CAN WELFARE ABUSE BE WELFARE IMPROVING?*

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Abstract

In this paper, I analyze numerically and quantitatively a model of labor search with unemployment insurance, voluntary quits and various labor attachment requirements. In particular, I study welfare consequences of unemployment insurance design where workers may abuse the welfare system by quitting their jobs voluntarily in order to receive benefits and search for another job. A simulation of the model calibrated to the US labor market shows that there are possible welfare gains associated with pursuing optimal re-entitlement policy for workers quitting their jobs voluntarily as compared to the actual policy employed in the US. By inducing different unemployment benefit eligibility requirements, the model provides a novel explanation for empirical observations about differences in unemployment rate, duration and income inequality between the US and European labor markets. Finally, I explore the assumption of monetary search costs and show that it can explain the empirically documented worker search behavior.

Key words: Unemployment Insurance, Labor Search, Voluntary Quits

JEL: J64, J65, J68

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1 Introduction

In the late 1970s the labor markets in the US and Europe began to diverge and these differences are profoundly visible until today. Unsurprisingly, this contrasting evolution has attracted interest of many economists. Among many topics related to it, arguably the most attention has been devoted to unemployment insurance systems. This line of research primarily focused on normative aspects like optimal design of the unemployment insurance and positive aspects like its incidence on worker's behavior. In this paper I model one particular aspect of unemployment insurance which differs strikingly between the two continents: the benefit entitlements for workers quitting jobs voluntarily. While in the US no quitter is eligible for receiving unemployment benefits[1], the entitlement policy in Europe is generally more generous and usually allows for payment of benefits in such cases subject to some sanctions. The exact requirements and sanctions have been described by Venn (2012). In general, there is a fixed work experience (or rather a social security contribution) requirement which is the same for both fired workers and quitters - usually it varies between 6 to 18 months of employment within the last 12-36 months preceding unemployment. On top of it, in order to discourage quitting, there are sanctions[2] in form of payment suspensions: in Lithuania and Slovakia there are no such sanctions, in Denmark there is a 3-week sanction, in Austria - 4; in Belgium - 7; in Sweden - 9; in Germany - 12. Nevertheless, there are also European countries not paying out the benefits for voluntarily unemployed, like Estonia, Italy or the Netherlands. To the best of my knowledge there is no research analyzing the welfare effects of these policy choices. This paper is trying to fill this gap.

In particular, I analyze numerically a discretized version of the McCall (1970) and assume that there are no sanctions for quitters, let every fired worker be eligible for benefits and look for the optimal re-entitlement policy for voluntary quitters, i.e. for how long should such workers be employed in order to be eligible for receiving unemployment benefits upon the quit. In order to pick the best policy I perform a social welfare analysis. This is a natural approach as it requires a consistent accounting for both benefits (such as more time and resources available for job search) and adverse incentive effects of the unemployment insurance (such as workers being more picky, generating possibly higher unemployment rate and consequently higher tax rate to finance

[1]Some states in the US allow quitters to apply for benefits if backed with a “good cause”. Nevertheless, there are many states (as e.g. the seven largest states) which disqualify all the voluntary quits.

[2]These sanctions are often not executed if the employer does not contest worker's unemployment insurance claim.

the welfare system).

In order to find a job, an *ex ante* homogenous worker exercises a costly search effort. When a worker becomes unemployed, she receives the unemployment benefit defined as a replacement ratio tied to her recent wage which depends on the amount of effort exercised in the last unemployment spell. This mechanism, together with exogenous firings, generates (1) an *ex post* heterogeneity among the workers being reflected in different reservation wages, and (2) a welfare abusive behavior of workers in the model with a benefit entitlement for quitters.

The latter means that there are some jobs in the economy which workers enter solely in order to regain eligibility for the benefits, quit the job short after and search for a better one thereafter. Indeed, Christofides and McKenna (1996) studied data from Canadian Longitudinal Labour Market Activity Survey for 1986/87 and found empirical evidence for a similar kind of a worker behavior. In particular, they found a significant increase in the job separation probability in the week right after a worker satisfies unemployment benefit eligibility. This finding was later confirmed by Green and Riddell (1997) and Baker and Rea (1998) who studied the same data for the year 1990. The US labor market was studied by Jurajda (2002) who found that entitlement for unemployment insurance significantly increases the probability of a lay-off. Although these studies do not look explicitly at voluntary quits, given that we should not always blindly believe in a dichotomy between lay-offs and voluntarily quits (see for example Feldstein (1976)), it is surely possible for many quitters to pass themselves off as being fired. However, it also seems very reasonable that there is still a significant share of quits due to personal reasons of the employees (especially in labor markets where quitters receive benefits). In what follows, I am modeling the latter phenomenon where there is a clear distinction between the two groups.

Furthermore, in the model presented below workers behave opportunistically in order to improve upon the match quality. Indeed, Tatsiramos (2009) presents empirical evidence for the role of unemployment insurance in correcting the misallocations in labor markets: he finds that for workers entitled to receiving benefits the subsequent employment spells are longer and that this relationship is more profound in countries with relatively more generous welfare systems.

Results suggest that the optimal policy is characterized by entitlement to unemployment insurance for quitters. Furthermore, the shorter is the required worker experience on the job, the higher is the associated welfare. Importantly, these results should be robust to the possibility of quitters passing themselves off as being laid-off, as surely not every worker is able to do this and as firing a worker is associated with non-negligible firing costs (for example in the US the unemployment insurance tax is experience rated).

Importantly, the results of the model suggest that the policy studied here may account to some extent for observed differences between the US and European labor markets. Firstly, following the optimal policy generates a higher unemployment rate. This is due to the fact that next to fired workers, the policy introduces category of voluntarily unemployed. Secondly, it reduces both pre- and after-tax income inequality. This is due to two effects induced by the entitlement policy: (1) the improvement of quality of matches allowing more workers to access high paying jobs, and (2) the increase in the budget balancing tax rate bringing the income of employed individuals closer to the income of unemployed. Thirdly, as under the optimal policy workers become more picky about the job offers, it increases the time spent in the unemployment state.

Moreover, I investigate mostly ignored in the literature assumption of monetary search costs. The model shows that this assumption, as opposed to the usually employed in the literature assumption of separable search costs, is able to generate empirically relevant effort spike at the benefit exhaustion.

My paper builds on a long literature of unemployment insurance. While the most common rationale for the payment of unemployment benefits is to provide risk averse workers with income insurance allowing for consumption smoothing, there is also a smaller strand of research work starting with Burdett (1979) which does not see the unemployment insurance solely as a serious distortion but rather argues for the role of insurance as a subsidy to search. In this literature the role of unemployment insurance is not only to give unemployed the time and resources to find a job but also to find the *right* one, i.e. it allows the workers to improve upon the quality of matches in labor markets. In this paper, I argue for a similar role of unemployment insurance.

While searching for reasons of labor markets divergence, Ljungqvist and Sargent (1998) argued that although in times of low micro-economic labor volatility the presence of unemployment insurance system has moderate impact on the unemployment rate, the systems which are relatively more generous may have a much more profound effect on the number of unemployed in times of high turbulence. Marimon and Zilibotti (1999) used a model with both heterogenous workers and firms, search frictions and skilled-biased technological change coupled with the assumption of complementarity between capital and capital-specific-skills to show that the differences in generosity of unemployment systems may account for the observed discrepancies between the US and European labor markets. In particular, they showed that although upon the technologyspecific shock the economy with more generous unemployment welfare system has a higher unemployment rate, it is characterized by a higher quality of matches, i.e. a higher growth of productivity per worker and a relatively lower wage inequality - a result complementary to the one in Ljungqvist and Sargent (1998). In this work, I identify a concrete real world policy which may be a channel of effects similar to these described in Marimon and Zilibotti (1999).

