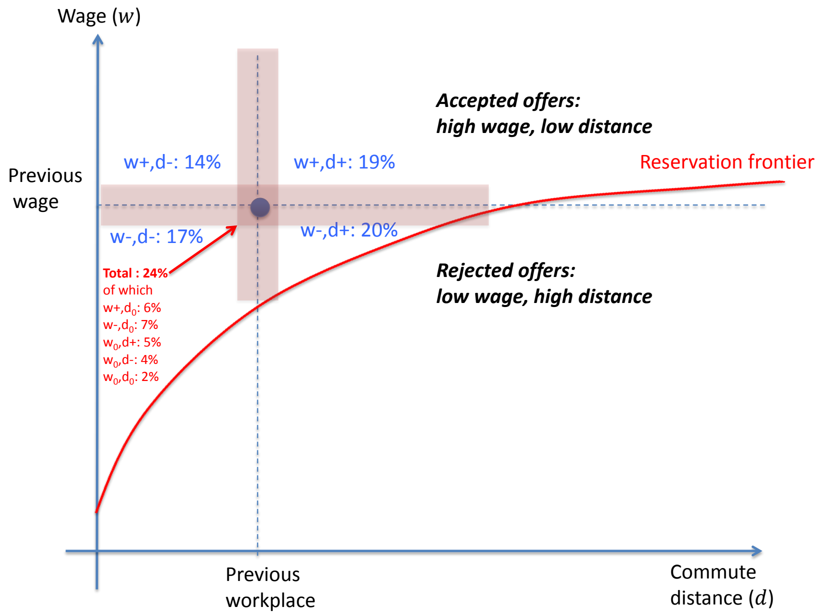
Under the assumption of independence of the joint distribution of wages and distance, the rejection rate increases in D: at a higher distance, it is more likely that the drawn wage will not compensate for distance.

2.4 The effect of distance on wages

The model thus explicitly accounts for the role of distance on reservation wage and on expected, accepted wage. The reservation frontier in wage and distance can be represented as in Figure 1, here under the assumption of concave costs of distance $c(\tau\rho)$. The figure also displays the proportions of each unemployment-employment trajectory from the data used in next Section.[2]

[2]We use here the same notations as in previous sub-Section, as well as new notations for "wage stayers" (w_0) and "city stayers" (d_0). Labels $d+$, d_0 and $d-$ therefore reflect the trajectories towards longer, identical and shorter commuting distances respectively, while $w+$, w_0 and $w-$ represent trajectories towards jobs paid more than +4% than the previous job, similar wages, that is in the interval (+4%;-4%) and finally paid less than 4% than the previous job.

Figure 1: Reservation Frontier and Acceptance-Rejection Areas.



Notes: Percentages in reported on the Figure refer to the fraction in Austria of the newly employed individuals in each of the quadrants defined by the wage/commute distance in their previous job. Source: author's calculations from Section 3.

In the data, we do not directly observe the reservation distance but only accepted wages and accepted commute distances. When the two distributions in wages and distances are independent, it is possible to calculate conditional wages and their slope with respect to commute distance with a simpler formula. In this specific case we have:

$$w^e(\rho) = \frac{1}{1 - F(R(\rho))} \int_{R(\rho)}^{w^{\max}} w dF(w)$$

and the slope of w^e with respect to ρ is

$$\begin{aligned}
\frac{\partial w^e}{\partial \rho} &= \frac{c'(\tau\rho).f(R(\rho))}{[1 - F(R(\rho))]^2} \int_{R(\rho)}^{w^{\max}} w dF(w) + \frac{-c'(\tau\rho)R(\rho)f(R(\rho))}{1 - F(R(\rho))} \\
&= \frac{f(R(\rho))c'(\tau\rho)}{1 - F(R(\rho))} (w^e - R(\rho))
\end{aligned}$$

The slope is clearly positive, as accepted wages are above the reservation one at any given distance. It is not linear and might be either convex or concave, depending on the features of the wage distribution $F(\cdot)$.

3 Empirical analysis

3.1 Geography and institutional background

Time and costs associated to commuting are relevant for the majority of Austrian workers. Indeed, in the year 2001, 92% of the total workforce commuted and 86% of the total workforce commuted daily. 67% of the daily commuter cover the major commuting distance by car, 20% commute by public transport and 13% either walk or commute by bicyle. 68% of the daily commuting individuals work in a different municipality than they live in. Yet, 80% stay within a political region (there are 99 political regions), hence many stay in the same county, which means that mobility is limited in Austria. As people do not incur long commutes on average, one concern for our analysis might be that individuals try to avoid commuting by relocating. Although there can be benefits in terms of commuting, there is certainly a cost involved in relocating. Compared to the US, residential mobility in Austria is low. Fischer (2002) provides calculations for the US. For Austria, we calculate that less than 6% (between 10-15% for the US) change the residential municipality and less than 1.6% (above 5% for the US) cross the county border annually. In particular in our sample, less than 5% change the residence over the turn of unemployment[3].

The geography of Austria adds to make it an interesting country to study commuting. Austria is a relatively small country yet with potentially large commute distances due to the presence of the Alps and the particular longitudinal shape: the maximum distance from west to east is around 700 kilometers. Cutting through Münich in Germany, the distance between the northwestern city of Bregenz to Wien (Vienna) is 618 kilometers and six hours drive. The distance between the southern city of Klagenfurt to the northern city of Linz is only 251km but it takes 3 hours to reach the other city given the mountains. Figure 2 plots Austria and the altitude of each municipality. The white lines constitute borders of municipalities. The black lines depict the borders of NUTS3 regions. A dark colour indicates that the municipality is high above sea level. Altitude ranges from 110 to 1600 meters above sea level. The Alps in the middle of the country are clearly visible as are the

[3]Sources: CPS 2001 Statistik Austria, own calculations from tax records.

flat parts in the east towards Hungary. This variety in the terrain is likely to have an impact on how individuals commute.

We will study the effects of unemployment insurance extensively. The unemployment system in Austria, as in many other countries, consists of a first part where eligible individuals receive Unemployment Insurance (UI) benefit (UB). The level of UI benefits is calculated based on base earnings, where base earnings refer to average earnings in the baseline period. The baseline period is the year $t-1$ for job seekers who enter unemployment between July and December of year t. The baseline period is the year $t-2$ for job seekers who enter unemployment from January to June in year t. Baseline earnings are multiplied with the replacement rate to calculate unemployment benefits. Benefits are capped from below and above, the cap being adjusted annually for inflation. We will exploit these caps to identify the effects of unemployment benefits in our analysis below.

The potential duration of unemployment benefits (PBD) is a function of past work experience and age. For instance, job seekers who have been working for a at least 3 out of the previous 5 years, and are 40 years or older when registering for unemployment benefits receive 39 weeks of unemployment benefits compared to 30 weeks if they are less than 40 years old.[4] A similar discontinuity exists at age 50, where PBD increases from 39 to 52 weeks, for job seekers who worked 9 out of the previous 15 years.

Once unemployment benefits are exhausted, individuals are eligible for means tested Unemployment Assistance (UA; Notstandshilfe) benefits. The means test includes in particular family income and wealth which makes it unlikely for many individuals to actually get UA benefits. Conditional on getting UA benefits they can be fairly high, as much as 92% of UB. UA does not end, but job seekers need to re-apply for UA once every 26 weeks.

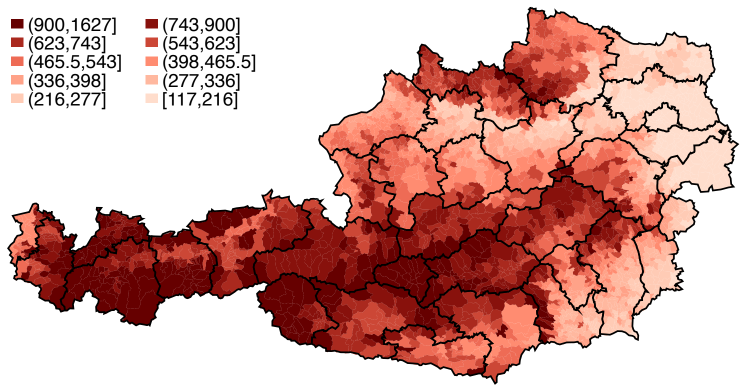
3.2 Data and Sample

We combine data from different sources to reach our final data set. First, the Austrian Social Security Database (ASSD)[5] contains detailed information on the work history for all private sector workers from 1972 to present. It contains both a unique plant and person

[4] See Nekoei and Weber (2014) who analyze this discontinuity.

[5] See Zweimüller *et al.* (2009) for a detailed description of the data set.

Figure 2: Altitude of Municipalities



identifier. Second, the unemployment register contains detailed information on both UI and UA benefits for the years 1988 to 2007. Third, we use data from a road trip planning firm to measure travelling time between any two municipalities.[6]

To construct our data set we obtain all unemployment spells from the ASSD that last at least for 7 days. For a given unemployment spell we figure out information about the last and next (if there is one) employment spell. For the relevant employer-employee relation before and after unemployment, we obtain the following variables: exact date of termination and start of the relation, average daily wage (yearly contribution to the social security system divided by the number of working days), geographic location (municipality-level[7]), industry affiliation of the employer. For the individual we know the month of birth and gender and we can calculate tenure on either job, experience, sickness, occupation (blue/white collar).

The two variables age and experience allow us to calculate the potential benefit duration for UI benefits. Knowing this duration, we are able to distinguish between time of UI and (potential) UA receipt for each unemployment spell. For each unemployment spell we

[6]Our data set only contains individuals who live and work in Austria. Hence we do miss commuters across national borders. Official statistics suggest that we do not miss out many cases. From the census 2001, there are 3.6 millions individuals listed as employed of which 57,730 (1.59%) said they live in Austria but work abroad, mostly in Germany. We know the precise number of Austrian cross border workers only for Switzerland. Namely in 2013Q3 there were 8,119 Austrians who crossed the border at least once a week to work in Switzerland. Back in 2002Q3 the figure was 6,985. Conversely, the tax data authority indicates that of those who have to pay taxes in Austria, 5.8% live abroad and this latter number also includes individuals temporarily living abroad.

[7]There were 2376 municipalities in 2014.

know the exact duration on days. Furthermore, the data allow us to calculate the non-employment duration. This is the number of days between the succeding and the previous job. The ASSD data allow us to determine the basis on which benefit are calculated, which is typically different from the previous wage. We can identify the unemployment spells form the ASSD data in the unemployment register. From the unemployment register, we obtain the municipality of residence, the UI and UA benefit level, education and information on the family situation.

The third data set, road trip planning data from the year 2000, contains time and distance in kilometers between any pair of municipalities. This distance is measured between the centroids of the municipalities. Hence, for each unemployed individual we can calculate previous and succeding distance to the workplace[8].

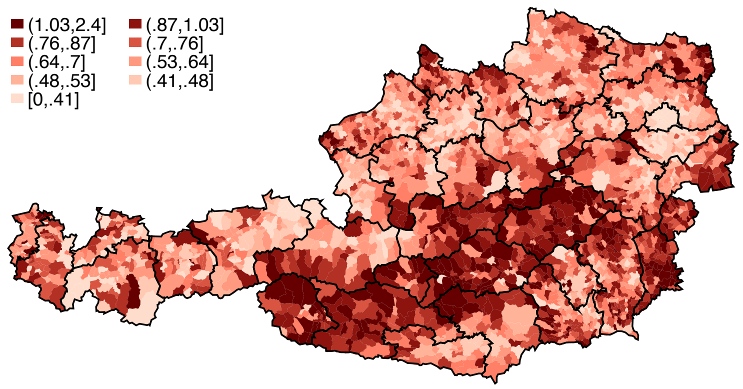
We restrictthe analysis along some dimensions. First, we focus on unemployment spells starting between January 1995 and December 2004. The main reason to start after 1994 is to avoid interactions with a major change in the unemployment system that extended the potential benefit duration substantially for certain individuals[9]. Second, we include individuals aged 20 to 54 at the start of unemployment. We do not want to include older individuals to avoid interactions between unemployment and early retirement, which is strong in Autria as assessed in Inderbitzin *et al.* (2013). Third, we exclude individuals with a commute of more than two hours prior to unemployment. These are most likely weekly commuters and may have a different search patterns relative to daily commuters, who are of main interest in our study. Fourth, individuals who quit voluntarily[10] and those who return to the same employer are excluded. The particular data we use need two more restrictions. First, the average daily wage we are measuring confounds hours and the wage rate. This is a major problem for women but not for men. We focus on men because virtually all men work fulltime. Second, the commuting time we measure is not door to door but municipality to municipality. This is a potential source of measurement error which may be particularly relevant in metropolitan areas, where the actual commuting time is highly affected by the

[8]Note that our data contains information on plant location. People who work in headquarters of firms are not in our data as their municipality code is missing.

[9]See Lalive and Zweimueller (2004) for an analysis of this reform.

[10]Identified through a waiting period of 28 days.

Figure 3: Average Commuting Time by Residency



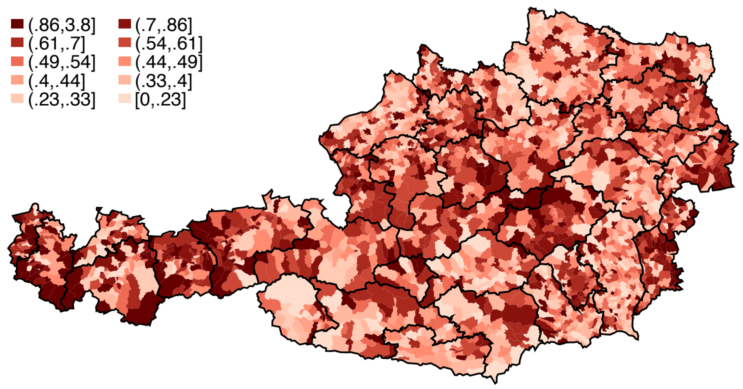
exact location of residences and workplaces. As a robustness check, we exclude the largest 5 cities in Austria except Vienna, namely Graz, Linz, Salzburg, Innsbruck and Klagenfurt. For Vienna we can identify the 23 districts and treat each of them as single municipalities. This is not possible for the other cities.

A first look at the structure of commuting in Austria is given in Figures 3 and 4. Figure 3 illustrates commuting time by place of residence. It is evident that individuals who live in mountaineous areas commute longer. Those who live in flatter areas (north east) or valleys (west) experience shorter commutes. Hence, workers do trade-off distances with amenities (e.g. living in the countryside). If we draw the same picture not by municipality of residence but municipality of work (Figure 4), we do not see such a clear geographical pattern: for each workplace, there is a more balanced distribution of commute time and we do not find strong evidence of concentration in space of larger commute times by workplace.

3.3 Stylized facts on wage and commute changes

We report in Table 2 the summary statistics for the full sample (154,677 spells). We also split these statistics for each of the four possible outcomes (where $w+$, $w-$, $d+$, $d-$ represent, respectively, workers experiencing a transition from a lower to a higher paid job ($w+$), workers experiencing a transition from a higher to a lower paid job ($w-$), workers experiencing a transition from a closer job to a job further away ($d+$), and finally workers experiencing a transition from a job further away to a closer job ($d-$). The latter subset also

Figure 4: Average Commuting Time by Workplace



includes workers who find a job at the same distance, denoted hereafter by d_0: conditional on changes, there is a 16% mass of people remaining in the same city before and after a transition through unemployment.

Workers, on average, spend 25 weeks in non-employment; those who find a wage at least as high as the last wage spend 20 to 21 weeks in non-employment. Individuals finding a job at the same distance as the previous job are non-employed on average for 22 weeks. Workers finding a job at a different location are non-employed on average for a longer time (about 24 weeks). The number of weeks in registered unemployment is smaller (row 2), around 15 to 20 weeks. We also calculate potential benefit duration, which is around 32 weeks (row 3). The average replacement rate is around 40% for unemployment benefits in the unemployment regime (UI, row 4). Data also include information on the amount under an assistance regime (UA), which we will introduce in the next Section to enrich the model. Row 5 gives the mean replacement rate including zeros (that is, for workers eligible to the regular unemployment insurance regime) and row 6 gives the mean replacement rate for workers under the UA regime. The replacement rate of the UA regime is close to the UI regime. Indeed, once UA is granted, it amounts to around 90% of UI benefits which translates into the lower replacement rate despite the fact that the sample is much different - UI is populated by higher wage workers.

Previous daily wage is 59.98 euros (full sample); the next wage is 57.67 after exiting non-employment. For those getting a higher wage, the new wage is 67; for wage losers, instead, the mean wage is around 50 euros. Previous commute time is .443 of an hour (that is 0.438x60=26.58 minutes one way). Commute time after is 0.62 of an hour, almost 40mn. On average those who commute more now commute around an hour; those who commute less commute 0.298 of an hour, that is 18 minutes.

Table 2: Summary Statistics

	Full Sample Mean (Std.Dev.)	$w+$ Mean (Std.Dev.)	w_0 Mean (Std.Dev.)	$w-$ Mean (Std.Dev.)	$d+$ Mean (Std.Dev.)	d_0 Mean (Std.Dev.)	$d-$ Mean (Std.Dev.)
Non-empl (wks)	25.04 (37.88)	20.35 (29.83)	20.84 (28.75)	27.68 (38.62)	24.53 (35.67)	21.95 (31.36)	23.78 (33.72)
Unempl (wks)	18.04 (23.62)	15.22 (19.74)	16.42 (20.44)	20.29 (26.08)	17.96 (23.43)	16.61 (21.42)	17.94 (23.44)
PBD [weeks]	32.35 (6.23)	31.91 (6.01)	32.63 (6.4)	32.61 (6.34)	32.2 (6.08)	32.59 (6.48)	32.35 (6.27)
RR UI benefits (B)	0.4 (0.156)	0.442 (0.177)	0.396 (0.137)	0.365 (0.129)	0.402 (0.155)	0.401 (0.157)	0.399 (0.156)
RR UA (overall)	0.032 (0.111)	0.03 (0.116)	0.027 (0.101)	0.034 (0.106)	0.032 (0.11)	0.028 (0.104)	0.033 (0.112)
RR UA (eligible) (b)	0.374 (0.126)	0.432 (0.138)	0.379 (0.104)	0.338 (0.105)	0.375 (0.124)	0.378 (0.123)	0.373 (0.127)
UI benefits	24.45 (5.42)	23.41 (5.34)	24.37 (5.12)	25.27 (5.3)	24.41 (5.33)	23.96 (5.33)	24.58 (5.41)
UA benefits	20.56 (6)	19.53 (5.79)	20.63 (5.56)	21.12 (5.99)	20.57 (5.84)	19.89 (5.72)	20.69 (6.09)
Altitude [100m]	4.262 (2.488)	4.332 (2.525)	4.273 (2.428)	4.158 (2.431)	4.2 (2.425)	5.071 (2.619)	3.921 (2.372)
Time to Next Large City	24.58 (25.41)	25.17 (25.64)	25.3 (25.43)	23.49 (24.98)	24.94 (25.24)	26.27 (27.24)	22.88 (24.42)
Wage Before ([Euros],w_{-1})	59.98 (21.44)	50.79 (14.99)	59.28 (17.02)	67.84 (23.51)	59.66 (21.77)	58.49 (19.85)	60.43 (21)
Wage After (w^+, w^-)	57.67 (19.39)	66.67 (19.38)	59.24 (17.03)	49.24 (15.97)	58.37 (19.47)	56.45 (19.02)	57.33 (19.42)
Change Wage	-2.079 (22.8)	15.872 (13.736)	-0.04 (1.399)	-18.598 (19.707)	-1.293 (23.71)	-2.038 (20.887)	-3.096 (22.421)
Commuting before ([hrs], d_{-1})	0.443 (0.412)	0.441 (0.412)	0.438 (0.407)	0.448 (0.413)	0.323 (0.338)	0.273 (0.373)	0.675 (0.41)
Commuting after ([hrs], d^+, d^-)	0.615 (0.789)	0.647 (0.822)	0.601 (0.77)	0.59 (0.762)	0.989 (0.977)	0.273 (0.373)	0.298 (0.303)
Change Commuting	0.171 (0.807)	0.206 (0.838)	0.163 (0.778)	0.143 (0.786)	0.666 (0.902)	0 (0)	-0.377 (0.349)
Numb. Children	1.111 (0.796)	1.095 (0.767)	1.119 (0.795)	1.118 (0.814)	1.109 (0.791)	1.099 (0.756)	1.113 (0.81)
Married	0.401 (0.49)	0.377 (0.485)	0.416 (0.493)	0.416 (0.493)	0.395 (0.489)	0.392 (0.488)	0.41 (0.492)
White Collar	0.166 (0.372)	0.16 (0.366)	0.153 (0.36)	0.158 (0.364)	0.144 (0.351)	0.166 (0.372)	0.172 (0.377)
Exp 0-1.99y [Y]	1.7 (0.333)	1.668 (0.339)	1.691 (0.33)	1.726 (0.327)	1.702 (0.333)	1.696 (0.328)	1.693 (0.335)
Exp 2-4.99y [Y]	2.494 (0.583)	2.455 (0.604)	2.495 (0.564)	2.521 (0.571)	2.494 (0.584)	2.489 (0.582)	2.487 (0.587)
Exp 5-9.99y [Y]	3.438 (1.584)	3.278 (1.645)	3.473 (1.553)	3.519 (1.548)	3.38 (1.608)	3.457 (1.578)	3.437 (1.582)
Sector 1	0.026 (0.16)	0.029 (0.168)	0.032 (0.177)	0.022 (0.148)	0.024 (0.152)	0.041 (0.199)	0.023 (0.149)
Sector 2	0.701 (0.458)	0.677 (0.468)	0.7 (0.458)	0.723 (0.448)	0.717 (0.451)	0.674 (0.469)	0.693 (0.461)
Sector 3	0.211 (0.408)	0.236 (0.425)	0.207 (0.405)	0.189 (0.392)	0.194 (0.395)	0.23 (0.421)	0.224 (0.417)
Count	154677	61204	17852	68713	68744	24854	54171
Years	1995-2004						

In Figure 5 we take a closer look at the distribution of commute and wage changes between any two jobs spaced out by an unemployment spell. The first and the second rows represent the distribution of commute and wage changes, respectively, in levels (left panel) and in logs (right panel). The dispersion is quite large; in relative terms, given that the mean commute time is about 30 minutes, it turns out that the typical dispersion is higher for commute distances. From the left panels we can notice that commuting times are right skewed, while wages are symmetric.

The third row of Figure 5 also reports in the scatter plot of changes in log wages and commuting distance changes per unemployment status: we distinguish between individuals who find a new job while they are receiving unemployment benefits (black circles) and individuals who find a job only after they have exhausted unemploymet benefits and eventually receive unemployment assistance benefits (crosses). In both cases, the correlation appears to be positive: higher changes in commute time are associated with larger wage gains while lower commute distances are typically associated with negative wage growth between the previous and the next job. This scatter plot is first evidence that time until a job is found matters: those finding a job under the UA regime face a lower net wage growth conditional on distance change or vice versa.

We finally report the conditional densities of the sample in the cross section of accepted jobs, in Figure 6. The joint density of accepted wages and commuting times shows a peak at 57 Euros wage per day, and about 32 minutes of commuting time (top left and right subgraphs). Jobs that offer higher wages and longer commutes, or lower wages, and shorter commutes are also quite frequent. This is the pattern we saw in the previous figure.

Figure 5: Changes in Commuting Time and Wage from the empirical data analysis. Commute distances are measured in hours. Daily wages are measured in euros.

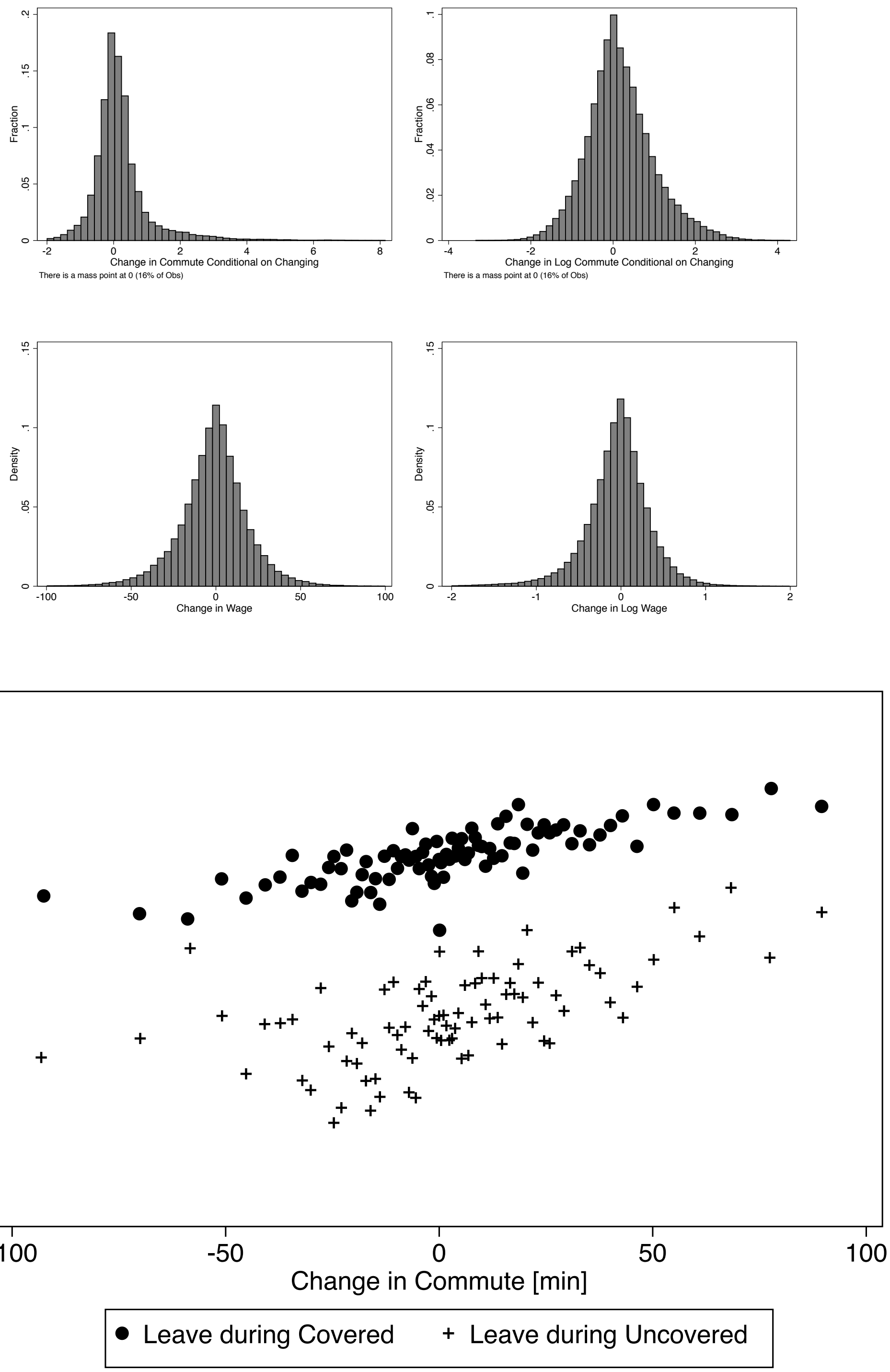
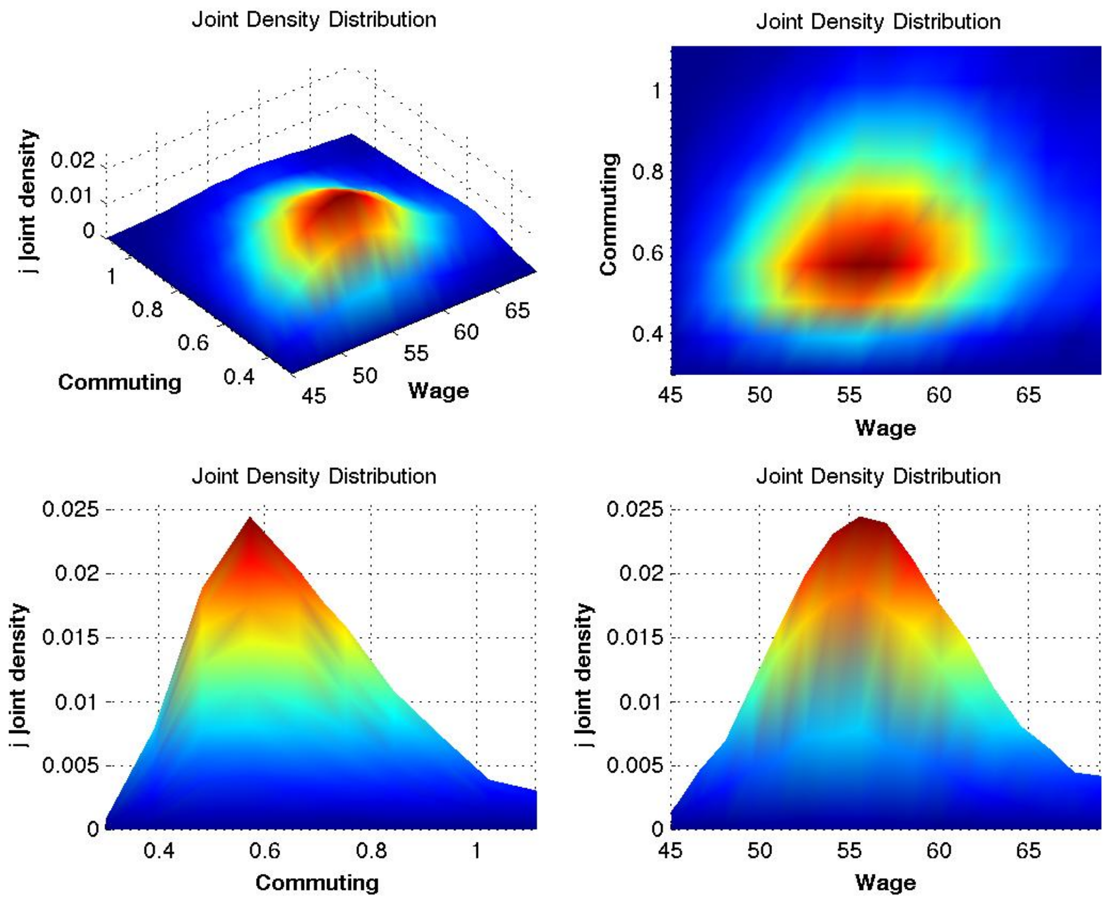


Figure 6: Joint Density Distributions from the empirical data analysis on Austrian data. Commute distances are measured in hours. Daily wages are measured in euros.

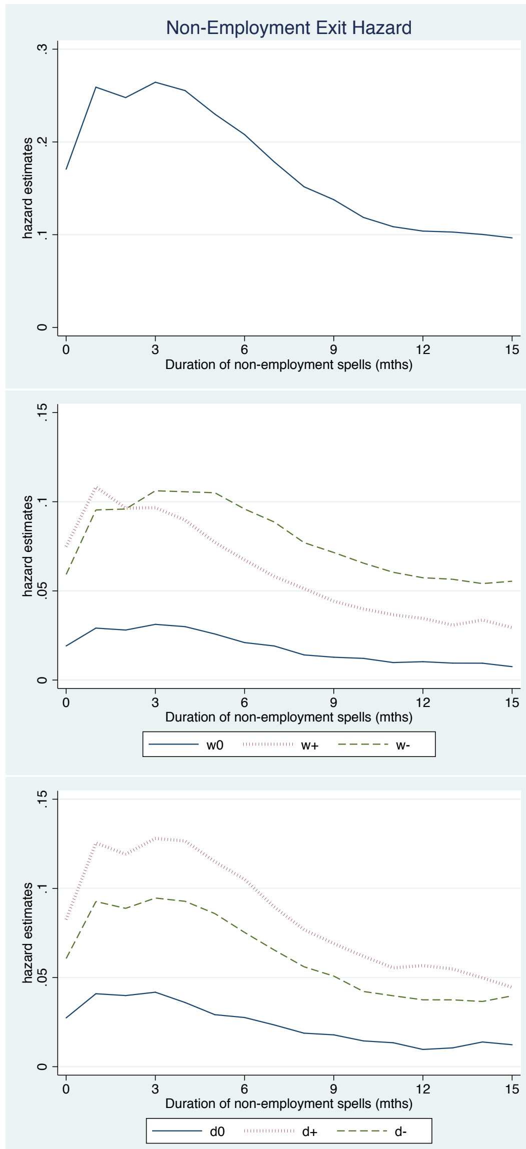


3.4 Empirical hazard rates and competing risks analysis: more wage cuts and less "city stayers" over time

With similar notations as in the theory part and in Table 2, we separate out transitions of workers towards a larger distance job ($d+$), those staying in the same city (d_0) and finally those facing a decline in commute distance ($d-$). Similarly for wages, we separate out workers facing transition to a higher wage ($w+$) and a lower wage ($w-$) and define transition to the same wage (w_0) if the new wage is within a range of 4% around the old wage.

The results are presented in Figure 7; it displays the profile of the hazard rate for the non-employment duration in the data. The unemployment exit hazard rate reaches a maximum between two to six months before it declines continuously. This could be because job seekers entering unemployment apply for jobs right away but need to wait until they receive a job offer. This is true for overall exits (top chart) and for each of the destinations (middle and lower chart).

Figure 7: Empirical Hazard Rates by Exit State



Notes: Figures report Kaplan-Meier estimates for the non-employment exit hazard. w stands for wage, d stands for commuting distance, + stands for increase compared to pre-unemployment, - stands for decrease to pre-unemployment. d_0 indicates that there is no change in distance. w_0 indicates changes in the wage of $\pm 4\%$. Source: ASSD, own calculations, all cities excluding the six biggest cities.

Our theory for job search in space predicted that relative hazards inform on search strategies. We now establish a few stylized facts related to the "competing risks", to assess how the different sub-hazards relate to each other over time. We proceed as follows. We first estimate sub-hazards using Cox-Regression defined by the type of job an individual finds[11]. We distinguish better paying jobs, worse paying jobs, and about equal paying jobs. The about equal paying category means the new wage is up to 4% above or below the previous job. We introduce this category to deal with the issue that we do not know for sure whether job seekers would accept the previous job. In a second step, we build *relative* hazard rates. For instance, we calculate the relative hazard of wages by dividing the hazard estimate for $w-$ by the hazard estimate for $w+$ telling us how the relative probability to end up in relatively worse jobs behaves over time. The same can be done with distances.

The relative hazards are illustrated in Figure 8. Each plot includes the unconditional relative hazard ratios (black lines in the graphs), as well as the hazard ratio after controlling for some observable characteristics (red solid line). The latter is a prediction from a Cox-Estimation where we control for a variety of observed characteristics presented in Table 2. The black dashed lines are the corresponding 95% confidence interval.

The upper left panel relates exits in worse paid jobs to exits in better paid jobs. As expected, the relative likelihood that individuals leave into worse paid jobs increases with the duration of non-employment. This is evidence that reservation wages are declining over time, consistent with job search theory when workers loose eligibility. Degen (2014) finds a very similar pattern for accepted wages in Austria. This result, well known, is in line with a large body of evidence in other countries. Further, the left panel in the second row shows that this arises mostly from strong wage cuts: the relative hazard $w-/w_0$ goes up, while the left panel in the third row shows stability over time of $w_0/w+$.