As I assume perfect distinction between lay-offs and quits, this paper is complementary to Hopenhayn and Nicolini (2009) where they derived an optimal unemployment insurance design under assumption that principal cannot distinguish quits from lay-offs. Their conclusion is that under the latter assumption the optimal contract involves conditioning of the benefit eligibility on worker's employment history. Moreover, their assumption generates an opportunistic worker behavior similar to the one imputed in my paper (which turns out to be welfare improving).

This paper is organized as follows. The next section provides description of the theoretical model. In Section 3 I calibrate the model to the US labor market. Section 4 presents the results. Finally, Section 5 concludes.

2 Model

The economy consists of a continuum of ex ante identical, risk-averse, infinitely- lived agents with measure normalized to 1. Time is discrete. Workers have no access to capital markets. In every period an unemployed worker receives with some probability a wage draw. This probability depends on the amount of random search effort chosen by the worker. After the draw she has to decide whether to accept the job or not. Employed workers make a decision about quitting or staying on the job.

2.1 Workers

Working does not yield disutility. Any worker can be either employed or unemployed and is maximizing her discounted life-time utility with respect to (1) the level of unobservable random search effort required to find the job q_t (when unemployed only, i.e. there is no on the job search) and then, if she draws a wage offer from some distribution, whether to accept it; or (2) the decision about staying on the job or quitting it in order to search for another. When employed she faces a risk of an exogenous separation happening at the Poisson rate σ.

Workers have a common instantaneous utility function $U(y)$ satisfying $U'(y) > 0$, $U''(y) < 0$ and an Inada condition at zero. When unemployed they exercise search effort q_t which is subject to convex costs (entering directly the utility function) given by $g(q_t) = \alpha q_t^{\zeta}$, where $q_t \in [0,1]$. Additionally, I assume that the mapping from worker's effort to the effective transition probability is governed by an increasing concave function $f(q_t) = \xi(1 - exp(-\chi q_t))$. This function is just an additional and indirect way of incorporating search costs in the model by introduction of decreasing marginal effectiveness of worker's effort.

For computational simplicity I assume that the worker is not allowed to borrow or save. This means that she consumes what is available to her in the given period. This assumption is not too unrealistic for two reasons. First of all, nearly half of job losers in the United States report zero liquid wealth at the time of job loss (Chetty, 2008). Secondly, as I assume no limits on benefits kicking in after surpassing some income threshold, we can think of this excess unemployment insurance income of workers who were recently on high paying jobs as a proxy for savings. If workers had access to capital markets, the main conclusions would most probably be qualitatively the same subject to a possible requirement of a longer work experience than derived below.

In each period an unemployed individual faces a stochastic employment opportunity: either she is offered a job opportunity for wage w or not. There are n different wage offers that the worker may draw and their support is on the $[0,1]$ interval. Denote this wage distribution by F. To explain this heterogeneity in wages, just think of n different technologies and of many firms having access solely to one of them. Also, I assume that the wage rate received by an employed worker is constant over time. Without loss of generality, let the after-tax wages be represented by $w_i^{\tau} = w_i(1-\tau)$, where w_i is the ordered increasingly in i wage index with $w_i \in [0,1]\ \forall i \in \{1,2,...,n\}$; and τ is a linear tax used to finance the welfare system - see discussion in Section 2.2 below. Finally, monitoring of job applicants is impossible and therefore a worker who rejects a work opportunity continues to receive unemployment benefits according to her benefit payment path.

Importantly, I assume that the cost of search effort is in terms of consumption, i.e. worker's utility function is of the form[3] $U(y - g(q_t))$. This means that high income workers face lower utility costs for a given search effort. Thus, in this model the role of unemployment benefit is not only to insure workers against the state of unemployment

[3]Typically in the literature search effort is modeled in terms of physical effort, which implies the separable utility function of the form $U(y) - g(q_t)$.

but also to provide them with a subsidy to search so that they can find the *right* job. In other words, unemployment benefits enable workers to exert higher search effort by providing them with the necessary means. This effect is especially strong right before the benefit exhaustion. Moreover, this assumption is realistic in two ways. First of all, searching for a job costs money as well as time. Any unemployed worker that wants to find a job has to buy and maintain a suit, travel for an interview, send out applications on nice paper or get some professional training. Secondly, many consumption expenditures such as a comfortable car or a home computer are complementary to job search. The effect we get from this lack of additive separability is that workers expecting a decline in their income will search even more intensively in order to avoid a kind of unemployment lock-in. Effectively, these workers would be constrained by the resources available to them and so they want to avoid this situation. Such a modeling assumption was employed for tractability with CARA utility by Shimer and Werning (2007) and also by Werning (2001).

Finally, the mechanics generated by the assumption employed here are supported by the empirical evidence documented by Blau and Robins (1990), Wadsworth (1991) and more recently by Krueger and Mueller (2014) who found that unemployed workers eligible for unemployment compensation search more actively than those not eligible. Nevertheless, there are results speaking against the monetary search cost as for example Jones (1989) or Krueger and Mueller (2010) who find that higher benefits reduce the time devoted to search among benefit recipients. However, with unemployment benefits defined as a replacement ratio, such a behavior could stem from the fact that workers receiving higher benefits (and so having worked in better jobs) find themselves in a more favorable search environment not requiring that much of a time investment (e.g. due to knowing well connected people).

Since there is no research on the degree of substitutability of money and time devoted to job search (in the extreme think of wealthy individuals employing headhunters), both should be seen as reasonable modeling assumptions. Therefore, I investigate the validity of results derived below by re-examining the model with separable search cost. Note below in Section 4.1, however, that such a model is not able match the time profile of search effort documented in Krueger and Mueller (2010). In particular, it cannot generate search effort spike at the benefit exhaustion. On the other hand, the monetary cost of search can fully explain this behavior.

2.2 Unemployment System

The design of the unemployment insurance system together with search frictions and exogenous separations are the source of *ex post* heterogeneity among the workers. It is financed with linear taxes raised by the government running a balanced budget. The tax distorts the decision about the search effort chosen. Any unemployed worker whose match was separated exogenously qualifies for benefits. Note that below I calibrate the model to the exogenous separation probability of 0.1 quarterly. This implies that in expectation workers are fired once in 2.5 years. This work experience satisfies labor attachment requirement in virtually every country.

The worker who decided to quit the job voluntarily is eligible for benefits if she had worked in her last job for at least $\hat{T}$ periods; otherwise she produces the value of h while staying at home (i.e. this value is not financed by the government and together with search costs pins down the outside option of the worker). Any unemployed and eligible worker receives the value of $b_t = b\left(w\right) + h$ for T periods (policy parameter) and $b_t' = s\left(w\right) + h$ from T onwards until she finds a new job. Unemployment benefits are defined as a replacement ratio of worker's last wage, thus $b\left(w\right) = \nu_b w$ and $s\left(w\right) = \nu_s w$, where w is her last wage and it holds that $0 \leq \nu_s < \nu_b < 1$, i.e. in what follows I do not consider a flat benefit payment schedule.