The upper right graph relates exits into jobs farther away to jobs that are closer to home. Both the unconditional and the conditional relative hazards are almost flat. This implies that the succeding job can be either closer or farther away from home. This ratio is 1.5 and stable over time, meaning that there is a larger fraction of distance losers ($d+$). This may be surprising since one would perhaps have expected, parallel to the decline in the reservation wage over time, that workers could face an increase in their reservation distance; this may suggest the absence of action along the distance margin. However, this interpretation is

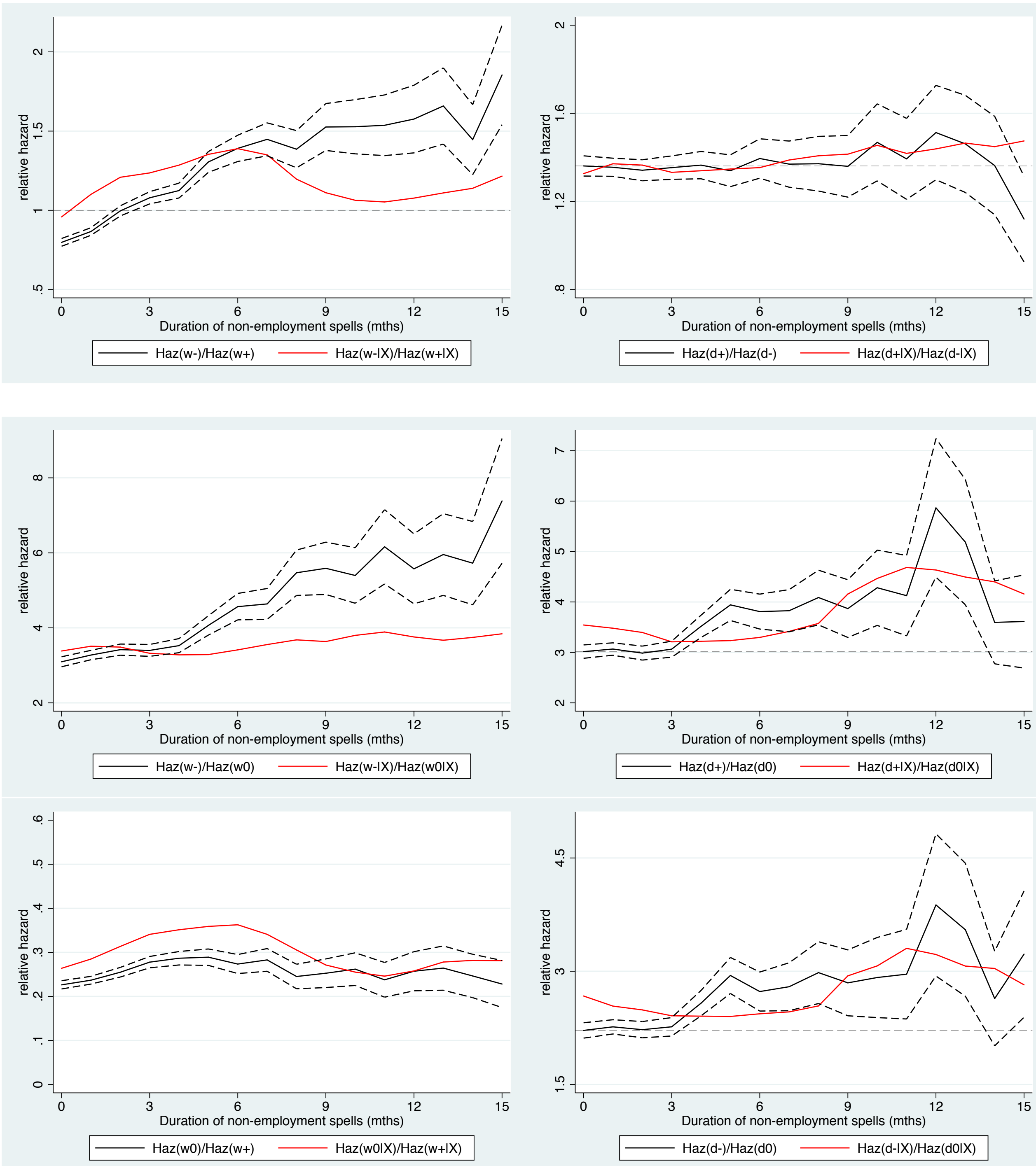
[11] Note that doing so does not mean we split the sample by wage or distance, the type of job an individual finds merely defines which sub-hazard this inividual contributes to estimating. We follow standard practice in competing risks estimation.

wrong, as indicated in the subsequent rows. The reason is not the insentivity of the distance margin, but rather due to the fact that hazard rates away from the previous city actually evolve relative to the hazard of the "city stayers". This hazard rate account for the 16% of individuals in our sample who do not change the commuting distance in the new job as compared to the old job.

In fact, the unexpected result uncovered here is that the pattern of search *with respect to the previous city* varies quite a lot over time. Indeed, we obtain instead quite strong trends in relative hazard ratios where the denominator is the hazard rate of city stayers, as shown in the right panel in the second and third rows. The second row (right panel) relates exits into farther away jobs to exits into jobs at the same distance. Overall, there is a larger portion of unemployed individuals finding a new job farther away than staying in the same city. The proportion of "distance losers" ($d+$) relative to stayers (d_0) goes *up* over time. For workers experiencing such a move to a more distant city, this is indeed a change upward of the reservation distance strategy, that may be explained by a decline in the unemployment insurance. We also find a positive trend in time for the "distance winners" ($d-$) relative to stayers (d_0) (third row, right panel): individuals are indeed relatively more likely to find a job in the same place at the beginning of the non-employment duration than to move closer to home. This suggests that workers tend to search first for jobs in their previous workplace before searching jobs closer to home. As time goes however, some workers give in and get closer, possibly sacrificing on wages. Overall, it is relatively more likely to find a job in the same place at the beginning of the non-employment duration than towards the end of the non-employment duration.

There are various possible interpretations of the above results, that the old workplace is a relevant margin for job search, especially at the beginning of the unemployment spell. Jobs are typically concentrated in space, e.g. finance jobs in the capital, and job seekers have work experience in only a few industries. Job seekers in spatially concentrated industries are more likely to find a job in the same city as before, until they change sector if unsuccessful. In that case, they also change their area of search and therefore move to another city. Another explanation would be that unemployed workers have more information about the old workplace e.g. through informal search channels. Both explanations

Figure 8: Relative conditional hazard rates from empirical data analysis



Notes: Figures report relative Kaplan-Meier estimates for the non-employment exit hazard. w stands for wage, d stands for commuting distance, + stands for increase compared to pre-unemployment, - stands for decrease to pre-unemployment. d_0 indicates there there is no change in distance. w_0 indicates changes in the wage of $\pm 4\%$. The black solid lines with the 95% confidence interval are unconditional relative hazard rates. The red solid lines are relative hazard rates from Cox estimations including a full set controls listed in Table 2. Source: ASSD, own calculations.

can be true simultaneously and would produce the same observable consequences. We have explored these explanations by conducting the same analysis for workers who work in geographically clustered industries as opposed to workers who work in geographically uniformly distributed industries. We obtain similar results for both types of industries, suggesting that the information channel is important.

3.5 The impact of unemployment benefits on hazard rates: identification strategy

We will estimate a basic Cox-model of the sub-hazard rates. Our particular focus here is on identifying the effects of three unemployment insurance parameters on the nature of jobs individuals accept. The identification of the effects of unemployment benefits, benefit duration, and unemployment assistance is obtained as follows.

First, unemployment benefits are determined by previous earnings. The benefit schedule exhibits two kinks as in Card *et al.* (2012), one at the bottom of insured earnings and one at the top of insured earnings. Conditional on previous earnings and other observables, the remaining variation in unemployment benefits mainly stems from the presence of the kinks. If individuals cannot manipulate previous earnings to shift themselves beyond one of the kinks, the variation in unemployment benefits generated by the kink can be assumed to be exogenous. Importantly, the earnings that constitute the benefit base are not necessarily the ones where the job was lost. The relevant earnings to determine unemployment benefits are either from the previous year or two years before, depending on when the individual starts claiming unemployment benefits. It is hardly possible for job seekers to manipulate the relevant previous earnings that ultimately determine the level of unemployment benefits.

Second, similar reasoning holds for the potential duration of unemployment benefits (PBD). PBD depends on previous work experience and age with discontinuous changes after several work experience thresholds, and two age thresholds (40 years and 50 years). Our strategy to exploit those changes is to add flexible functions of previous work experience and age into the Cox-regressions. Appendix Figure C.2 documents the non-linearities used in the strategy. Recall that the coefficient of a regressor in the multiple regression model is the partial correlation of that regressor with the dependent variable. The bottom graph of Figure C.2 shows PBD after all regressors in the model, including work experience and age, have been partialled out. The residual is close to zero almost everywhere, except at age 40 and age 50. PBD exhibits discrete jumps at these ages, thus identifiying the coefficient on PBD. PBD effects are identified from the age and previous work experience discontinuities in PBD.

We are not aware of a quasi-experimental design for unemployment assistance. We use the observed level of unemployment assistance conditioning on some potential determinants of unemployment assistance receipt (marital status, previous wage).

3.6 Evidence of disincentive effects

Table 3 displays the effects of the level of benefits from unemployment insurance B and from assistance b on hazard rates. Column 1 displays the results while controlling for the effect of benefits under the UI regime (B) and potential benefit duration (PBD). The sign on the hazard rate is strongly negative. The effect of potential benefit duration is also negative and significant. The regressions include a number of other factors, including tenure profiles, marital status and family composition, as well as provincial dummies (NUTS3), industry dummies, altitude, and year effects[12].

The second column introduces further the value of unemployment assistance (b) for those having exhausted their UI rights. So B measures the replacement rate for job seekers on UI, and b is the replacement on unemployment assitance for job seekers on assistance. In this specification, potential benefit duration captures the number of weeks remaining before exhausting benefits. Both levels of UI (B) and UA (b) reduce the hazard rate, although the effect of b is smaller than B. The effect of PBD is still negative but less so.

The next columns investigate which sub-hazards are more strongly affected by changes in the unemployment insurance parameters. Making UI more generous should not affect exits to good jobs (paying a higher wage), except via reduced search intensity. Indeed, point estimates for UI benefits and assistance are small in column (w+). More generous

[12]Table C.1 in the appendix shows the full set of covariates.

unemployment insurance makes exits to jobs that pay the same or worse much less likely (columns $w-$ or w_0). So, making UI more generous improves chances that job seekers find a better paid job, *relative* to finding a worse paid job.

Regarding the links between UI and distance, one would expect more generous UI to reduce the rate of leaving to jobs further away from home (column $d+$). This is true for potential benefit duration which reduces the rate of accepting jobs far away from home. However, for benefits, we do not see that increasing UI reduces exists to jobs further away from home. Instead, increased UI reduces the rate of leaving for a job in the same city (column d_0), relative to jobs closer or farther away from home. This might be because increased UI facilitates job search in new areas. UI benefits enlarge the search radius around the previous city. All estimates attached to UI generosity display negative signs, this reflecting the effect of UI on search intensity. The impact of UI and UA on joint wage and distance changes is displayed for completeness in Appendix Table C.2.

Table 4 offers a summary of the differential effects of benefits and assistance on changes in distance and wages, where the reference is staying in the same city and at a wage within the -4%/+4% range. Interestingly, benefits and assistance raise significantly the occurence of the outcome “higher wage”; benefits reduce the occurrence of the outcome “lower wage”, assistance being unsignificant here. Further, netting out the $d-$ coefficients to the d_0 coefficients, it appears that benefits increase the likelihood to get closer to home than staying in the same city; and, for wage increases and wage stability (first two rows), netting out the $d+$ coefficients to the d_0 coefficients implies that benefits increase the likelihood to get further away to home than staying in the same city.

In summary, in a majority of cases, unemployment insurance reduces reservation wages at a given distance, and promotes search outside the same city, especially closer to home, as expected, but also further away, which is per se a less expected result. Appendix D explores whether this may be due to credit constraints. Evidence lightly points out in this direction (see Appendix Table D.3).

Table 3: Cox-model Estimates, hazard rates, all destinations, by wage change and by commute distance change

	(all)	(all)	($w+$)	($w-$)	(w_0)	($d+$)	($d-$)	(d_0)
B	-0.542***	-0.640***	-0.350***	-2.494***	-1.475***	-0.537***	-0.652***	-0.910***
	(0.031)	(0.026)	(0.036)	(0.054)	(0.063)	(0.037)	(0.040)	(0.060)
b		-0.271***	-0.314***	-0.589***	-0.522***	-0.261***	-0.289***	-0.258***
		(0.033)	(0.052)	(0.044)	(0.100)	(0.047)	(0.052)	(0.082)
PBD [weeks]	-0.003***	-0.001	-0.004**	0.006***	-0.000	-0.004***	-0.000	0.003
	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.001)	(0.002)	(0.002)
Nuts3 FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spells	154,677	154,677	154,677	154,677	154,677	154,677	154,677	154,677
Individuals	118,343	118,343	118,343	118,343	118,343	118,343	118,343	118,343
Log L	-1613517	-1613357	-666060	-737931	-196332	-748354	-591330	-266454
Share Exits	0.96	0.96	0.40	0.44	0.12	0.44	0.35	0.16

Notes: Duration variable is nonemployment in months. Estimates refer to coefficients. w_0 contains changes in wage of ± 4%. Control Variables: Potential Benefit Duration, net wage used for calculation of replacement rate. Experience in the last two, five and ten years (5 is net of 2 and 10 net of 5 years), altitude of the municipality of residence, time to the next large city, age in years, real wage and occupation of the last job before unemployment, marital status and number of children. Voluntary quits and recalls are excluded, only Replacement Rates weakly below 1 and potential benefit durations above 0 are considered. Standard errors are clustered on individual level. Significance is indicated as follows: * (p<0.01), ** (p<0.05), *** (p<0.01).

Table 4: Coefficients from Table C.2, relative to exit (w_0, d_0)

	Benefits			Assistance		
	$d+$	d_0	$d-$	$d+$	d_0	$d-$
$w+$	1.49***	1.177***	1.508***	0.529**	0.533*	0.539**
w_0	0.454***	0	0.348**	0.491*	0	0.226
$w-$	-0.694***	-0.585***	-0.758***	0.22	0.412	0.241

Notes: The table summarizes estimates from a competing risk Cox regression to each combination of wage and distance destination. The table reports coefficients on unemployment benefits (B) and unemployment assistance (b) relative to the coefficient estimated for the constant wage and same municipality of residence destination (w_0,d_0). Significance is indicated as follows: *(p<0.1), **(p<0.05), *** (p<0.01).

4 Extending the model to account for the empirical facts

This Sections enriches the model to take stock of these finding. It adds several dimensions to the previous analysis in Section 2. In particular, it shows how to account in a simple way:

1. for the existence of potential credit market imperfections;
2. for the local dimension of job search, and the particular role of the previous workplace that seems to be central in the Austrian case;
3. it also extends the model to the existence of two unemployment compensation profiles, insurance and assistance.

4.1 Mild liquidity constraints, unemployment and the role of benefits

The previous results were derived under the assumption that agents face no liquidity constraint. Under the assumption of a search cost taking the form $C(D, \lambda) = M(D) + e(\lambda, D)$, where the first part may be thought as a monetary component and the second part as disutility of effort and distance, this requires that the income from benefits and other assets is larger than the financial cost, or that the unemployed workers may borrow at the same rate as the employed workers save. Indeed, this assumes that the rate of interest r is the same for borrowers (the unemployed) and savers (some of the employed). Another "almost equivalent" assumption is that the unemployed workers who have just been laid-off either still have financial assets or full access to financial liquidity. In that case, the situation of the newly unemployed workers is similar to that of the employed workers, which was our working hypothesis so far.

We represent this alteration with the assumption that the newly unemployed workers have access to the same rate of interest for a random time, and under some Poisson intensity process, undergo a drop in their financing capacity.

In that case, a *mild liquidity constraint* is that they face a higher interest rate r^+ but may still borrow at this rate and therefore, choose the optimal range of search. Another extreme assumption is that these unemployed workers, after being hit by a financial constraint, cannot even borrow and face a *strict liquidity constraint*, under which their current income must equal their spendings: consumption and monetary search costs. We do not detail the model solutions in this case since we do not find strong evidence in favor of such strict constraints in the data and only leave this for the Appendix (sub-section B.2). These unemployed workers must now discount the future at their rate of pure time preference, and r^+ must now be interpreted as such a rate, going say from 4% a year to 20% a year.

In other words, the newly unemployed workers are decumulating assets and make optimal search decisions; following a financial shock unemployed workers have no longer any asset and must either borrow at a higher rate or face cash-constraints and discount the future at their rate of time preference.

Lemma 3 (**unemployment benefits impact**). *i) In the absence of liquidity constraints, an increase in unemployment benefits increases the value of unemployment by a factor* $1/r$. *ii) Under mild liquidity constraints, the impact is* $1/r^+$ *and thus smaller.*

The proof of the impact of unemployment benefits on the value of unemployment is also in Appendix B.2 in all possible cases.

4.2 Introducing two levels of unemployment compensation

Now, we assume that there are two levels of benefits: B (insurance) and b (assistance). Workers switch randomly from B to b at Poisson rate α[13]. The value of unemployment depends on the eligibility status; let U_c and U be these values for workers covered by UI and by UA, respectively, and ρ the commute distance. Let λ and λ_c be the arrival rates of job offers per unit of superficy, and first simplify the exposition in treating λ and λ_c as simple parameters. As already shown in Section 2, the optimal values of λ can be easily calculated once the optimal search radius D^* has been chosen.

We also assume that the financial constraint of the unemployed gets more severe as time goes. However, instead of assuming that agents can accumulate and decumulate wealth, we make the simplifying assumption, already discussed in Section 4.1, that individuals face a higher rate of discount after a Poisson shock; although in principle the loss of eligibility to unemployment insurance and the more difficult access to liquidity are distinct stochastic processes, we assume that they occur simultaneously, which simplifies the derivation of the model. Then, we simply assume that the covered unemployed workers access to credit at rate r_c, which is lower than that the rate r faced by the uncovered workers. We also assume that search effort dimensions (here D only) and consumption are non-separable, with an interaction term proportional to parameters δ and δ_c; δ (δ_c) positive (negative) means that the disutility of distance is lower (higher) for higher income recipients. The full derivation of the extended model can be found in Appendix A.2.

4.2.1 Reservation wage profiles under two unemployment regimes

The following Lemma highlights how job seekers change their reservation wage when switching from the UI to the UA regime.

Lemma 4. *Assuming $\delta = \delta_c$ and $r = r_c$, the reservation wage for a given distance is higher for eligible unemployed workers than for uneligible workers. The difference is in(de)creasing*

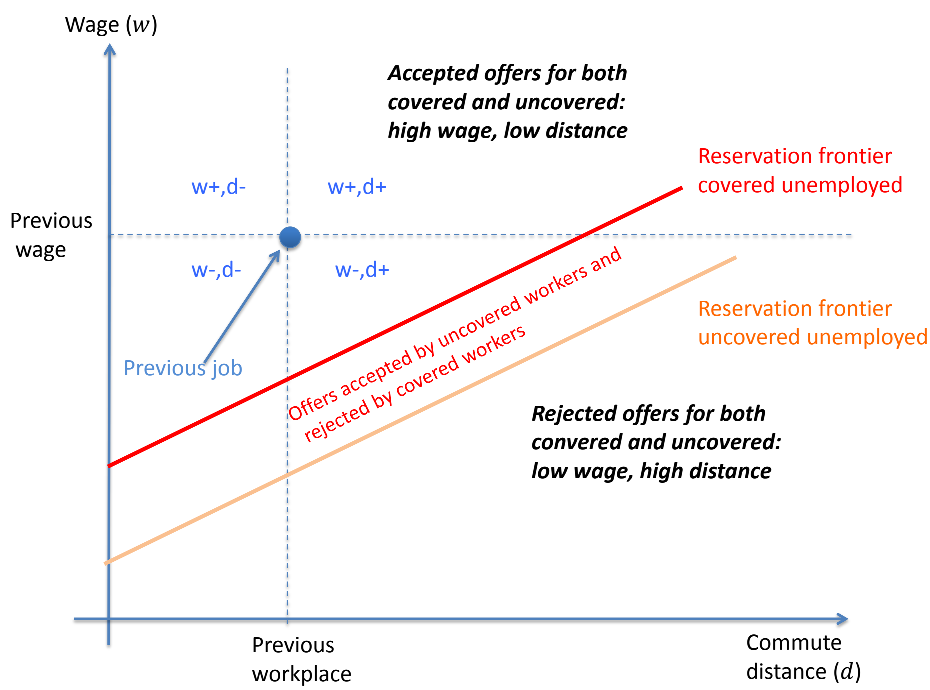
[13] Many real world UI systems are not stationary, e.g. unemployment benefits run out after a fixed number of months. Non-stationarity can matter for job search behavior, as studies on benefit exhaustion show (Meyer (1990)). Card *et al.* (2007b) discuss end of benefit behavior and find it matters much less than earlier studies would suggest. Our specification buys us simplicity at a reasonable cost.

in commute distance if $\delta < (>)0$.

$$R_c(\rho) - R(\rho) = \frac{r_c + s}{1 + \delta\tau\rho}(U_c - U) > 0. \quad (7)$$

We can grasp the main intuition by focusing on the simple case with separability between monetary income and distance and linear commute distance cost function. In this case, we already proved that reservation wages are linear in the commute distance and the marginal rate of substitution is constant, denoted by τ. In this case, the linearity comes from the fact that wages enter linearly in the utility function and that commute costs are linear in distance. It follows that the reservation frontier in wage and distance is linear, and can be represented as such in Figure 9.

Figure 9: Theoretical Reservation Frontiers and Acceptance-Rejection Areas



4.3 Directing search towards the previous city

The main insight of the previous empirical part is that workers seem to search first in the previous city, and then extend their range of search. We want to give a theoretical counterpart to this complex job strategy. Assume now that workers can target the effort strategy λ differentially in space, contrary to what was assumed before. To keep things relatively simple, we assume that workers can distribute their search effort either in the previous city (with intensity of arrival of offers λ^0) or in any other city within the range D (with intensity of arrival of offers λ). Because space is continuous in our setting, we define the previous workplace as a range of values centered on the mean of the distance distribution (d_0): the lower and the upper bounds of the range are denoted as d_{0^-} and d_{0^+}, respectively.

The optimal search strategy is therefore six-tuple (D, D_c, λ^0, λ^0_c, λ, λ_c). The first order conditions for the optimal search radius stay as in the benchmark model (see equation 18 and 19). The new first order conditions on optimal search intensity are reported in Appendix A.3.

The specification we adopt for the cost functions is the following:

$$C(D, \lambda, \lambda^0) = \tau D + c^0 D^{\eta_c} + c^\lambda \left[\gamma^{\lambda^0}(\lambda^0)^{\eta_\lambda} + (\lambda)^{\eta_\lambda}\right]$$

$$C'_\lambda(D, \lambda, \lambda^0) = c^\lambda \eta_\lambda (\lambda)^{\eta_\lambda - 1}; \quad C'_{\lambda^0}(D, \lambda, \lambda^0) = c^\lambda \gamma^{\lambda^0} \eta_\lambda (\lambda^0)^{\eta_\lambda - 1};$$

As regards the part of the search cost which depends on distance (D), we assume that it is made by two components: the first one is a monetary component, and the second one is a convex function which represents agent's disutility from searching farther away from residence. The cost of search effort only presents a convex disutility component. As discussed in Section 4.1, the monetary component of the search cost (summarized by τ) enters the agent's budget constraint. In this way we can study the case of binding liquidity constraints, which leads to sub-optimal choices of the radius of search. Regarding the disutility component, c^0 and c^λ are the weights of the distance and the effort dimensions, respectively. η^c and η^λ are the elasticities of the subjective part of the cost function to these two search margins. Furthermore,γ^{λ^0} captures how costly is the search effort in the previous workplace relatively to search outside. We assume $\gamma^{\lambda^0} < 1$ to indicate that the search efficiency is likely to be larger in the previous workplace, either for industry concentration or for existing social networks.

Furthermore, covered workers are assumed to be relatively more efficient in searching in the previous workplace ($\gamma_c^{\lambda^0} < \gamma^{\lambda^0}$): in absence of other dimensions of heterogeneity, the asymmetry in the search cost is needed to rationalize the empirical observations that covered workers exit unemployment more quickly and they are relatively more "city stayers". Moreover, there are several empirical reasons that may justify this choice: shorter non-employment spells are often associated with a richer human and social capital and are considered as a positive signal by potential employers.

5 Calibration of the richer model and the role of policy parameters

5.1 Calibration parameters and summary of the main variables

As Figure 7 showed, the hazard rates decrease over time. This may arise due to: i) discouragement from job seekers as time goes - e.g time varying search costs; ii) lower quality of job offers due to the exhaustion of offers in the initial pool of search (e.g. the same city); iii) a stigma effect from being long-term unemployed and thus less efficient search as time goes; iv) more impatient workers over time, hence reducing their search effort; v) illiquid workers who cannot afford paying for the optimal search effort and who restrict their range of search; vi) finally, heterogeneity of workers and a composition effect in the pool, so that those less efficient dominate over time. Mechanisms ii) and iii) are for instance assessed in Kroft *et al.* (2013), who find a negative association between the length of elapsed unemployment spells and the likelihood to obtain a job interview.

We therefore enrich the model with a set of assumptions encompassing these various mechanisms and consistent with these interpretations. Assume the existence of two types of unemployed workers: covered workers are entitled to benefits B, and uncovered workers are assistance recipients $b < B$. Covered workers are assumed to face a relative higher efficiency of search in the same city, while uncovered workers face instead a less efficient search effort. This hypothesis captures the first three explanations of the declining hazard rate listed above. Additionally, covered unemployed workers face a lower rate of interest and are thus more patient and search *ceteris paribus* more; the uncovered, under assistance, face a higher rate of interest and search less. This assumption is consistent with previous point iv). Appendix B.2 extends the model in the direction indicated by point v). We do not explicitly address point vi), instead. Hence, as time goes, we observe both a decline in the absolute hazard rate and, under adequate choice of the relative efficiency of search in the same city, a decrease over time of the hazard rate in the same city relative to the hazard rate outside the city.

We then choose the various parameters so as to replicate the qualitative results on hazards, relative hazards and sub-hazards as in Section 2. The full calibration is reported in Table 5. The rate of interest is set to 4% annually for the employed workers and for the covered unemployed workers (under UI), and at 12% for the uncovered workers (under UA). The discount in the search cost of prospecting in the same city is $\gamma_c^{\lambda^0}$=0.07 for covered workers, but that comparative advantage of the previous city decreases for the uncovered workers and that discount parameter goes to γ^{λ^0}=0.14 instead. Further details on the calibration strategy are relegated to Appendix A.5.

Table 6 reports the main equilibrium variables of the model. The simulated reservation frontier, the counterpart of the theoretical Figure 1, is instead represented in Figure 10: since we assume a negative $\delta = \delta_c$ and a linear cost function, the reservation frontier turns out to be convex. The blue and the red vertical lines represent the radius of search for uncovered and covered workers, respectively.

An outcome of the model is that covered workers ask for higher wages ($R_c > R$)[14], search closer ($D_c < D$) and search more intensely ($\lambda_c > \lambda$; $\lambda_c^0 > \lambda^0$). The higher search intensity of covered workers is due to their comparatively higher efficiency, as stressed in the previous section. This allows them to exit unemployment more quickly ($haz_c > haz$). Moreover, job seekers under the UI regime are more likely to find a job in the previous workplace, as evident from the higher fraction of city stayers among covered workers.

[14] More exactly, covered workers have a higher reservation frontier: their reservation wage is higher for any given commute distance. The figures reported in Table 6 are the reservation wages calculated at D.

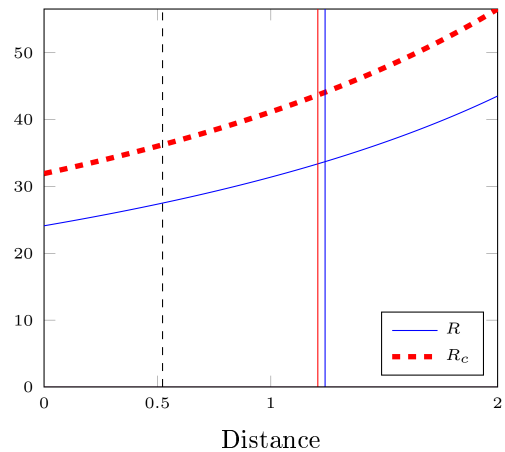
Table 5: Calibration

Parameter	Description	Value
r	discount rate	0.01
s	separation rate	0.004
c^0	cost of search (distance)	5.00
$c^\lambda = c_c^\lambda$	cost of search effort	80000
η_c, η_λ	elasticity of the search effort cost	1.50
γ_{λ^0}	cost of search in the same city	0.07
$\delta = \delta_c$	complementarity between income and distance	-0.20
Policy parameters		
B	Unemployment Insurance (UI)	20.59
b	Unemployment Assistance (UA)	1.76
$1/\alpha$	Potential Benefit Duration	5.00
τ	unit commuting cost	1.00
Wage and distance distributions		
$\mu^F = \mu_c^F$	mean wage	58.84
$\sigma^F = \sigma_c^F$	sd wage	18.90
$\mu^G = \mu_c^G$	mean distance	0.47
$\sigma^G = \sigma_c^G$	sd distance	0.47

Table 6: Main endogenous variables of the calibrated model

	Covered	**Not covered**
Observed outcomes		
Average wage (euros per day)	64.75	60.25
Average distance (min)	25.51	25.84
Hazard rate	0.1126	0.0467
Rejection rate	0.012	0.003
Share city stayers	18.88	5.12
Unemployment	0.012	0.051
Decisions		
Reservation wage	43.63	33.03
Search radius (min)	71.08	73.84
Effort outside d_0	0.0030	0.0020
Effort inside d_0	0.0200	0.0100
Sub-hazard rates		
$sub-haz(w+,d+)$	0.0098	0.0052
$sub-haz(w-,d+)$	0.0096	0.0064
$sub-haz(w+,d-)$	0.0256	0.0131
$sub-haz(w-,d-)$	0.0295	0.0166
$sub-haz(w+,d_0)$	0.0182	0.0024
$sub-haz(w-,d_0)$	0.0199	0.0030

Figure 10: Simulated reservation frontiers



Notes: The vertical dashed line is the previous city (d_0); the vertical red (resp. blue) solid line is the optimal range of search of covered unemployed workers D_c^* (resp. of uncovered workers D^*). Distance is measured in hours.

5.2 Search strategies, hazard and relative hazards as a function of non-employment spells

Figures 11 and 12 plot the results of the simulations. The model performs relatively well under different dimensions. First, we are able to replicate the decrease in the absolute hazard and in the sub-hazard rates (Figure 11). Second, we match the empirical result that the share of workers exiting unemployment as wage loosers is increasing over time (column one in row two of Figure 11). Third, the model can account for the fact that agents are more likely to expand the radius of search the more time they spend into unemployment (column 2 in row two of Figure 11). Fourth, agents exhaust job offers inside the previous workplace as time goes. In summary, the lower part of Figure 11 shows that the extended model qualitatively accounts well for the empirical dynamics of sub-hazards that were depicted in Figure 8.

The underlying mechanisims of the model are represented in Figure 12: as time goes, the reservation wage R goes down and the search radius D on average increases. This happens because covered workers search closer and are more picky regarding the wage. The right panel of Figure 12, however, shows a new finding: a large part of the action here also comes from the changes over time of the hazard rate for the category of "city stayers" d_0, that is people getting job offers in the same city where they used to work. This is an interesting finding, because it suggests that two spatial margins matter: a) the commute distance, based on search strategy D centered around the city of residence; b) the targeted search strategy λ but especially λ_0, that may temporarily be centered around the previous city of work.

5.3 Comparison of calibration moments with the data

The map of densities of hazard rates in the cross-section of unemployed workers represented in Figure 13 in the distance-wage space, for both covered and uncovered workers, are quite similar to the equivalent empirical densities in Figure 6. One can also represent the "predicted" accepted wages in the model for both covered and uncovered workers. This corresponds to the solid and dashed lines in Figure 14. The solid line for covered workers is close to the empirical observations. The dashed line for uncovered workers is higher compared to the empirical observations. This suggests that our model may capture well the effects of unemployment insurance but less so the effects of unemployment assistance. This gives room for improvement of the calibration exercise, introducing more ex ante heterogeneity in the pool of uncovered workers (those under UA).

Figure 13: Joint Density Distributions from simulations of the extended theory. Commute distances are measured in hours. Daily wages are measured in euros.

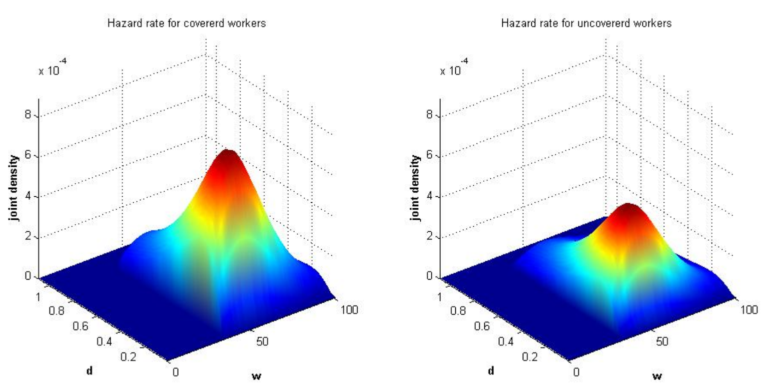


Figure 11: Simulated hazard rates from the extended theory. Black solid line: total hazard. Dashed colored line: sub-hazards, summing up to total hazards

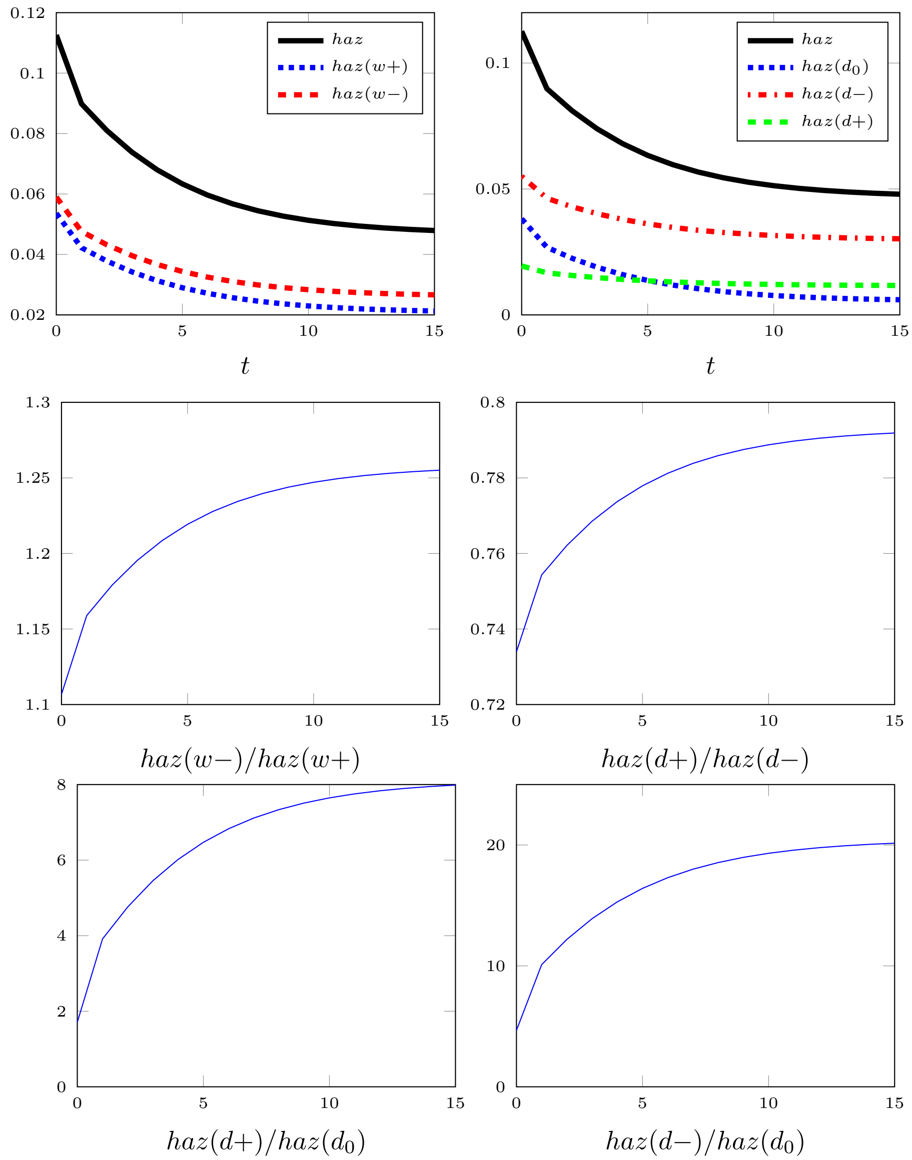


Figure 12: Search strategies from the extended theory. Reservation wage, search radius and relative intensity of effort in the same cuty (λ^0) relative to other cities (λ)

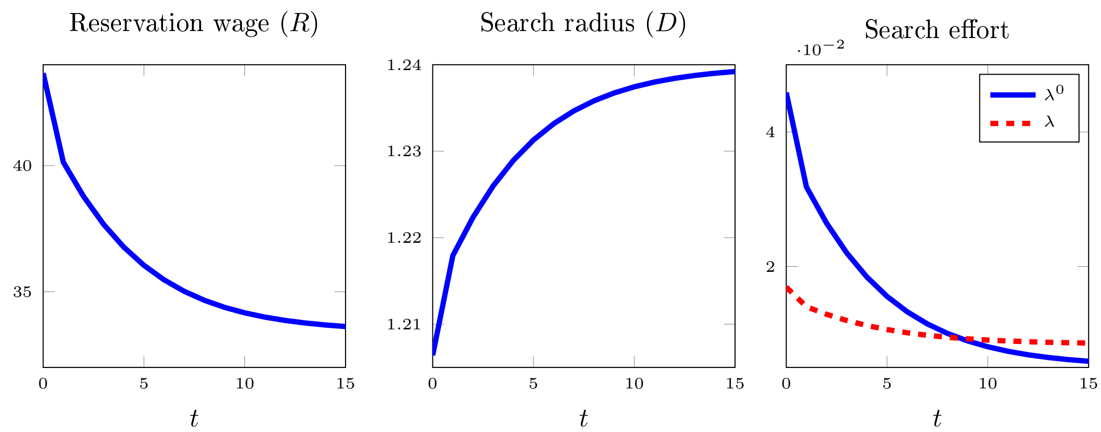
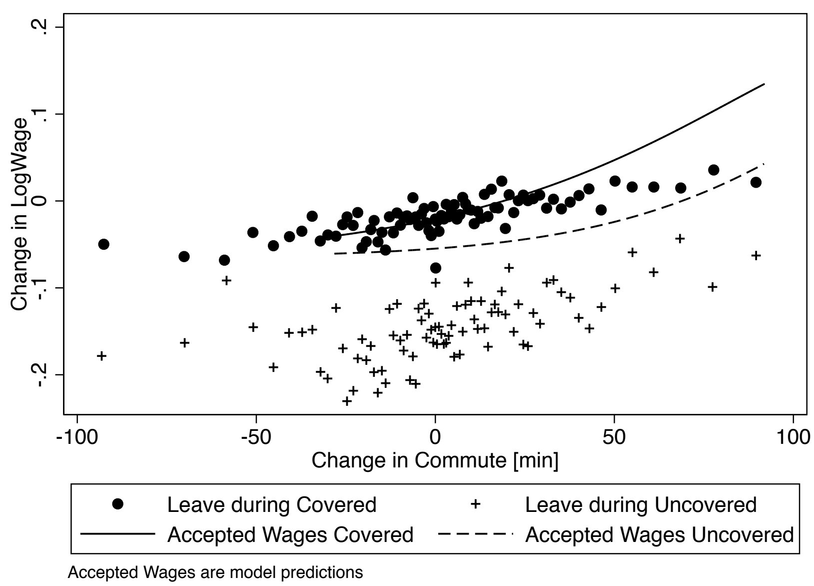


Figure 14: Changes in Commuting Time and Wage: data (stars and dots) and simulations from extended theory (solid and dash lines).