Given that search effort in this model is endogenous and affects transition probabilities, the unemployment insurance design provides additional incentives for unemployed to search for a job in order to avoid falling in the low-benefit state. At the same time, it gives rise to two negative effects: the first of suboptimal search effort and the second of rejecting job offers or quitting some jobs endogenously.

2.3 Recursive Formulation

Given Sections 2.1 and 2.2, each worker's current state can be captured with a vector $s = \left(x, t, w\right)$ of three state variables:

1. Worker's current status x: if employed $x = \mathrm{e}$, or if unemployed $x = \mathrm{u}$.

2. Time t spent in current stage. Notice that for unemployed workers after the drop in the benefit schedule from high to low, i.e. in period $T + 1$, the value of unemployment is constant over time due to the benefit schedule being constant from that point onwards. A similar argument applies to the employed workers. Therefore, $t \in \left\{1, 2, \ldots, \max\left\{\hat{T}, T + 1\right\}\right\}$. In particular, if a worker has been

employed for $t < \hat{T}$ periods and decides to quit, she immediately jumps from the state $\{e, t, w_i\}$ to the low benefit state $\{u, T+1, w_i\}$. However, if a match is separated exogenously or endogenously after at least $\hat{T}$ periods on the job, then the unemployed worker is entitled to benefits, i.e. she lands in the state $\{u, 1, w_i\}$.

3. Worker's most recent[4] wage $w \in \{w_1, \ldots, w_n\}$.

Therefore, the following Bellman equations hold for unemployed and employed workers:

$$\begin{aligned} V_u(t,w) &= \max_{q_t} \{U(b(t,w) - g(q(t,w)))\} \\ &+ \max_{q_t} \left\{ f(q_t)\beta \sum_{w'} \max\{0, V_e(1,w') - V_u(t',w)\} \mathbb{P}(w') + \beta V_u(t',w) \right\} \end{aligned} \tag{1}$$

where $t' = \min\{t+1, T+1\}$.

$$V_e(t,w) = U((1-\tau)w) + \beta\left(\sigma V_u(1,w) + (1-\sigma)\max\left\{V_u(t'',w), V_e(t^\dagger,w)\right\}\right) \tag{2}$$

where $t'' = \begin{cases} 1 & \text{if } t = \hat{T} \\ T+1 & \text{if } t < \hat{T} \end{cases}$, $t^\dagger = \min\left\{t+1, \hat{T}\right\}$.

Finally, notice that given the setup, the model possesses the *reservation wage property.* Due to the design of the unemployment system and search effort constraints imposed upon the worker, the reservation wage (just as the effort exerted q_t) depends on worker's current unemployment benefit, i.e. on the two states: length of unemployment spell t and last wage w.

Proposition (Reservation Wage Property): Consider a financially constrained worker exercising search effort to find a job in the market described in Section 2.1 and facing unemployment system described in Section 2.2. Then the optimal job search strategy of such a worker has a reservation wage characterization conditional upon worker's current state: the worker will accept a job if and only if the wage draw w' is weakly greater than her reservation wage, i.e. $w' \geq \bar{w}(t,w)$.

Proof. See the Appendix B.

The model setup implies that when faced with w_n, the worker will take up the job and work full-time until exogenously separated as there is no better job to search for

[4]This state variable also captures current wage of an employed worker.

and being employed at this wage entails strictly higher value than being unemployed. A worker who receives a wage offer weakly greater then her reservation wage, will take up the job. Moreover, depending on realization of the wage offer and worker's expectation about the possible future draws, workers may either accept the job and remain on it until exogenously separated or may take it only for $\hat{T}$ periods and quit it one period later. This follows from the fact that worker's expected value of employment when she is searching for a job may be higher than the value of employment at some w_i but on the other hand, due to the possibility of a reset of the unemployment benefit entitlement after a long enough employment, the latter may be higher than the value of being unemployed (depending on worker's unemployment history and recent wage).

2.4 Steady State Equilibrium and Government

In the steady state, the measure of workers in each of the states is constant over time. Let D_u and D_e be a cross sectional distributions over the states of all the (un)employed workers in the economy and let $d_u(t, w)$ and $d_e(t, w)$ be the mass of (un)employed workers currently in a given state with $\sum_t \sum_w (d_u(t, w) + d_e(t, w)) = 1$, i.e. the two are the associated probability mass functions. Steady state is characterized by an invariant cross sectional distributions D^* (and probabilities d^*) such that $D^*\Gamma = D^*$, i.e. M^* is a left eigenvector for Γ with eigenvalue 1.

Moreover, revenue and expenditures of the government have to be balanced in each period. Thus, I close the model with the following condition:

$$\left[\tau \sum_{t=1}^{\hat{T}} \sum_{w} w d_e^* (t, w)\right] = \left[\nu_b \sum_{t=1}^{T} \sum_{w} w d_u^* (t, w) + \nu_s \sum_{w} w d_u^* (T + 1, w)\right] \tag{3}$$

Equation (4) equalizes the government revenue (equal to the taxable portion of the income of employed workers) with the expenditure of the government (equal to the measure of unemployed receiving low and high benefits multiplied by the expenditure).

2.5 Welfare, Inequality and Unemployment Duration Measures

In order to rank each policy choice $\hat{T}$ given a tax rate τ balancing government's budget, I propose a simple measure of overall welfare given by the utility of workers in each state (upon the optimal consumption-search decision) weighted by the measure of individuals in each state:

$$Welfare = \sum_{t=1}^{T+1} \sum_{w} d_u^* (t, w) U (c_u (t, w) - g (q (t, w))) + \sum_{t=1}^{\hat{T}} \sum_{w} d_e^* (t, w) U (c_e (t, w)) \tag{4}$$

Furthermore, in order to measure (pre- and after-tax) income inequality[5] associated with each policy I use the Gini coefficient given by:

$$Inequality = 1 - \frac{\Sigma_{i=1}^{n} \mathbb{P} (y_i) (S_{i-1} + S_i)}{S_n} \tag{5}$$

where y_i denotes (pre- or after-tax) income, $S_i = \Sigma_{j=1}^{i} \mathbb{P} (y_j) y_j$, $S_0 = 0$ and $y_i < y_{i+1}$. A coefficient of 0 means perfect equality.

Moreover, I propose the following measure of expected mean unemployment duration:

$$\begin{aligned} UD \quad = \quad & \sum_{t=1}^{T} \sum_{w} \left(t + \sum_{\hat{t}=t+1}^{T} \left(\hat{t} \prod_{\tilde{t}=t}^{\hat{t}-1} \mathbb{P} \left(w' < \bar{w} \left(\tilde{t}, w \right) \right) \right) \right) d_u^* (t, w) \\ & + \sum_{w} \left(\sum_{i=1}^{\infty} (T + i) \left(\mathbb{P} (w' < \bar{w} (T + 1, w)) \right)^{i-1} \right) d_u^* (T + 1, w) \end{aligned}$$

i.e. the weighted (by mass of unemployed workers in given states) average of expected unemployment duration. Each worker's expected unemployment duration is given by the sum of products of possible unemployment periods t and corresponding probabilities of moving into them.

3 Calibration

I calibrate the model to the properties of the existing unemployment insurance system in the US. The calibration of the non-separable model described below is later on referred to as a *baseline* calibration. I assume a weekly periodicity. I assume the CRRA utility function $U (y) = \frac{y^{1-\theta}}{1-\theta}$ with a coefficient of risk aversion $\theta = 1$, i.e. the lower bound of empirically relevant measures of risk aversion reported in Mehra and Prescott (1985). For exogenous separation probability, I choose a quarterly value of $\sigma = 0.1$ from the

[5]Whenever I use the term 'inequality' without specifying it being pre- or after-tax, the statement holds true for both.

Job Openings and Labor Turnover Survey as in Hall and Milgrom (2008). The assumed discount factor is $\beta = 0.98$.

Table I: Wage distribution (pre-tax)

w_i	0.0297	0.0383	0.0493	0.0634	0.0815	0.1046	0.1343	0.1724
$\mathbb{P}(w_i)$	0.0022	0.0068	0.0182	0.0407	0.0758	0.1181	0.1541	0.1683

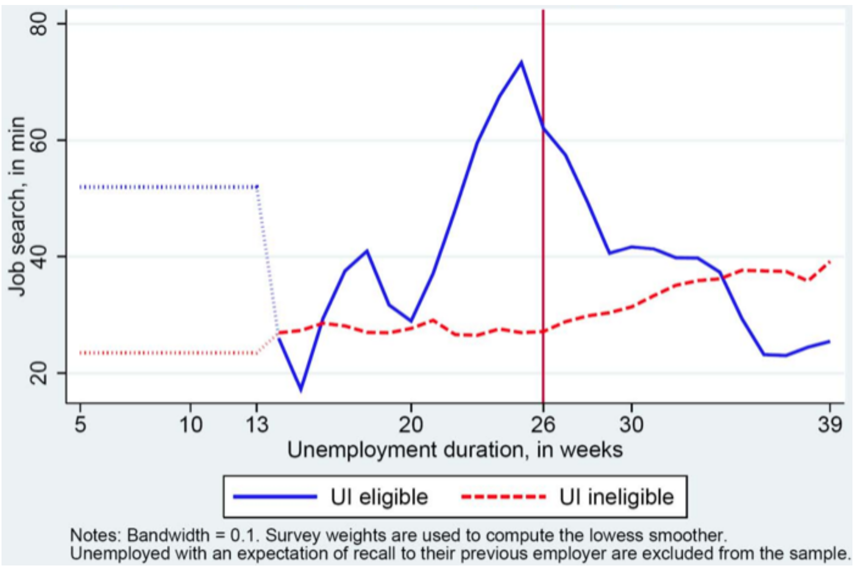
0.2212	0.2840	0.3647	0.4686	0.6026	0.7758	1
0.1541	0.1181	0.0758	0.0407	0.0182	0.0068	0.0022

Hall and Mueller (2013) approximate distribution of wage offers in the US as log-normal, and more importantly they conclude that the standard deviation of wage offers for workers with the same productivity is 0.3. On the other hand, Krueger et al. (2010) report that wage dispersion among men in the US equals 0.44 (dispersion among women is smaller). Given this, the two values constitute lower and upper bound for the dispersion of log wages, respectively. Thus, I assume the wage distribution F to be log-normally distributed with dispersion parameter $\rho = 0.35$ and $\mu = -1.7581$ (to have the support on $[0, 1]$). Also, I assume that there are $n = 15$ different wages in the market. Noteworthy, if we think about some of the workers in economy as e.g. managers and waiters, the assumed variance parameter is very large. In real life such workers are facing different wage distributions with a much smaller dispersion. Nevertheless, the model accounts for this phenomenon to some extent by the mechanism of reservation wages and effective restrictions on possible search effort. The wage distribution implied is summarized in Table I.

Since most of the US state welfare trust funds pay out half of the last wage for 6 months and a nil from then on, I take $\nu_b = 0.5$, $\nu_s = 0$ and $T = 26$. Furthermore, the baseline calibration to the US requires no entitlement to unemployment benefits after any voluntary quit. However, in Section 5 I will look for an optimal value of the re-entitlement parameter $\hat{T}$.

For the search effort, I choose the grid to consist of $m = 50$ equidistant points from the $[0, 1]$ interval. More importantly, in case of monetary search costs, I choose the home-production value h and cost functions parameters α, ζ, χ and ξ such that: (1) the baseline model under no-entitlement policy replicates the mean US unemployment rate since 1930s equal to 7.10%, and (2) the shape of search effort along the unemployment path for an unemployed worker with the most recent gross wage $w_8 = 0.1724$ (which is the most common in the economy) resembles the one documented by Krueger and Mueller (2010) (shown in Figure I). Note that in their work, the search effort is measured in job search minutes (as is most common in the literature). Since effort in this paper is in monetary units and there is no empirical research on this subject, I aim to match the relative magnitudes of the search effort in different stages of unemployment for eligible workers. In order to do so, I look for parameter values that after solving the model for optimal decisions give the relevant ratios of search effort at the beginning of unemployment, at the peak (benefit exhaustion) and at the bottom which approximately are equal to the counterpart ratios in Krueger and Mueller (2010) for workers eligible for unemployment insurance. The parameters chosen for the search cost function and value of home production are $\alpha = 0.1675$, $\zeta = 1.335$ and $h = 0.0375$. For the function f, I choose parameters such that the search profile matches the evidence and $\lim_{q_t \to 1} f(q_t) = 1$. These are $\chi = 0.01$ and $\xi = 100.5$. Notice that the assumed values imply that the function f is essentially equivalent to identity function. In other words, I use the function f solely in order to have a non-degenerate search effort profile in the counterpart separable model.

Figure I: Job search (in minutes) by unemployment duration



Note: due to noisiness of the data in the first 13 weeks the Figure shows average time allocated to search, from week 14 on the Figure presents LOWESS-smoothed data.
Source: Krueger and Mueller (2010)

Under the assumption of separable search costs, although the calibration strategy is similar, I pick different values for parameters. This is due to the fact that workers are no more facing consumption constraints and so are able to exercise an unrealistically high search effort. In order to calibrate model to the targeted unemployment rate, I drive down the outside option value by increasing search costs and decreasing value of home production. Moreover, in order for the effort profile to (at least partially) resemble empirical evidence, I choose the function f to have a much higher curvature. Thus, I choose $\alpha = 14.22$, $\zeta = 2.9$, $\chi = 4.05$, $\xi = 1.1719$ and[6] $h = 0.00001$. Table II summarizes the calibration.

Table II: Parameter values in the model

parameter	interpretation	value (NS / S)	source/target
β	discount factor	0.98	modeling choice
θ	risk aversion coefficient	1	Mehra-Prescott (1985)
σ	exogenous separations rate	$\frac{1}{10 \cdot 13}$	JOLTS/Hall and Milgrom (2008)
ν_b	replacement ratio for high benefit	0.5	UI system in the US
ν_s	replacement ratio for low benefit	0	UI system in the US
T	periods of (high) UI entitlement	26	UI system in the US
n	number of wages	15	modeling choice
m	search effort grid parameter	50	modeling choice
F	distribution on wages	log-normal	modeling choice
μ	dist. log-scale parameter	-1.7581	support of F on $[0, 1]$
ϱ	dist. shape parameter	0.35	Hall and Mueller (2013), Krueger et al. (2010)
h	value of home production	0.0375 / 0.00001	target U and search profile
α	search cost f-n g parameter 1	0.1675 / 14.22	target U and search profile
ζ	search cost f-n g parameter 2	1.335 / 2.9	target U and search profile
χ	function f parameter 1	0.01 / 4.05	target U and search profile
ξ	function $f$parameter 2	100.5 / 1.1719	target U and search profile

Notation: NS - non-separable utility, S - separable utility.