5.4 Policy implications from the calibration

The next stage is to describe the comparative statics of unemployment insurance for agents subject to mild liquidity constraints. In what follows, we will explore systematically the comparative statics of B, b and Potential Benefit Duration ($1/\alpha$) on the main endogenous variables of the model, the reservation strategies and distance search as well as employment and unemployment. In Appendix B.2 we further consider the case of agents who are strictly liquidity constrained and compare the difference in the search behaviour implied by the calibration exercise.

Figure 15 shows the response of the main variables of the model to a variation of the policy parameters, namely the unemployment insurance enjoyed by covered workers (B), the unemployment benefit received by workers who lost the insurance (b) andPotential Benefit Duration (PBD).

Variation of B and PBD often have opposite effects on covered (on UI) and uncovered (on UA) workers. Increases in B and PBD make the covered workers choosier: they decrease their radius of search and their reservation wage increases. Furthermore, they reduce the search intensity both inside and outside the previous workplace. The joint effect is a reduction in the hazard rate for covered workers. On the contrary, B has no disincentive effect on uncovered workers, since they do not actually receive it. We can observe a mild entitlement effect instead: B raises the value of re-employment and therefore the effort made by uncovered workers to find a job. The result of a larger B on uncovered workers is therefore that D increases as long as the search effort increases, while R decreases. As a result, uncovered workers are more likely to exit unemployment. Changes in b makes both types of workers choosier, leading to a reduction of the hazard rate for both types of searchers.

Table 7 presents the elasticities of outcomes and decisions with respect to the parameters of the unemployment insurance system. Consider, first, the effects of increasing the unemployment benefit level for covered job seekers. Accepted wages and commuting distance display only a small reaction, but the unemployment exit hazard decreases, so unemployment duration increases, and job seekers reject more wage offers. Why does unemployment duration increase? The reservation wage barely increases, explaining the small increase in rejections, but the search radius decreases substantially. Moreover, job seekers search less, both inside the previous workplace, and outside it.

Changes to the duration of unemployment benefits also affect covered job seekers directly. Increasing the duration of benefits increases wages somewhat, and reduces commuting dis-

Table 7: Elasticities from simulations of the extended theory

	Covered job seekers			Uncovered job seekers		
	B	b	PBD	B	b	PBD
Observed outcomes						
Average wage	-0.00707	0.00091	0.02100	-0.00017	0.00081	-0.00105
Average distance	-0.03718	-0.00182	-0.05775	0.00038	-0.00591	0.00238
Hazard rate	-0.08693	-0.01569	-0.40646	0.00314	-0.02832	0.01993
Rejection rate	0.02072	0.01303	0.24616	-0.00884	0.06527	-0.05663
Share city stayers	-0.00718	0.00349	0.24564	0.04675	0.00327	-0.34502
Unemployment	0.02950	0.00384	0.75683	0.02634	0.03240	-0.20575
Decisions						
Reservation wage	0.01606	0.00418	0.09902	-0.00150	0.01181	-0.00957
Search radius	-0.10222	-0.00519	-0.14854	0.00112	-0.01752	0.00710
Effort outside d_0	-0.07389	-0.01310	-0.33641	0.00283	-0.02460	0.01796
Effort inside d_0	-0.04779	-0.01243	-0.31006	0.00264	-0.02078	0.01678

Notes: The elasticity of y with respect to x is defined as $\left(\frac{\Delta y}{y}\right) / \left(\frac{\Delta x}{x}\right)$. Elasticities are computed from simulations, considering the following policy changes: ΔB from 40 to 50 % of the previous wage; Δb from 8% to 10% of the benchmark B; Δ PBD 30 to 39 weeks.

tance. The unemployment exit hazard decreases substantially, rejections increase, more people work in the previous workplace, and more people are unemployed. Job seekers increase their reservation wage strongly, and decreases their search radius. Search intensity also plummets, both inside and outside the previous workplace.

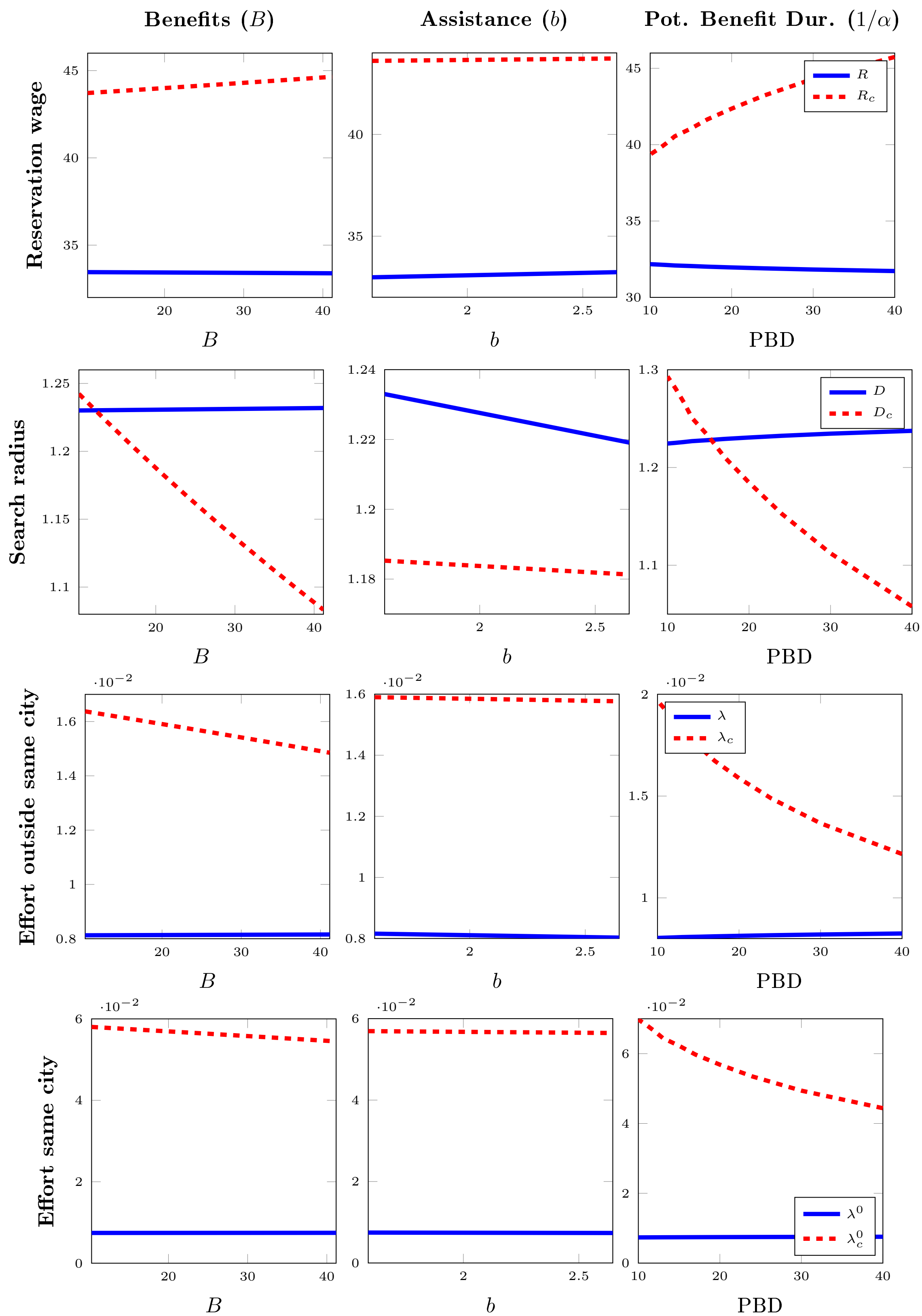
Changes in unemployment assistance, b, affect covered job seekers only once their benefits have run out. Covered job seekers react to unemployment assistance changes in a way that mimics unemployment insurance, B, but elasticities are smaller because job seekers discount the future changes in unemployment assistance. Forward-looking job seekers do take changes to the social assistance level into account.

Table 7 also shows results for uncovered job seekers. Changes in unemployment assistance affect uncovered job seekers directly. Assistance levels have small effects on accepted wages, and distances, but lower the unemployment exit hazard considerably. Uncovered job seekers reject more wage offers, and unemployment increases, once the unemployment assistance level is increased. Uncovered job seekers leave unemployment less quickly because they search less, both inside and outside the previous workplace. The reservation wage increases somewhat, and the search radius decreases, but the elasticities are a bit smaller than the effort elasticities.

Uncovered job seekers could also be affected by changes in the benefits levels and durations of covered job seekers because, by leaving unemployment, uncovered job seekers gain entitlement to regular unemployment benefits. Yet, the entitlement effect of raising the benefit level is small for uncovered job seekers. Elasticities are essentially zero. Changes to potential benefit duration have somewhat larger effects for uncovered job seekers, especially on the share city stayers and unemployment.

We would like to stress three insights from these simulations. First, studying average wages and average commuting distances will not necessarily provide information on the underlying decisions. Wages and commuting distances move less than reservation wages and search radius. Second, studying how many job seekers work in the same workplace as prior to unemployment is potentially revealing about the allocation of effort. The "share city stayers" reacts strongly to changes in potential benefit duration but not at all to changes in the benefit level with corresponding changes in search effort. Third, benefit levels affect outcomes less strongly than corresponding changes in the duration of unemployment benefits. This is interesting and somewhat counter-intuitive since changes to the unemployment benefit duration have no immediate impacts on covered job seekers. But job seekers are forward looking and the threat of loosing benefit payments changes decisions already well ahead. This finding, based on simulations, is in line with empirical studies on the effects of potential benefit duration vs benefit duration, e.g.Lalive *et al.* (2006).

Figure 15: Policy effects on search strategies from extended theory



6 Summary and conclusion

Taking the wage-commute distance arbitrage seriously, the paper has developed and then enriched a search model where the unemployed choose a range over which to search, an intensity of search in that area and how to allocate search effort in a particular city (their previous workplace). This model allows us to define the main concepts and to discipline the empirical analysis. It additionally clarifies the efficiency role for unemployment insurance, namely to alleviate the liquidity constraints of the unemployed. Indeed, if search in space is costly not only in terms of effort but also financially, especially away from the city of residence, benefits will help expanding the range of search under the existence of liquidity constraints.

The data analysis uncovers many regularities. Based on an administrative social security dataset covering all newly unemployed workers in Austria, which contains information on the current residence, the previous workplace and the subsequent workplace for those re-hired, we established a set of facts.

A. Commute time is dispersed and leads to a wage-distance trade-off: i) in a sample of employed workers having entered the unemployment spells, 57.2% of them had more than 20 minutes of one way commute distance, while 23.7% had more than 40 mn to the workplace; 22.6% of them used to work in the same city as where they live; ii) there is a positive correlation in the data between finding a job with a higher wage and finding a job with a higher distance; iii) almost as many people face a wage increase as a wage decrease after finding a new job; iv) almost as many workers face a commute distance increase as people facing a commute distance decrease.

B. Reservation wage strategies vary over time: the hazard rate of getting a lower paid job increases relative to the hazard rate of getting a better paid jobs, both for individuals facing an increase in the commute distance and for individuals facing a decline in the commute distance.

C. Spatial search strategies vary over time too: i) over time, after the initial peak, people are much less likely to find a job in the same city than to face an increase in the commute distance. An interpretation is that job seekers initially search more intensely in the same city and then prospect relatively more outside the city; those prospecting at a shorter distance may be liquidity constrained unemployed, who will accept a lower wage but cannot afford expensive job search; ii) over time, the likelihood to commute longer distances increases relative to other hazard rates (no distance change or lower distance); an interpretation is that, for a given wage offer, the reservation distance increases over time for those not liquidity constrained.

D. Disincentive effects of social transfers (UI, UA and duration of UI) are quite robust: i) they imply a negative effect on hazard rates and this applies to all sub-hazard rates (higher and lower wages, higher and lower commute distance); ii) in relative terms however, they raise the incidence of getting higher paid jobs as compared to the previous wage; iii) Quantitatively, our calibrated model implies an elasticity of hazard rate to benefits of -0.12; while explorations of the role of strict liquidity constraints suggest negligible effects on unemployment.

A Theory Appendix

A.1 Proof of Lemma 1

Proof. The proof is easy. The reservation wage $R(\rho)$ is defined by

$$\begin{aligned} r_c W(R(\rho), \rho) &= R(\rho) - c(\tau\rho) + s(U_c - W(R(\rho), \rho)) \\ &= R(\rho) - c(\tau\rho) + s(U_c - U) = r_c U \end{aligned}$$

so that

$$R(\rho) = \tau\rho + r_c U + s(U - U_c) \tag{8}$$

and similarly,

$$\begin{aligned} r_c W(R_c(\rho), \rho) &= R_c(\rho) - c(\tau\rho) + s(U_c - W(R_c(\rho), \rho)) \\ &= R_c(\rho) - c(\tau\rho) = r_c U_c \end{aligned}$$

so that

$$R_c(\rho) = c(\tau\rho) + r_c U_c \tag{9}$$

Hence Lemma 1.

A.2 Extended model: two levels of unemployment compensation

This Section contains the equations from the extended model presented in Section 4. As in Section 2, we use notations $F_\rho(w)$ and $G(\rho)$ for the cumulated distributions of wages and distances separately. The Bellman equations with two levels of unemployment insurance are, respectively:

$$r_c U_c(D) = B - c(D_c) + \delta_c D_c B + 2\pi\lambda_c \int_0^{D_c} \left(\int_w Max[W(w,\rho) - U_c; 0] dF_\rho(w) \right) dG(\rho) + \alpha(U - U_c) \tag{10}$$

$$rU(D) = b - c(D) + \delta D b + 2\pi\lambda \int_0^{D} \left(\int_w Max[W(w,\rho) - U; 0] dF_\rho(w) \right) dG(\rho) \tag{11}$$

The value functions for employment are, under the assumption that the employed workers have the same easy access to credit and saving plans as the covered unemployed:

$$r_c W_c(w,\rho) = w - c(\tau\rho) + \delta_c(\tau\rho)w + s(U_c - W_c(w,\rho)) \tag{12}$$

where $c(\tau\rho)$ is the commute cost for employees. The presence of τ captures the possibility that search and commuting distance may affect disutility differently. Equation 12 similarly applies to uncovered workers.

The solutions proceed from the previous analysis, except that $\frac{\partial W_c}{\partial w}(w,\rho) = \frac{1}{r_c+s}(1+\delta_c\tau\rho)$; $\frac{\partial W_c}{\partial \rho}(w,\rho) = \frac{1}{r_c+s}(-c'(\tau\rho)\tau + \delta_c\tau w)$ so that, denoting by $R_c(\rho)$ the reservation wage of an eligible worker associated with distance ρ, defined as $W_c(R_c(\rho),\rho) = U_c(D_c^*) = U_c$ (for simplicity we drop the optimal strategy D_c^*) and by $R(\rho)$ the reservation wage of an uncovered worker associated with distance ρ, defined as $W(R(\rho),\rho) = U(D^*) = U$, we can rewrite the value of employment as a linear function of w:

$$W_c(w,\rho) - U_c = \frac{1+\delta_c\tau\rho}{r_c+s}(w - R_c(\rho)) = S_c(w,\rho) \tag{13}$$

Similar steps lead to

$$W(w,\rho) - U = \frac{1+\delta\tau\rho}{r+s}(w - R(\rho)) = S(w,\rho)$$

We can now derive the reservation wages:

$$R(\rho) = \frac{1}{1+\delta\tau\rho}\left[c(\tau\rho) + r_c U + s(U - U_c)\right] \tag{14}$$

$$R_c(\rho) = \frac{1}{1+\delta_c\tau\rho}\left[c(\tau\rho) + r_c U_c\right] \tag{15}$$

From 14 and 15 we can compute the derivative of the reservation wage with respect to distance:

$$\frac{\partial R}{\partial \rho} = \frac{c'(\tau\rho)}{1+\delta\tau\rho} - \frac{\delta\tau}{(1+\delta\tau\rho)^2}\left[c(\tau\rho) + r_c U + s(U - U_c)\right] \tag{16}$$

Equation 16 shows that the reservation wage is a non linear function of commute distance. This slope should be compared to the slope of the empirical relationship displayed in the last panel of Figure 5. Our calibration ensures the positivity of the relationship.