Finally, Table III presents the targeted empirical moments and the ones implied by the two tested models. The model with monetary search costs matches the empirical moments very well. On the other hand, the separable model performs relatively poorly. Section 4.1 below provides a more detailed discussion of optimal decisions (including search effort) and explains why the latter fails.

4 Results

In this section, I discuss the results from solving the calibrated model for different policy experiments. Although throughout the paper I used the non-separable utility, I also provide results for the separable utility case as a robustness check of the model's pre-

[6]Due to numerical precision problems stemming from the functional form of the utility function, the separable model with $\theta = 2$ is not possible to solve and so I choose $h = 0.01$ (with all the other parameters as in Table II).

Table III: Empirical and implied moments of search effort

Moment	$\frac{Benefit\ Exhaustion}{Beginning\ UI}$	$\frac{Benefit\ Exhaustion}{End\ UI}$
Empirical	$\frac{72}{51} \approx 1.41$	$\frac{72}{27} \approx 2.66$
Non-Separable Model	1.4	2.69
Separable Model	1.64	1

Note: Table presents approximate moments of search effort (in minutes per week) documented in Krueger and Mueller (2010) (*Empirical*) and corresponding implied moments in both versions of the model. Empirical moments come from Figure I: $\frac{Benefit\ Exhaustion}{Beginning\ UI}$ is the ratio of search effort of UI eligible at the peak and in week 1; $\frac{Benefit\ Exhaustion}{End\ UI}$ is the ratio of search effort of UI eligible at the peak (week 26 in the model) and at minimum (week 27 in the model).

dictions. In Section 4.1, I discuss the implied optimal policy functions. In Section 4.2, I provide a quasi comparative statics results, i.e. a comparison of the model predictions when one of parameters changes. Then, Section 4.3 presents the main results of this paper - the equilibrium properties of this economy under various re-entitlement policy settings. In particular, I show the potential welfare benefits of following the optimal policy. Finally, Section 4.4 discusses some of differing features between European and US labor markets and attempt to reconcile them with predictions of the model. The model is solved numerically - for description of the method see Appendix A.

4.1 Optimal Decisions

Figure II presents optimal decisions under different specifications. As a robustness check, I also provide results for the risk aversion coefficient[7] $\theta = 2$. Also, when comparing cases below, remember that calibrations of the model under non-separable and separable cases assume different values of parameters.

The first row shows the optimal policy functions in the baseline model with no re-entitlement policy in place for a worker eligible for benefits who was recently employed with wage $w_8 = 0.1724$ and for a worker currently on the job paying w_8. The search effort (nominal, i.e. q_t and not effective $f(q_t)$) increases over time, peaks in period 26 with effort of 0.70 when the benefit entitlement expires and then goes down to 0.26

[7] The upper bound of empirically relevant measures of risk aversion reported in Mehra and Prescott (1985).

for the remaining periods when the worker's search is constrained by the amount of resources available from the home production.

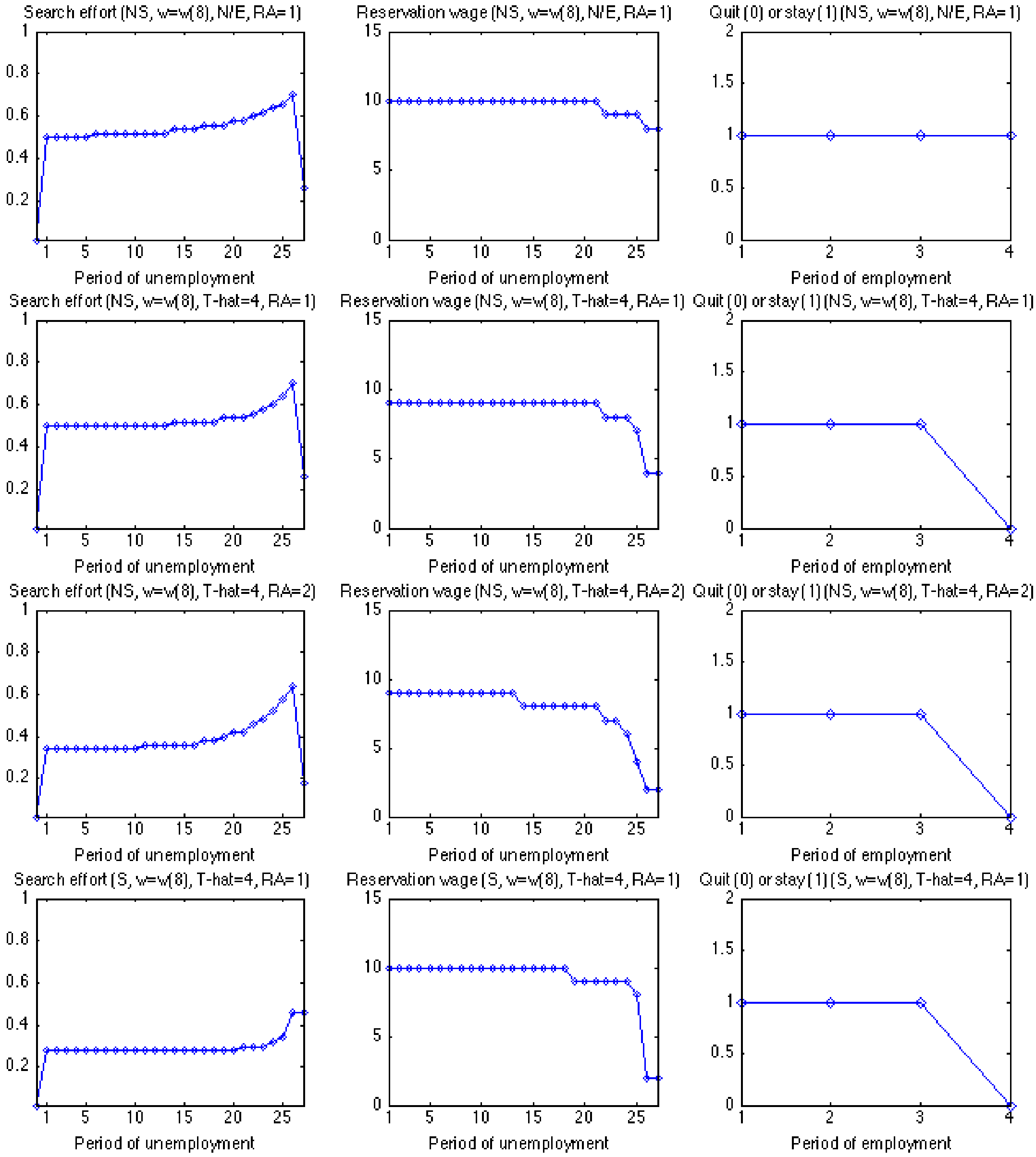
Note that although workers have no access to saving and borrowing, with monetary search cost they still manage to smooth their consumption. In particular, immediately after the transition from employment to unemployment state risk-averse workers do not want to experience a huge drop in consumption and so they do not choose to exert maximal effort.

Furthermore, the steady increase of the effort exercised is due to workers having no savings and thus rationally expecting that a drop in the benefit payment schedule may imply for them facing a kind of a lock-in in the low benefit state and having to pick a much worse job than before the drop. This logic is reflected in worker's decision about the reservation wage: as she approaches the decline in benefit payments her reservation wage declines, i.e. she becomes willing to accept a worse job offer in order to avoid falling into the inferior state (behavior akin to discouragement). The decline of reservation wage over the spell of unemployment is in line with empirical evidence as shown by Krueger and Mueller (2014). Moreover, the increase in search effort and decrease in reservation wage together imply an observed in the empirical literature spike in job finding rate at the benefit exhaustion. The last plot shows that once the worker enters a job paying $w_8 = 0.1724$, she will remain on it until exogenously separated.

The second row shows a more interesting case of the same model but with the re-entitlement policy requiring workers to have worked for at least 4 weeks in order to be eligible for receiving benefits. In this case, the spike in search effort is more profound and the reservation wage decreases earlier and by more. This has to do with a moral hazard introduced by this policy, i.e. as the worker gets closer to the decline in benefit payment path, she is willing to accept some jobs[8] only to quit them after having worked for $\hat{T} = 4$ periods when she regains the eligibility for benefits. She does so in order to be able to continue exercising high search effort and to have higher chances of finding a better paying job.

[8]Obviously, there are also wages for which the worker will not agree to work at all or will work until exogenously separated.

Figure II: Optimal policy



Notation: NS - non-separable utility, S - separable utility, w - most recent wage received, N/E - no-entitlement, T-hat - re-entitlement policy parameter, RA - risk aversion parameter.

The third row shows an intuitive result: the higher is risk aversion, the sooner the worker increases her search effort and the faster and deeper is her decline in the reservation wages. Note the difference in values of effort chosen between the cases of $\theta = 1$ and $\theta = 2$ - it is due to differences in intertemporal elasticity of substitution.

Finally, as a robustness check, Figure II also shows the optimal policy functions for a separable utility case which implies no binding constraint for the effort chosen. Nevertheless, due to calibration of the functions f and g, the unemployed worker does not choose the maximum search effort. Note that the level of (nominal) search effort in this case is much lower than in the previous ones. This is due to the high curvature of the function f which rewards workers exercising a relatively low nominal effort q_t with a much higher effective one $f(q_t)$.

Importantly, although we observe an increase of effort over the unemployment spell, the separable model is not able to generate a drop at the benefit exhaustion. Although workers' available resources after benefit exhaustion are extremely low, they decide to maintain the search level (and ignore the disutility it generates) in order to escape the bad state as soon as possible. Nevertheless, also in this case we observe the opportunistic worker behavior.

4.2 Scenario Comparison

I perform a quasi comparative statics exercise and present changes in values of key statistics on impact of change of relevant parameters. In order to do so, I solve the model for many different values of a parameter of interest while holding everything else constant. Table IV provides results of this exercise, i.e. the qualitative total effects of changes in the level of replacement ratio, length of unemployment benefits payments and exogenous probability of moving from employment to unemployment on reservation wages, search effort, unemployment rate, tax rate, welfare and inequality.

Consider first the effect of an increase in generosity of the welfare system, i.e. increase of the replacement ratio ν_b. As unemployed workers receive higher benefits, they become more picky about the jobs they are willing to accept - firstly due to the outside option having relatively higher value, and secondly due to having *possibility* of exercising higher search effort and effectively facing a better wage distribution.

As it comes to the search effort actually exercised, the effect is on average positive. The main reason for it is the assumed here monetary cost of search - as more resources are available to search-constrained workers, they take advantage of it in order to escape the unemployment state and the prospect of falling into the unemployment lock-in after benefit exhaustion. There is also a counter-effect of a higher tax rate needed to finance the reform but its effect is less significant. This comparative statics finding is to the contrary of standard findings in literature as e.g. in Shavell and Weiss (1979), where with a separable utility there was no binding search constraint and so higher benefits lowered the cost of a job loss and thus lowered search effort. The separable utility version of my model confirms its robustness by replicating this standard observation (not shown in the table).

As the unemployment rate depends on both reservation wage and search effort decisions, effect on it is ambiguous. As far as it concerns the implied tax rate, note that apart from a direct effect of an increase or decrease in benefit spending, there is an indirect effect since workers have higher reservation wages and thus are on average in higher paying jobs. These two outweigh the opposite effects of higher tax contributions due to higher wages received and of a possibly lower unemployment rate. Thus, the tax rate has to be increased in order to balance the government budget.

For parameter ν_b below some (generally high) threshold[9], the welfare goes up as the replacement ratio increases. The reason for it is that higher benefits allow workers to search more intensively, and so they end up on average in better paying jobs. In other words, the welfare abuse due to the moral hazard effect turns out to be less significant than the welfare improvement associated with fixing the employment mismatch. However, for values of ν_b above the threshold, this relationship is reversed as the workers have access to abundant resources above what is necessary for optimal search and the moral hazard effect begins to dominate.

Similarly, for ν_b small enough, the increase in the replacement ratio and the tax rate bring the value of unemployment benefits closer to the value of wages and so the inequality in the economy decreases. However, once ν_b is large enough, more workers access top paying jobs because they have the resources required to search intensively and are more picky so they wait for a high wage offer to arrive. The distribution of workers across lower wage category stays nearly the same. This leads to a higher inequality.

As the length of the benefit entitlement period is increased, workers stick longer to their initial reservation wage (which is the highest over the unemployment spell) and so on average the reservation wages go up. Moreover, given that workers expect to have the same benefits for longer, their search effort at the beginning of unemployment spell goes down but converges to the same value as they approach the exhaustion period.

[9]Under the baseline calibration this threshold is at the level above 0.9

Table IV: Scenario comparison

	$d\bar{w}$	dq_t	dU	$d\tau$	$dWelfare$	$dInequality$
$d\nu_b$	+	+	?	+	?	?
dT	+	-	+	+	+	?
$d\sigma$	-	-	+	+	-	+

Note: Table shows scenario comparison of total changes in key statistics on impact of change in parameters

As a result, the unemployment rate increases. For similar reasons as above, the tax rate on employed workers increases and so does the welfare as the benefit entitlement period is prolonged.

However, the effect on inequality is ambiguous. For T low enough the relationship between inequality and this parameter is negative - higher tax rate on employed reduces net wage income and redistributes it to the unemployed. However, once T is large enough this relationship is no longer clear for reasons similar to the ones discussed above.

Raising the exogenous separation rate σ has standard effects. It is effectively reducing the expected duration of the employment spell and so it decreases the value of being employed. In particular, it decreases the value of being employed in higher paying jobs by more (in absolute value) than in lower paying ones. Therefore, the worker searches less and becomes less picky about the job offers. Since separations occur more often, the unemployment rate goes up and so does the tax rate required to finance the welfare system. However, although the tax rate goes up and redistributes some wealth from working class to unemployed, the inequality increases. The reason for it is that workers are accepting now lower wage offers (and consequently on average unemployment benefit per worker is lower) and that unemployment goes up.

Given that the model captures correctly some of the trade-offs faced by workers in the real labor markets, I proceed to the central part of this paper.

4.3 Unemployment, Welfare and Inequality

In what follows, I present the socially optimal equilibria. There are two more classes of equilibria. One with a much higher tax rate balancing the government budget where the associated unemployment rate is implausibly high and the associated welfare is lower than in the case presented below (think of a Laffer curve). The second with a continuum of trivial autarky equilibria with a tax rate in region above 0.9 where no one decides to work and everyone stays in the low benefit state (this is an equilibrium given the calibration with $\nu_s = 0$).