A.2.1 Optimal search strategies

The first order condition on the radius can now be derived. Let $w^{\max}$ be the upper support of the wage distribution. We have

$$rU(D) = b - C(D) + \delta Db + 2\pi\lambda\mathbb{E}_{w,\rho}S(w,\rho) \tag{17}$$

$U(D)$ is maximised when

$$C'_D(D^*) - \delta b = 2\pi\lambda\mathbb{E}_w S(w, D^*)g(D^*) \tag{18}$$

Similarly, $U_c(D_c, \lambda_c)$ is maximised when:

$$C'_D(D_c^*) - \delta_c B = 2\pi\lambda_c\mathbb{E}_w S(w, D_c^*)g(D_c^*) \tag{19}$$

Similar expression as in Section 2 hold for the optimal search intensity λ and λ_c.

A.2.2 Extension of Lemma 3 to two types of unemployed workers

We now have:

$$rU(D,\lambda) = b - C(D,\lambda) + 2\pi\lambda \int_0^D \int_{R(\rho)}^{w^{\max}} S(w,\rho)dF_\rho(w)dG(\rho)$$
$$r_cU_c(D_c,\lambda_c) = B - C(D_c,\lambda_c) + 2\pi\lambda_c \int_0^{D_c} \int_{R_c(\rho)}^{w^{\max}} S(w,\rho)dF_\rho(w)dG(\rho) + \alpha(U - U_c)$$

The first value equation, through the envelope condition, leads as before to: $r\frac{dU}{db} = 1$; the second value equation leads to

$$(r_c + \alpha)\frac{dU_c}{dB} = 1 + \alpha\frac{dU}{dB}$$

A.2.3 Dynamics of the pool of covered and uncovered job seekers

Let us denote by $N_c(t)$ and $N_{nc}(t)$ the number of covered and uncovered unemployed workers at time t for a given cohort entering unemployment at time $t = 0$. We have, for all $t > 0$:

$$dN_c/dt = -(haz_c + \alpha)N_c$$
$$dN_{nc}/dt = -haz N_{nc} + \alpha N_c$$

These first order partial differential equations are easy to solve. In particular, we have that:

$$N_c(t) = N_c(0)e^{-(haz_c+\alpha)t} \tag{20}$$
$$N_{nc}(t) = N_{nc}(0)e^{-haz.t} + \frac{\alpha e^{-haz.t}}{haz_c + \alpha - haz} N_c(0)\left(1 - e^{-(haz_c+\alpha-haz)t}\right) \tag{21}$$

where both lines are obtained in fixing the integration constant to get the initial value at time $t = 0$ (entrance into the unemployment spell). Further, if all new entrants are covered, we have that $N_{nc}(0) = 0$. The two equations (20) and (21) determine the fractions of each of the four groups, that is, the covered and uncovered job seekers in the population of applicants.

A.3 Extended model: directing search towards the previous city

The new first order conditions on optimal search intensity now read as follows:

$$C'_\lambda(D, \lambda, \lambda^0) = 2\pi \Bigg[\int_0^{d_0-} \int_{R(\rho)}^{w^{\max}} \left[\frac{1 + \delta\tau\rho}{r + s}(w - R(\rho)) \right] dF_\rho(w)dG(\rho) + \int_{d_0-}^{D} \int_{R(\rho)}^{w^{\max}} \left[\frac{1 + \delta\tau\rho}{r + s}(w - R(\rho)) \right] dF_\rho(w)dG(\rho) \Bigg] \tag{22}$$

$$C'_{\lambda^0}(D, \lambda, \lambda^0) = 2\pi \int_{d_0-}^{d_0+} \int_{R(\rho)}^{w^{\max}} \left[\frac{1 + \delta\tau\rho}{r + s}(w - R(\rho)) \right] dF_\rho(w)dG(\rho) \tag{23}$$

A.4 Extended model: hazard rates

There are now six sub-hazard rates $sub-haz(w^+, d^+)$, $sub-haz(w^+, d^-)$, $sub-haz(w^-, d^+)$, $sub-haz(w^-, d^-)$, $sub-haz(w^+, d_0)$, $sub-haz(w^-, d_0)$, where the sum of these six sub-hazard rates is the total hazard rate haz. Taking advantage of the empirical evidence, we assign a peculiar role to the previous workplace, here proxied by the median distance. To discretize space, we define the area around the previous workplace as a small circle centered in d_0. Let ε be the radius of this small circle, it is useful to define $d_{0^-} \equiv d_0 - \varepsilon$ and $d_{0^+} \equiv d_0 + \varepsilon$. We calibrate ε to be 10% of d_0.

Moreover, we allow for the possibility that individuals exert effort in the previous workplace at a different (possibly higher) rate, denoted by λ^0 and λ_c^0 for uncovered and covered workers, respectively. Notice that, under this assumption, the value of unemployment should be rewritten:

$$rU(D) = b - c(D) + \delta Db + 2\pi\lambda^0 \mathbb{E}_\rho|_{\rho\in[d_{0^-}, d_{0^+}]} S(w,\rho) + 2\pi\lambda \mathbb{E}_\rho|_{\rho\in[0,d_{0^-})\cup(d_{0^+},D]} S(w,\rho)$$

The optimality conditions conversely do not change, provided that we always ensure $D > d_{0^+}$ and $D_c > d_{0^+,c}$.

We thus define the total hazard rate of covered and uncovered workers as:

$$haz = 2\pi\lambda \left[\int_0^{d_{0-}} \int_{R(\rho)}^{w^{\max}} dF_\rho(w) dG(\rho) + \int_{d_{0+}}^{D} \int_{R(\rho)}^{w^{\max}} dF_\rho(w) dG(\rho) \right] + 2\pi\lambda^0 \left[\int_{d_{0-}}^{d_{0+}} \int_{R(\rho)}^{w^{\max}} dF_\rho(w) dG(\rho) \right]$$

$$= 2\pi\lambda \left[\int_0^{d_{0-}} [1 - F_\rho(R(\rho))] dG(\rho) + \int_{d_{0+}}^{D} [1 - F_\rho(R(\rho))] dG(\rho) \right] + 2\pi\lambda^0 \left[\int_{d_{0-}}^{d_{0+}} [1 - F_\rho(R(\rho))] dG(\rho) \right]$$

$$haz_c = 2\pi\lambda_c \left[\int_0^{d_{0-}} \int_{R_c(\rho)}^{w^{\max}} dF_{c,\rho}(w) dG_c(\rho) + \int_{d_{0+}}^{D_c} \int_{R_c(\rho)}^{w^{\max}} dF_{c,\rho}(w) dG_c(\rho) \right] + 2\pi\lambda_c^0 \left[\int_{d_{0-}}^{d_{0+}} \int_{R_c(\rho)}^{w^{\max}} dF_{c,\rho}(w) dG_c(\rho) \right]$$

$$= 2\pi\lambda_c \left[\int_0^{d_{0-}} [1 - F_{c,\rho}(R_c(\rho))] dG_c(\rho) + \int_{d_{0+}}^{D_c} [1 - F_{c,\rho}(R_c(\rho))] dG_c(\rho) \right] + 2\pi\lambda_c^0 \left[\int_{d_{0-}}^{d_{0+}} \int_{R_c(\rho)}^{w^{\max}} dF_{c,\rho}(w) dG_c(\rho) \right]$$

A.5 Calibration

The calibration strategy is as follows. First, we fix the parameters for which we have some information. For instance, we set B (the unemployment insurance) and b (unemployment benefits) to be 35 % and 3% of the average wage, respectively. Our benchmark calibration assumes an annual interest rate of 4% for workers covered by unemployment insurance (B), while long-term unemployed face a higher borrowing rate ($r_c = 12\%$ annually). We assume wages and distances are distributed log-normally and we set the mean and the standard deviation to their empirical counterparts. We can allow for arbitrary values of correlation, but in the baseline calibration strategy we start with independent distributions. We set the separation rate so as to match an average unemployment rate around 6%. For the disutility component of the search cost function we assume separability between distance and search intensity and convexity in each argument ($\eta_c = \eta_\lambda = 1.5$). Importantly, we assume that agents (both covered and uncovered) weight less the effort provided to search in the previous workplace rather than outside ($\gamma^{\lambda^0}, \gamma_c^{\lambda^0} < 1$). Moreover, covered workers suffer less from the intensity of search in the previous workplace than uncovered agents ($\gamma_c^{\lambda^0} < \gamma^{\lambda^0}$). This is an important assumption: because we do not introduce other dimensions of heterogeneity, the asymmetry in the search cost is needed to rationalize the empirical observations that covered workers exit unemployment more quickly and they are relatively more "city stayers". The weight on the cost of search intensity has an alternative interpretation as the efficiency of the search process. It is rational to make the assumption that covered workers are relatively more efficient in searching jobs for several not self-excluding reasons, as discussed in Section 5.1. We set $\delta = \delta_c = -0.2$; this calibration implies that, for any given income (consumption) level, agents are better off when they search/commute less.

Given that our dataset does not provide any specific information about the private cost of commuting and the transport infrastructures, we choose a linear commuting cost function with coefficient (τ) equal to 1. This monetary component also enters the search cost function with the same coefficient.

For a given set of parameters, the dynamic of the hazard rate, the sub-hazards and their ratios is driven by the relative share of workers belonging to the covered or uncovered state, respectively. More precisely, in each period the hazard rate is a weighted average of the hazard rate of covered and uncovered workers, where the weights are represented by the share of workers in these two states, respectively. As time goes, the share of uncovered workers increases, thus triggering the dynamic of the hazard rates. Hence, in the model, the dynamic is entirely due to the different search strategies chosen by covered and uncovered workers.

Table B.1: Effects of Potential Benefit Duration on covered job seekers

PBD (weeks)	**0**	**26**	**52**	**99**	**104**
Observed outcomes					
Average wage (euros per day)	61.73	65.15	66.24	67.21	67.27
Average distance (min)	27.51	25.14	23.97	22.53	22.41
Hazard rate	0.2307	0.1004	0.0707	0.0481	0.0466
Rejection rate	0.004	0.013	0.015	0.017	0.017
Share city stayers	0.15	20.54	24.67	28.38	28.67
Unemployment	0.000	0.015	0.025	0.042	0.043
Decisions					
Reservation wage	33.55	44.80	48.41	51.83	52.09
Search radius	1.52	1.14	1.01	0.87	0.86
Effort outside d_0	0.0297	0.0144	0.0108	0.0079	0.0077
Effort inside d_0	0.1042	0.0520	0.0401	0.0307	0.0301

B Supplementary Results: theory

B.1 Policy simulations

Tables from B.1 to B.6 report the changes in the observed outcomes and the decisions of the unemployed for different policy experiments. Regarding the Potential Benefit Duration, we consider the absence of UA (0 weeks), 26 weeks like in the US, the double of this value (52 weeks) and two extreme values (99-104 weeks) which correspond to the maximum reached during the last recession. For the UI we consider a wide range of values, varying the replacement rate from 0 to 80%, which is among the maximum values observed in reality (Denmark). In Austria the current replacement rate is around 40%. UA is expressed in terms of UI, ranging from 0 to 50%.

The information conveyed by the tables are the same as in Figure 15 and discussed in Section 5.4.

Table B.2: Effects of Potential Benefit Duration on uncovered job seekers

PBD (weeks)	**0**	**26**	**52**	**99**	**104**
Observed outcomes					
Average wage (euros per day)	60.51	60.34	60.29	60.25	60.24
Average distance (min)	25.70	25.86	25.91	25.95	25.96
Hazard rate	0.0446	0.0469	0.0477	0.0484	0.0484
Rejection rate	0.003	0.003	0.003	0.003	0.003
Share city stayers	11.58	4.61	3.46	2.70	2.65
Unemployment	0.082	0.048	0.041	0.035	0.034
Decisions					
Reservation wage	34.00	33.19	32.94	32.70	32.68
Search radius	1.21	1.23	1.24	1.25	1.25
Effort outside d_0	0.0078	0.0082	0.0083	0.0084	0.0084
Effort inside d_0	0.0072	0.0075	0.0076	0.0077	0.0077

Table B.3: Effects of Unemployment Insurance (B) on covered job seekers

Replacement rate	**0**	**0.20**	**0.4**	**0.6**	**0.8**
Observed outcomes					
Average wage (euros per day)	65.34	64.97	64.69	64.47	64.31
Average distance (min)	26.35	25.86	25.39	24.92	24.44
Hazard rate	0.1209	0.1162	0.1114	0.1066	0.1016
Rejection rate	0.011	0.012	0.012	0.012	0.012
Share city stayers	18.99	18.93	18.86	18.80	18.72
Unemployment	0.012	0.012	0.012	0.012	0.012
Decisions					
Reservation wage	43.38	43.72	44.06	44.42	44.79
Search radius	1.31	1.23	1.17	1.11	1.06
Effort outside d_0	0.0169	0.0163	0.0157	0.0151	0.0145
Effort inside d_0	0.0592	0.0579	0.0565	0.0552	0.0538

Table B.4: Effects of Unemployment Insurance (B) on uncovered job seekers

Replacement rate	**0**	**0.20**	**0.4**	**0.6**	**0.8**
Observed outcomes					
Average wage (euros per day)	60.37	60.37	60.36	60.36	60.35
Average distance (min)	25.83	25.84	25.84	25.85	25.85
Hazard rate	0.0466	0.0466	0.0467	0.0468	0.0468
Rejection rate	0.003	0.003	0.003	0.003	0.003
Share city stayers	4.93	5.03	5.15	5.27	5.40
Unemployment	0.050	0.051	0.052	0.052	0.053
Decisions					
Reservation wage	33.47	33.45	33.42	33.40	33.37
Search radius	1.23	1.23	1.23	1.23	1.23
Effort outside d_0	0.0081	0.0081	0.0081	0.0082	0.0082
Effort inside d_0	0.0074	0.0074	0.0074	0.0075	0.0075

Table B.5: Effects of Unemployment Assistance (b) on covered job seekers

Percentage of B	**0**	**0.25**	**0.5**
Observed outcomes			
Average wage (euros per day)	64.69	64.88	65.09
Average distance (min)	25.55	25.41	25.23
Hazard rate	0.1145	0.1089	0.1028
Rejection rate	0.012	0.012	0.013
Share city stayers	18.81	19.03	19.30
Unemployment	0.012	0.012	0.012
Decisions			
Reservation wage	43.46	44.04	44.70
Search radius	1.19	1.17	1.15
Effort outside d_0	0.0161	0.0154	0.0147
Effort inside d_0	0.0576	0.0554	0.0529

Table B.6: Effects of Unemployment Assistance (b) on uncovered job seekers

Percentage of B	**0**	**0.25**	**0.5**
Observed outcomes			
Average wage (euros per day)	60.31	60.47	60.66
Average distance (min)	26.00	25.52	24.97
Hazard rate	0.0481	0.0439	0.0395
Rejection rate	0.003	0.003	0.004
Share city stayers	5.10	5.16	5.21
Unemployment	0.050	0.055	0.062
Decisions			
Reservation wage	32.53	33.76	35.12
Search radius	1.25	1.19	1.12
Effort outside d_0	0.0083	0.0077	0.0070
Effort inside d_0	0.0076	0.0071	0.0066

B.2 The strict liquidity constraints case

In the case the unemployed have decumulated their assets and face a subsistance level for consumption, say $\underline{\mathcal{C}}$, they face the following strong cash constraint that prevents them from searching optimally in space:

$$b \geq \underline{\mathcal{C}} + M(D)$$

Lemma 5 (strict liquidity constraints). *In the absence of assets and under separability of the cost function, e.g. $C(D, \lambda) = M(D) + e(\lambda, D)$ where the first part is monetary, the constrained range of search is sub-optimal if*

$$\bar{D}(b) = M^{-1}(b - \underline{\mathcal{C}}) < D^*$$

The constrained value is increasing in the level of benefits and decreasing in the subsistence level. In turn, the optimal effort λ^* will itself react to the constrained value $\bar{D}(b)$.

This Lemma introduces a new role of unemployment insurance in the presence of imperfect financial markets as studied in Baily (1978), Chetty (2008) or Werning (2002) or Shimer and Werning (2003). It recognizes that search costs are not only time costs or disutility costs, but have a monetary component due to the existence of the spatial dispersion of jobs. The equivalent results of Lemma 3 in the strict liquidity constraints case can be summarized as follows:

Lemma 6 (unemployment benefits impact). *Under strict liquidity constraints as in Lemma 5, the impact of benefits on U is larger than the inverse of the discount rate.*

The proof of this Lemma and 3 in the text is based on the derivatives of

$$rU(D,\lambda) = b - C(D,\lambda) + 2\pi\lambda \int_0^D \int_{R(\rho)}^{w^{\max}} S(w,\rho) dF_\rho(w) dG(\rho)$$

with respect to b for the ongoing rate of interest. Denote by $\tilde{D}$ the minimum between the optimal search radius D^* and the constrained level $\bar{D}(b)$: we have

$$\begin{aligned} r\frac{dU}{db} &= 1 \\ &+ \frac{\partial \lambda^*}{\partial b}\left[-C'_\lambda + 2\pi \mathbb{E}_{w,\rho} S(w,\rho)\right] \\ &+ \frac{\partial \widetilde{D}}{\partial b}\left[-C'_D(\widetilde{D},\lambda) + 2\pi\lambda \mathbb{E}_w S(w,\widetilde{D})\right] \\ &+ 2\pi\lambda \int_0^D \frac{\partial R(\rho)}{\partial b}\left[-S(R(\rho),\rho) f(\rho)\right] dG(\rho) \end{aligned}$$

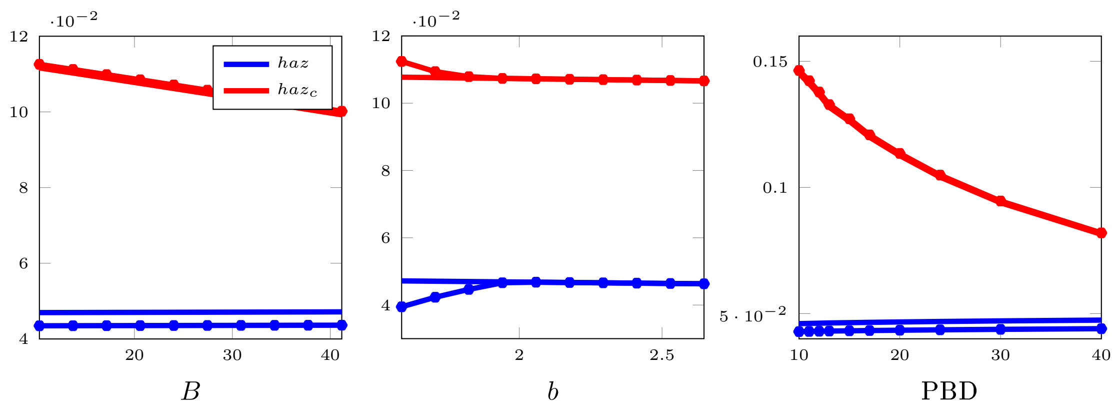
The last line is by definition equal to zero since the surplus is equal to zero at $R(\rho)$. In interior solutions, by the envelope theorem, the second and third lines are equal to zero as well. Hence, the effect of benefits is equivalent to a permanent rise in the income of the unemployed workers, who will enjoy both higher benefits as unemployed and choose higher wages in the future. The situation is different for credit constrained unemployed workers; indeed, if $D = \bar{D}(b) < D^*$ is the constrained level of the range of search, then the envelope condition of the third line does not hold. In this case, $-C'_D + 2\pi\lambda \mathbb{E}_w S(w, D^*) > 0$; then, the effect of benefits on the value of unemployment is larger than $1/r$.