Table V and 7 summarize results of solving both the separable and non-separable models for different re-entitlement policy options for $\theta = 1$ and $\theta = 2$, respectively. For example, a policy parameter $\hat{T} = 1$ stands for a re-entitlement requirement of having worked for at least 1 week on the last job in order for the worker to be eligible for receiving unemployment benefits; $\hat{T} = N/E$ stands for a policy of not giving unemployment benefits for quitters.

Table V: Results of the model with $\theta = 1$

$\hat{T}$	$\theta = 1$											
	τ (%)		Unemployment (%)		Welfare		Inequality (%)				UD (weeks)	
	NS	S	NS	S	NS	S	NS		S		NS	S
							pre-tax	after-tax	pre-tax	after-tax		
1	4.57	5.24	8.08	9.05	-0.9331	-0.9081	13.90	13.66	15.04	14.74	8.60	10.15
2	4.54	5.14	8.05	8.87	-0.9333	-0.9105	13.94	13.70	15.01	14.72	8.54	10.07
4	4.50	5.05	7.96	8.70	-0.9341	-0.9129	13.98	13.75	15.04	14.76	8.37	10.00
6	4.48	5.00	7.91	8.63	-0.9347	-0.9141	14.05	13.81	15.11	14.84	8.21	9.79
13	4.39	4.79	7.78	8.24	-0.9365	-0.9202	14.21	13.98	15.11	14.86	7.92	9.42
26	4.34	4.58	7.65	7.86	-0.9391	-0.9265	14.49	14.26	15.13	14.91	7.71	8.99
N/E	4.14	4.43	7.09	7.08	-0.9617	-0.9849	16.02	15.77	17.40	17.11	7.04	8.02

Notation: UD - unemployment duration, NS - results for a model with non-separable utility assumption, S - with separable utility, N/E - no re-entitlement policy.

Importantly, in both cases of non-separable and separable search effort cost assumptions there is an (overall) welfare improvement associated with following a re-entitlement policy as compared to the actual US policy of no re-entitlement[10]. Moreover, the shorter is the re-entitlement requirement for the worker the greater is the welfare improvement. Effectively the benefits of providing the search subsidy to the workers outweigh the costs generated by the moral hazard of rejecting/quitting jobs. The intuition for this result is that, although the policy generates higher unemployment rate, it allows for improvement of quality of matches in the economy, i.e. more workers are able to find better and higher paying jobs in which they wish to remain for long. This is confirmed by the steady state distribution of workers (see Table VI). Note also that following optimal policy is associated with presence of workers in a new low wage category. Not surprisingly, all the conclusions survive in the model with higher risk aversion $\theta = 2$, where the case for insurance is even stronger.

Moreover, the strong case for payment of benefits for quitters is due to the fact that when the search effort is not directly observable, the optimal policy equips the government with an indirect monitoring technology: by taking up a job, the unemployed

[10]This statement is not trivial due to the requirement of balanced government budget.

Table VI: Steady state distribution

w_i	0.0297	0.0383	0.0493	0.0634	0.0815	0.1046	0.1343	0.1724
N/E (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60
$\hat{T} = 1$ (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01

w_i	0.2212	0.2840	0.3647	0.4686	0.6026	0.7758	1
N/E (%)	1.13	5.07	40.73	27.18	12.18	4.56	1.45
$\hat{T} = 1$ (%)	0.02	0.05	42.70	29.41	13.20	4.95	1.57

Note: Table shows the steady state distribution of employed and unemployed workers in non-separable model with $\theta = 1$ under no entitlement and optimal policy

workers are sending the government a credible signal that they are actually searching for a job (and moreover are actually willing to work) and not using benefits purely for consumption purposes. Thus, when a worker quits a job voluntarily, the government rightly believes that the match quality was bad and decides to further assist the worker in searching for a better job by providing her with benefits again. I refer to this opportunistic behavior as a welfare abuse since the unemployment insurance has been obviously not designed to induce such a behavior stemming from moral hazard. Consequently, as the intuition from the welfare improvement result suggests, the moral hazard effect generated by benefit entitlements for quitters is of a rather small magnitude. In the baseline model with $\hat{T} = 1$ only 0.75% of the whole population takes advantage of the welfare system (i.e. only 8.16% of unemployed and 0.01% of employed are in wage categories below w_{11} which are associated with the opportunistic behavior).

Given the entitlement for quitters, the steady state unemployment is characterized not only by fired workers, but also by voluntarily unemployed ones. Thus, the associated unemployment rate is higher. Moreover, as workers become more picky about jobs, the unemployment duration increases as workers decide to spend more time looking for a favorable wage offer.

Furthermore, following the (optimal) re-entitlement policy is associated with a higher unemployment rate and, as a consequence, a higher tax rate required to balance the government budget. The reason for it is the prospect of a possibly quick re-entitlement for benefits which effectively incentivizes workers to be more picky and so to spend more time on average in unemployment state in order to find a more suitable job. Nevertheless, the required increase in the labor income taxation is of a rather small magnitude.

Furthermore, under both assumptions of separability and non-separability the model kills two birds with one stone: the re-entitlement policy leads to an increase in efficiency and in equity at the same time. This is true for both the before- and after-tax income inequality and is not surprising given two effects working here in the same direction. First of all, a higher unemployment rate implies a higher share of benefit recipients. After introduction of the benefits for quitters, recipients of unemployment insurance are on average in higher wage categories and so receive higher benefit income. Secondly, due to higher unemployment the implied tax rate increases and so brings the income of employed individuals closer to the income of unemployed.

Table VII: Results of the model with $\theta = 2$

$\hat{T}$	$\theta = 2$											
	τ		Unemployment		Welfare		Inequality				UD (weeks)	
	NS (%)	S (%)	NS	S	NS	S	NS (%) pre-tax	NS (%) after-tax	S (%) pre-tax	S (%) after-tax	NS	S
1	4.41	4.54	7.79	7.58	-3.0114	-2.5356	16.41	16.02	14.30	14.06	7.70	7.68
2	4.39	4.51	7.77	7.55	-3.0117	-2.5376	16.43	16.04	14.33	14.09	7.65	7.54
4	4.39	4.37	7.73	7.35	-3.0142	-2.5449	16.45	16.07	14.28	14.05	7.57	7.43
6	4.38	4.28	7.70	7.17	-3.0154	-2.5526	16.49	16.10	14.21	13.99	7.51	7.23
13	4.29	4.09	7.52	6.82	-3.0303	-2.5685	16.44	16.07	14.11	13.91	7.12	6.99
26	4.23	3.95	7.43	6.59	-3.0363	-2.5816	16.59	16.22	14.17	13.98	6.90	6.67
N/E	4.09	3.94	7.02	6.56	-3.1058	-2.7306	17.51	17.16	16.15	16.39	6.28	5.96

Notation: NS - results for a model with non-separable utility assumption, S - with separable utility, N/E - no re-entitlement policy.

The implied budget balancing tax rate of 4.14% for the baseline model with no re-entitlement policy under the non-separable utility case speaks in favor of robustness of the results. The average unemployment tax rate in the United States varies depending on the state from 0.05% to 2%, as reported by Henchman (2011). Nevertheless, these tax rates are in many cases too low as during many recessions some of the unemployment insurance trust funds became insolvent due to too low fund reserves and increased unemployment caused by economic downturn.

Unsurprisingly, there are unrealistic calibrations with a high value of outside option for workers (i.e. with high home production value and low search costs that yield empirically implausible outcomes of a too high unemployment rate and a degenerate search profile) for both the separable and non-separable cases where there is no welfare improvement associated with changing policy from no entitlement to the one with a finite re-entitlement requirement.