Figures B.1 and B.2 compare the dynamics of the simulated hazard rates and of the search strategies with and without liquidity constraints.

Starred lines in Figures B.3 and B.4 represent policy simulations under a calibration that implies strict liquidity constraints for uncovered workers ($D = \bar{D(b)}$) . Covered workers turn out not to be constrained because the unemployment insurance they are entitled to is substantially higher than assistance. The results are especially interesting for policy changes affecting unemployment assistance (b). For low values of b, uncovered agents are liquidity constrained: this implies a sub-optimally low search radius and hazard rate. Notice that the presence of liquidity constraints affects search strategies also at early stages of the unemployment spell, since agents take into account the possibility of switching to the uncovered state.

Table B.7 summarizes these results in terms of elasticities.

Figure B.3: Policy effects on hazard rates: strict liquidity constraints for the unemployed under the UA regime



Notes: solid lines refer to the regime with mild liquidity constraints ($r > r_c$); dotted lines show results when unemployed agents under UA are subject to strict liquidity constraints.

Figure B.1: Simulated hazard rates: strict liquidity constraints for the unemployed under the UA regime

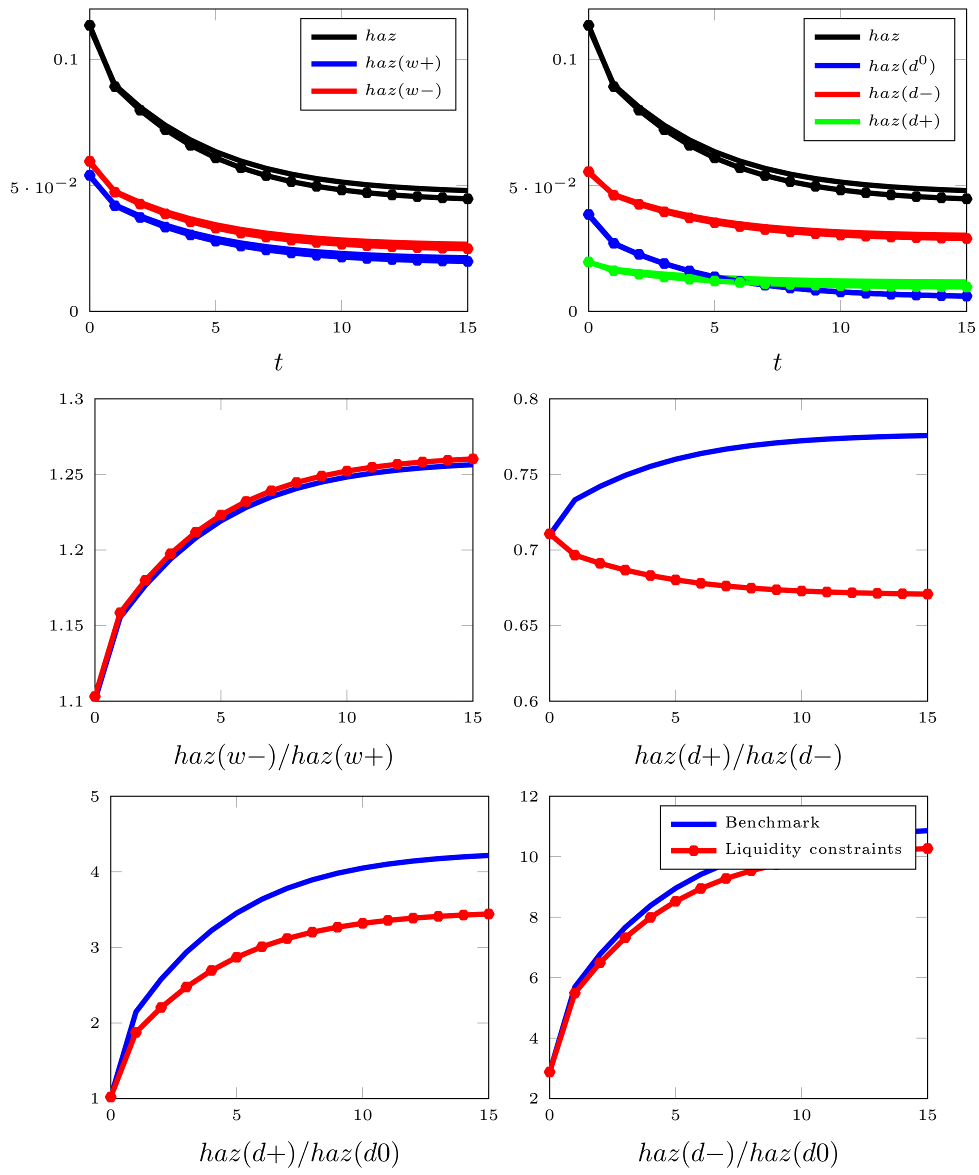


Figure B.2: Search strategies: strict liquidity constraints for the unemployed under the UA regime

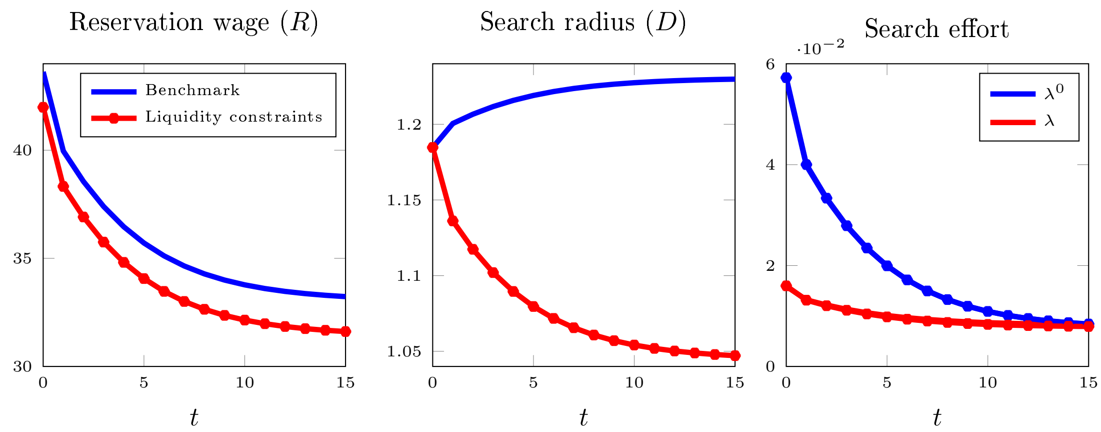
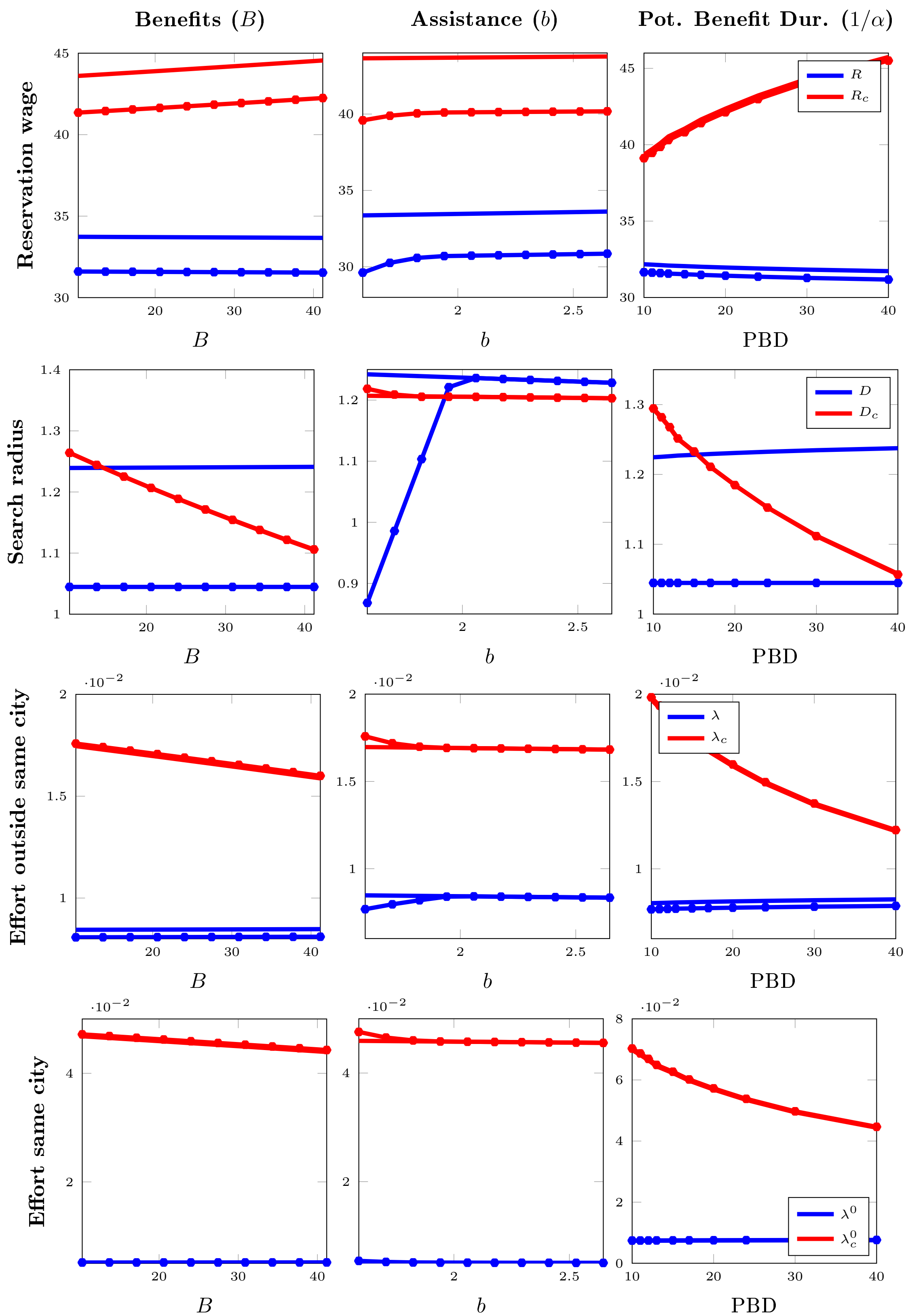


Table B.7: Elasticities of the model with strict liquidity constraints (for the workers under the UA regime)

	Covered job seekers			Uncovered job seekers		
	B	b	PBD	B	b	PBD
Observed outcomes						
Average wage	-0.00701	0.00934	0.02091	-0.00018	0.05378	-0.00115
Average distance	-0.03702	-0.00802	-0.05842	0.00000	0.46273	0.00000
Hazard rate	-0.08625	-0.11424	-0.40725	0.00277	0.53952	0.01776
Rejection rate	0.02079	0.10929	0.24895	-0.01042	1.56581	-0.06749
Share city stayers	-0.00558	-0.19833	0.23877	0.04798	-0.37945	-0.35029
Unemployment	0.02930	0.06746	0.75717	0.02651	-0.41595	-0.20347
Decisions						
Reservation wage	0.01597	0.03255	0.09952	-0.00160	0.09303	-0.01034
Search radius	-0.10181	-0.02287	-0.15013	0.00000	1.29386	0.00000
Effort outside d_0	-0.07337	-0.09554	-0.33739	0.00262	0.31476	0.01683
Effort inside d_0	-0.04732	-0.09486	-0.31042	0.00277	-0.15647	0.01779

Notes: The elasticity of y with respect to x is defined as $\left(\frac{\Delta y}{y}\right) / \left(\frac{\Delta x}{x}\right)$. Elasticities are computed from simulations, considering the following policy changes: ΔB from 40 to 50 % of the previous wage; Δb from 8% to 10% of the benchmark B; Δ PBD 30 to 39 weeks.

Figure B.4: Policy effects on search strategies: strict liquidity constraints for the unemployed under the UA regime



Notes: solid lines refer to the regime with mild liquidity constraints ($r > r_c$); dotted lines show results when unemployed agents under UA are subject to strict liquidity constraints.

B.3 Maximizing the social welfare function with benefits

The social welfare function is the sum of the value of unemployment and the social value of employment, possibly incorporating the social costs of commutes, to which unemployment insurance and assistance must be deducted. Some intermediate results will be useful. Denote by u_c and u_{nc} the number of unemployed workers who are covererd and non covered, respectively; we have the differente rates of unemployment by equality of inflows and outflows:

$$s(1 - u_c - u_{nc}) = u_c.(hazard_c + \alpha)$$
$$u_c \alpha = u_{nc}.hazard_{nc}$$

$$\begin{aligned} u_c &= \frac{s}{\alpha + s + hazard_c + \alpha s / hazard_{nc}}; \\ u_{nc} &= \frac{s}{\alpha + s + hazard_c + \alpha s / hazard_{nc}} \frac{\alpha}{hazard_{nc}} \\ u &= u_c + u_{nc} \end{aligned}$$

There are two special cases: when $\alpha = 0$ we obtain $u = s/(s + hazard_c)$; and when $hazard_c = hazard_{nc}$, we also have $u = s/(s + hazard_c)$.

Introducing the notations:

$$r\tilde{U}(D, \lambda) = 0 \times b - C(D, \lambda) + 2\pi\lambda \int_0^D \int_{R(\rho)}^{w^{\max}} \tilde{S}(w, \rho) dF_\rho(w) dG(\rho)$$
$$r_c\tilde{U}_c(D_c, \lambda_c) = 0 \times B - C(D_c, \lambda_c) + 2\pi\lambda \int_0^D \int_{R(\rho)}^{w^{\max}} \tilde{S}(w, \rho) dF_\rho(w) dG(\rho) + \alpha(\tilde{U} - \tilde{U}_c)$$

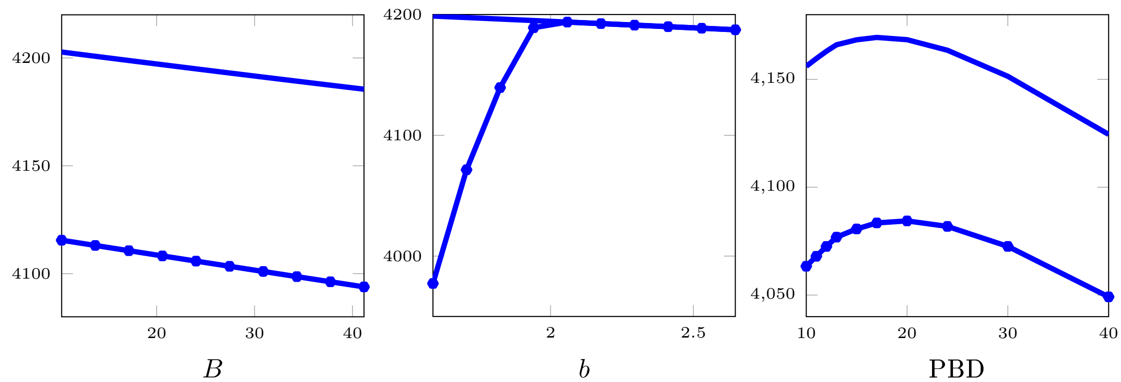
the social welfare function is therefore

$$\Omega = u_{nc}\tilde{U}(D, \lambda) + u_c\tilde{U}(D_c, \lambda_c) + (1 - u_c - u_{nc})\mathbb{E}_{w,\rho} \left[W(w, \rho) - SC(\rho) \right].$$

where $SC(\rho)$ represent the social costs of commuting[15]. We vary B and b under two polar

[15] For the social costs of commuting we utilize the following specification: $SC(\rho) = \tau^{social} \left[\frac{haz \cdot u_{nc}}{s} \mathbb{E}_{nc}(\rho) + \frac{haz_c \cdot u_c}{s} \mathbb{E}_c(\rho) \right]$.

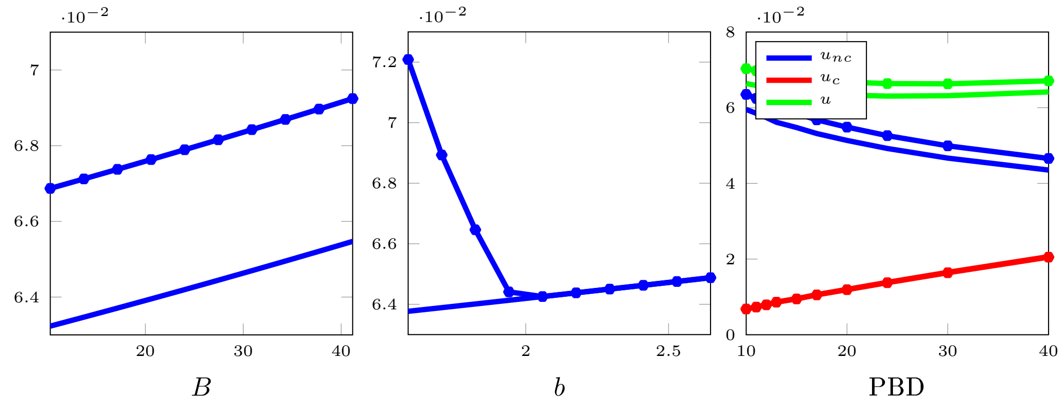
Figure B.5: Policy effects on social welfare



cases: one where agents under unemployment assistance (b) are only mildly constrained; one where agents under unemployment insurance B are not liquidity constrained but agents under unemployment assistance b cannot afford to pay for long search distances. The effects of policy changes on social welfare are plotted in Figure B.5 , where the solid line represents the behavior of the social welfare function under mild financial constraints and the starred line refers to the case where the uncovered workers are liquidity constrained for low values of assistance. It can be seen that the socially optimal level of unemployment insurance is zero, since welfare declines monotonically with B. Instead, if under mild liquidity constraint the same is true fom b (unemployment assistance), in the more realistic case of liquidity contraints for households in the assistance regime, there is an optimal level of unemployment assistance and social welfare, which first goes up as the range of search can be extended and the constraints are reduced. Once the cash constraint is suppressed however, higher levels of assistance reduce search intensity and welfare goes down again.

The gap between the dotted line and the solid line in Figure B.6 represents the percentage points of unemployment that can be attributed to the existence of strict liquidity constraints, the fact that the unemployed cannot search over the optimal range. This gap is 0.3 percentage points in the left panel, but the gap depends very much on the value of b which determines the value of D in the case of strict liquidity constraints; in the middle panel, the difference is as high as 0.072-0.064, that is 0.8 percentage points of unemployment.

Figure B.6: Policy effects on the unemployment rate: strict liquidity constraints for the unemployed under the UA regime



Notes: solid lines refer to the regime with mild liquidity constraints ($r > r_c$); dotted lines show results when unemployed agents under UA are subject to strict liquidity constraints.

C Supplementary results: empirics

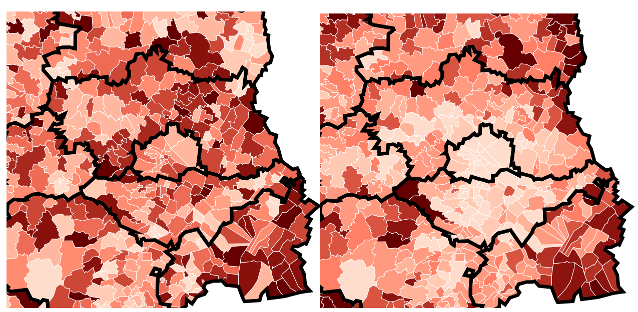


Figure C.1: Average Commuting Time by Workplace (left) and Residency (right) around Vienna from the empirical data analysis

Table C.2 reports the estimates of the effects of the policy parameters when the wage and the distance dimensions are considered jointly. We start by looking into how UI affects the rate of finding a better paying job, closer to home ($w+/d-$). This transition should not be affected by changes in the reservation wage or search radius, just by search intensity, thus representing a convenient baseline. Indeed, point estimates on UI parameters are small in absolute value. Compared to this baseline, UI significantly reduces exits to worse paid jobs, regardless of whether the job is closer or farther from home ($w-/d+$, $w-/d-$). Compared to the baseline, neither UI benefits nor assistance affect exists to better paid jobs located

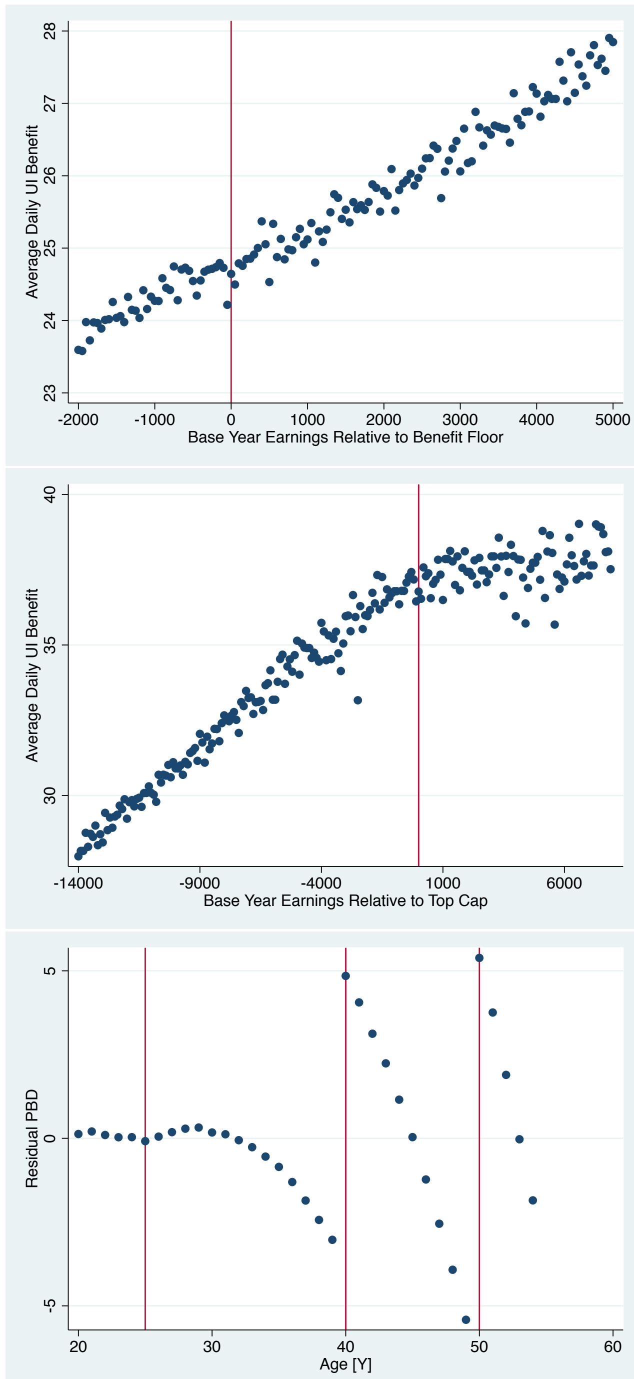


Figure C.2: Kinks in the UI benefit schedule and discontinuity in age further away from home ($w+/d+$). The key effect on distance is via potential benefit duration which reduces the transitions to jobs located further from home but has no effect on the baseline. Results for job seekers who make transitions into jobs that are different from the previous one suggest reservation wages adjust but search radius does not.

The remaining bivariate transition rates feature either a wage that stays the same (w_0) or a distance that stays the same (d_0). Results from outcomes where distance stays the same (columns 7 to 9) indicate a strong effect of UI benefits and assistance on transitions to worse paid, $w-/d_0$, (or equally paid, w_0/d_0) jobs, compared to the transition to better paid jobs ($w+/d_0$). The outcomes where wages stay the same (columns 3, 6 and 9 again) show somewhat more reduced transitions to the same city (w_0/d_0) as unemployment benefits or assistance increase, compared to being either further ($w_0/d+$) or closer to home ($w_0/d-$). Results on bivariate estimates are generally consistent with the univariate results.

Table C.1: Cox-model Estimates, same Results as Table 3 but with full set of covariates

	(all)	(all)	(w+)	(w-)	(w0)	(d+)	(d-)	(d0)
B	-0.542***	-0.640***	-0.350***	-2.494***	-1.475***	-0.537***	-0.652***	-0.910***
	(0.031)	(0.026)	(0.036)	(0.054)	(0.063)	(0.037)	(0.040)	(0.060)
b		-0.271***	-0.314***	-0.589***	-0.522***	-0.261***	-0.289***	-0.258***
		(0.033)	(0.052)	(0.044)	(0.100)	(0.047)	(0.052)	(0.082)
PBD [weeks]	-0.003***	-0.001	-0.004**	0.006***	-0.000	-0.004***	-0.000	0.003
	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.001)	(0.002)	(0.002)
Time to Next Large City	0.002***	0.002***	0.002***	0.001***	0.003***	0.002***	0.003***	-0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Altitude [100m]	0.036***	0.035***	0.037***	0.044***	0.021***	0.027***	0.015***	0.092***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.007)	(0.004)	(0.005)	(0.006)
Married	0.117***	0.115***	0.128***	0.119***	0.150***	0.105***	0.134***	0.102***
	(0.007)	(0.007)	(0.010)	(0.010)	(0.019)	(0.010)	(0.011)	(0.018)
Numb. Children	-0.009**	-0.008**	-0.014***	0.005	0.004	-0.011**	-0.007	-0.005
	(0.004)	(0.004)	(0.005)	(0.005)	(0.009)	(0.005)	(0.006)	(0.009)
Insured Wage [1000]	-0.069***	-0.070***	-0.098***	-0.001	0.002	-0.074***	-0.070***	-0.056***
	(0.003)	(0.003)	(0.005)	(0.005)	(0.006)	(0.004)	(0.005)	(0.007)
White Collar	-0.187***	-0.187***	-0.025*	-0.304***	-0.147***	-0.251***	-0.153***	-0.111***
	(0.008)	(0.008)	(0.013)	(0.012)	(0.023)	(0.012)	(0.013)	(0.020)
Wage Before ([Euros],w_{-1})	-0.002***	-0.002***	-0.036***	0.003***	-0.007***	-0.003***	-0.001***	-0.005***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)
Age [Y]	0.018**	0.018**	0.008	0.029**	-0.002	0.015	0.016	0.029
	(0.008)	(0.008)	(0.013)	(0.012)	(0.023)	(0.012)	(0.013)	(0.020)
Exp 0-1.99y [Y]	-3.123***	-3.175***	-3.065***	-2.158***	-1.909***	-3.306***	-3.785***	-1.385**
	(0.270)	(0.265)	(0.391)	(0.370)	(0.706)	(0.364)	(0.395)	(0.666)
Exp 2-4.99y [Y]	-0.566***	-0.567***	-0.646***	-0.525***	-0.569***	-0.525***	-0.599***	-0.610***
	(0.060)	(0.060)	(0.080)	(0.085)	(0.153)	(0.081)	(0.087)	(0.132)
Exp 5-9.99y [Y]	-0.119***	-0.117***	-0.096***	-0.116***	-0.082	-0.045*	-0.179***	-0.194***
	(0.019)	(0.019)	(0.027)	(0.028)	(0.052)	(0.026)	(0.030)	(0.045)
Nuts3 FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Squares	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cubic	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spells	154,677	154,677	154,677	154,677	154,677	154,677	154,677	154,677
Individuals	118,343	118,343	118,343	118,343	118,343	118,343	118,343	118,343
Log L	-1613517	-1613357	-666060	-737931	-196332	-748354	-591330	-266454
Share Exits	0.96	0.96	0.40	0.44	0.12	0.44	0.35	0.16

Notes: Duration variable is nonemployment in months. Estimates refer to coefficients. w0 contains changes in wage of +/− 4%. Squares and Cubic refers to the inclusion of polynomials of age, experience and past wage. Voluntary quits and recalls are excluded, only Replacement Rates weakly below 1 and potential benefit durations above 0 are considered. Standard errors are clustered on individual level. Significance is indicated as follows: * (p<0.05), ** (p<0.01), *** (p<0.001)

Table C.2: Cox-Model Estimates, sub-hazards

	$(w+, d+)$	$(w-, d+)$	$(w_0, d+)$	$(w+, d-)$	$(w-, d-)$	$(w_0, d-)$	$(w+, d_0)$	$(w-, d_0)$	(w_0, d_0)
B	-0.305***	-2.489***	-1.341***	-0.287***	-2.553***	-1.447***	-0.618***	-2.380***	-1.795***
	(0.049)	(0.065)	(0.093)	(0.056)	(0.069)	(0.106)	(0.082)	(0.092)	(0.133)
b	-0.316***	-0.625***	-0.354**	-0.306***	-0.604***	-0.619***	-0.312**	-0.433***	-0.845***
	(0.072)	(0.063)	(0.140)	(0.084)	(0.068)	(0.172)	(0.134)	(0.108)	(0.255)
PBD [weeks]	-0.005**	0.004**	-0.007*	-0.004	0.007***	0.002	0.001	0.006*	0.010*
	(0.002)	(0.002)	(0.004)	(0.002)	(0.002)	(0.005)	(0.004)	(0.003)	(0.006)
Nuts3 FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spells	154,677	154,677	154,677	154,677	154,677	154,677	154,677	154,677	154,677
Individuals	118,343	118,343	118,343	118,343	118,343	118,343	118,343	118,343	118,343
Log L	-321561	-333117	-87432	-236532	-282172	-67786	-105012	-119044	-40063
Share Exits	0.19	0.20	0.05	0.14	0.17	0.04	0.06	0.07	0.02

Notes: Duration variable is nonemployment in months. Estimates refer to coefficients. w_0 contains changes in wage of ± 4%. Control Variables: Potential Benefit Duration, net wage used for calculation of replacement rate. Experience in the last two, five and ten years (5 is net of 2 and 10 net of 5 years), altitude of the municipality of residence, time to the next large city, age in years, real wage and occupation of the last job before unemployment, marital status and number of children. Voluntary quits and recalls are excluded, only Replacement Rates weakly below 1 and potential benefit durations above 0 are considered. Standard errors are clustered on individual level. Significance is indicated as follows: * (p<0.1), ** (p<0.05), *** (p<0.01).

D Appendix: Robustness checks of Cox-Estimates and some light evidence of strong credit constraints

Table D.1 investigates the robustness of the estimates to the exclusion of largest cities. Differences are marginal.

Table D.3 is an attempt to decompose the results of the effects of benefits and assistance on different outcomes for individuals likely to be credit-constrained (people with at least 3 years of tenure on the job before UI (getting 2 months of salary as cash-on-hand) and those not. Interestingly, coefficients of the effect of benefits B of larger distance in the left of the table are larger for credit constrained agents, suggesting the existence of such effects.

Table D.1: Cox-model Estimates, excluding large cities but Vienna

	$(w+, d+)$	$(w-, d+)$	$(w_0, d+)$	$(w+, d-)$	$(w-, d-)$	$(w_0, d-)$	$(w+, d_0)$	$(w-, d_0)$	(w_0, d_0)
B	-0.306***	-2.633***	-1.381***	-0.330***	-2.612***	-1.479***	-0.627***	-2.709***	-1.920***
	(0.060)	(0.076)	(0.114)	(0.070)	(0.084)	(0.133)	(0.114)	(0.123)	(0.168)
b	-0.342***	-0.616***	-0.275	-0.372***	-0.454***	-0.716***	-0.258	-0.351**	-0.537
	(0.096)	(0.082)	(0.184)	(0.112)	(0.092)	(0.241)	(0.203)	(0.158)	(0.356)
PBD [weeks]	-0.006**	0.004*	-0.008*	-0.003	0.009***	0.002	-0.003	0.009**	0.008
	(0.003)	(0.003)	(0.005)	(0.003)	(0.003)	(0.006)	(0.005)	(0.004)	(0.007)
Nuts3 FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spells	104,885	104,885	104,885	104,885	104,885	104,885	104,885	104,885	104,885
Individuals	81,637	81,637	81,637	81,637	81,637	81,637	81,637	81,637	81,637
Log L	-226692	-225306	-60907	-155699	-176464	-43622	-60643	-66608	-26272
Share Exits	0.21	0.21	0.06	0.14	0.16	0.04	0.06	0.06	0.02

Notes: Duration variable is nonemployment in months. Estimates refer to coefficients. w_0 contains changes in wage of $+/-$ 4%. Control Variables: Potential Benefit Duration, net wage used for calculation of replacement rate. Experience in the last two, five and ten years (5 is net of 2 and 10 net of 5 years), altitude of the municipality of residence, time to the next large city, age in years, real wage and occupation of the last job before unemployment, marital status and number of children. Voluntary quits and recalls are excluded, only Replacement Rates weakly below 1 and potential benefit durations above 0 are considered. Standard errors are clustered on individual level. Significance is indicated as follows: * (p<0.1), ** (p<0.05), *** (p<0.01).

Table D.2: Cox-model Estimates, excluding the retail sector

	(w+d+)	(w-d+)	(w0d+)	(w+d-)	(w-d-)	(w0d-)	(w+d0)	(w-d0)	(w0d0)
B	-0.281***	-2.496***	-1.283***	-0.267***	-2.565***	-1.428***	-0.585***	-2.404***	-1.814***
	(0.052)	(0.067)	(0.099)	(0.060)	(0.072)	(0.112)	(0.088)	(0.097)	(0.142)
b	-0.258***	-0.592***	-0.319**	-0.310***	-0.589***	-0.679***	-0.354**	-0.495***	-0.684***
	(0.078)	(0.067)	(0.150)	(0.091)	(0.073)	(0.188)	(0.148)	(0.116)	(0.264)
PBD [weeks]	-0.006***	0.004*	-0.010**	-0.003	0.008***	0.002	-0.001	0.007**	0.009
	(0.002)	(0.002)	(0.004)	(0.003)	(0.002)	(0.005)	(0.004)	(0.003)	(0.006)
Nuts3 FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spells	137,794	137,794	137,794	137,794	137,794	137,794	137,794	137,794	137,794
Individuals	106,936	106,936	106,936	106,936	106,936	106,936	106,936	106,936	106,936
Log L	-282000	-298343	-77825	-206432	-249117	-59824	-90805	-105202	-35576
Share Exits	0.19	0.20	0.05	0.14	0.17	0.04	0.06	0.07	0.02

Notes: Duration variable is nonemployment in months. Estimates refer to coefficients. w0 contains changes in wage of $+/-$ 4%. Control Variables: Potential Benefit Duration, Netwage used for calculation of replacement rate. Experience in the last two, five and ten years (5 is net of 2 and 10 net of 5 years), altitude of the municipality of residence, time to the next large city, age in years, real wage and occupation of the last job before unemployment, marital status and number of children. Voluntary quits and recalls are excluded, only Replacement Rates weakly below 1 and potential benefit durations above 0 are considered. Standard errors are clustered on individual level. Significance is indicated as follows: * (p<0.1), ** (p<0.05), *** (p<0.01)

Table D.3: Cox-Model Estimates, sub-hazards by previous tenure

		Benefits			Assistance		
		$d+$	d_0	$d-$	$d+$	d_0	$d-$
Constraint	$w+$	1.680***	1.366***	1.065***	0.001	0.066	-0.523
	w_0	0.669***	0	-0.008	0.382	0	-0.603
	$w-$	-0.250	-0.019	-0.695***	0.504	0.735	0.321
Unconstraint	$w+$	1.468***	1.150***	1.498***	0.649**	0.634**	0.737**
	w_0	0.458***	0	0.380**	0.538*	0	0.439
	$w-$	-0.675***	-0.587***	-0.704***	0.127	0.310	0.235

Notes: The table summarizes estimates from a competing risk Cox regression to each combination of wage and distance destination. The table reports coefficients on unemployment benefits (B) and unemployment assistance (b) relative to the coefficient estimated for the constant wage and same municipality of residence destination (w_0,d_0). Significance is indicated as follows: *(p<0.1), **(p<0.05), *** (p<0.01). Unconstraint : people with at least 3 years of tenure on the job before UI (getting 2 months of salary as cash-on-hand). Constraint : other.

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