4.4 Empirical Observations vs the Model

The labor markets in Continental Western Europe and the United States have been at odds in many features for many years so far. First of all, since 1980s the unemployment rate for EU-15 countries has been persistently[11] higher than in the US by 1% to 4.5%, depending on the time period. Secondly, since mid-1980s income inequality in the US has risen much faster than in Europe and since then has been persistently higher. Thirdly, this increase in European unemployment rate has been accompanied by decreasing rates of exit from unemployment resulting in longer duration of unemployment spells and increase in the number of long-term unemployed.

As documented by Venn (2012), the unemployment insurance systems with and without benefit entitlement for workers quitting voluntarily are characteristic for many countries in Europe and the US, respectively. The model presented above abstracts from many important factors that could be equally likely to contribute to the differences in the US and European labor markets and focuses solely on entitlement to benefits for quitters in order to find whether it may explain at least some of the empirical evidence. As it turns out, the model is able to reconcile the first two observations. As I have shown, the mechanism employed in the model leads to a higher unemployment rate. The gap between the unemployment rate in the baseline case and various re-entitlement policy cases varies between 0.55% and 1%.

Also, following the benefit entitlement policy for workers quitting jobs voluntarily (Europe) is associated with a lower income inequality as compared to the alternative case (US). The income inequalities implied are not in line with empirics partly due to the relative degeneracy of the wage distribution assumed in the model in order to facilitate exposition of the results. Nevertheless, the model is most likely not able to explain the whole discrepancy since it does not account for many relevant labour market phenomena - take for example the assumption of the same wage distribution for both short- and long-term unemployed workers.

Finally, the associated with the optimal policy unemployment duration is higher. With the implied duration of 7 weeks in the baseline calibration, the model misses the target of 13 weeks which is the average duration in the US between 1948 and 2007. This gap may be not only due to the high weekly periodicity assumed in the model, but also to the lack of many other important market frictions assumed away for simplicity of analysis.

[11] The only exception was the unemployment rate in 2010 when the two got close to each other for short period of time but then diverged again.

Importantly, mind that the model has been calibrated solely to the US labor market which obviously has different fundamentals than the European. Given this and other important economic factors not included in the model, the prevalent in Europe policy of paying benefits after voluntary quits allowing for improvement upon the match quality may account for some but obviously not all of the observed differences in unemployment rates, duration and income inequality.

There is a vast literature discussing reasons for the observed difference in characteristics of the US and European labor markets. A good review of possible explanations is provided by Bertola and Ichino (1995). Thomas Sargent and Lars Ljungqvist ran a major research program that aimed at identifying the reasons of these differences. Their theory is that generous European welfare system combined with a permanent change in the microeconomic labor conditions led to a sustained and high unemployment rate in Europe. Although the model presented here also attributes the observed discrepancies to generous welfare systems, it points exactly at one particular policy which may be partially responsible for the observed divergence of labor markets. Moreover, it also shows that economists should not only investigate the reasons of these observations, but also look at their consequences (e.g. in welfare terms). It might well be the case that the higher unemployment rate in Europe does not necessarily represent a huge waste of human resources and welfare, but to the contrary allows for a better allocation. To fully address this question, economists need more comprehensive models taking relevant general equilibrium effects into account.

5 Concluding Discussion

In this paper, I study a framework of labor search with unemployment insurance, voluntary quits and various labor attachment requirements. In particular, I look for the optimal unemployment re-entitlement policy for quitters. In order to do this, I embark upon the method accounting for all the benefits and adverse effects generated by the policy, i.e. the social welfare analysis. To investigate this question, I construct a discretized version of the McCall model and solve it numerically.

The model is calibrated to the US labor market. The results raise the question about the observed choice of labor attachment requirements which are differing from country to country. In fact, as there are no studies justifying these numbers, the paper suggests that they may be rather ad hoc and may be a source of welfare inefficiencies. Furthermore, upon following the optimal policy the implied welfare, unemployment rate and duration are higher and the both pre- and after-tax income inequality is lower than in the no-entitlement for quitters case (which is characteristic for the US). Interestingly, given that in Europe quitters are often eligible for unemployment insurance, the model with the latter two results is in a position to explain partially the differing characteristics of the US and European labor markets. Moreover, the model performs well not only in directions in which it has been calibrated but also others like implying realistic unemployment insurance tax rates, the responsiveness of the search behavior and reservation wages to the generosity (magnitude and duration) of unemployment benefits.

I find the results in this paper complementary to the literature discussed above. First of all, I identify a concrete policy which may be a channel leading to discrepancies between the US and European labor markets in terms of unemployment rate and income inequality. Moreover, worker's opportunism was found in Hopenhayn and Nicolini (2009). I show that this opportunistic and seemingly inefficient behavior of workers quitting jobs in order to find a better one may be in fact welfare improving by allowing for a better allocation of workers at the cost of a higher unemployment rate. Thirdly, I investigate the consequences of the unexplored assumption of monetary search costs. It turns out that this assumption is capable of generating search behavior in line with the one documented in the empirical literature. Furthermore, this paper fills an important gap in unemployment insurance literature by analyzing welfare consequences of entitlement to benefits for quitters. Finally, the results presented here hint at the need of new direction of economic research concentrated on (1) the welfare consequences of unemployment and thus, among others, of the divergence of the US and European labor markets and (2) relevance of monetary costs and substitutability between time and money for job search.

The model lends itself easily to normative studies of optimal unemployment insurance design and to extensions like more involved and realistic eligibility criteria (for example labor attachment requirement for fired workers), sanctions (suspension periods for quitters), monitoring (penalties for insufficient search effort) and endogenizing wage distribution.

References

[1] Baker, M., and Rea, S., "Employment Spells and Unemployment Insurance Eligibility Requirements," *Review of Economics and Statistics*, 80 (1998), 80-94.

[2] Bertola, G., and Ichino, A. "Wage Inequality and Unemployment: United States versus Europe," *NBER Macroeconomics Annual*, 10 (1995), 13-66.

[3] Blau, D., and Robins, P., "Job Search Outcomes for the Employed and Unemployed," *Journal of Political Economy*, 98 (1990), 637-655.

[4] Burdett, K. "Unemployment Insurance Payments as a Search Subsidy: A Theoretical Analysis," *Economic Inquiry*, 42 (2008), 333-343.

[5] Chetty, R., "Moral Hazard versus Liquidity and Optimal Unemployment Insurance," *Journal of Political Economy*, 116 (2008), 173-234.

[6] Christofides, L. and McKenna, C., "Unemployment Insurance and Job Duration in Canada," *Journal of Labor Economics*, 14 (1996), 286-311.

[7] Feldstein, M., "Temporary Layoffs in the Theory of Unemployment," *Journal of Political Economy*, 84 (1976), 937-958.

[8] Green, D., and Riddell, C., "Qualifying for Unemployment Insurance: An Empirical Analysis," *Economic Journal*, 107 (1997), 67-83.

[9] Hall, R., and Milgrom, P., "The Limited Influence of Unemployment on the Wage Bargain," *American Economic Review*, 98 (2008), 1653-1674.

[10] Hall, R., and Mueller, A., "Wage Dispersion and Search Behavior," Unpublished manuscript, 2013.

[11] Henchman, J., "Unemployment Insurance Taxes: Options for Program Design and Insolvent Trust Funds," Tax Foundation Background Paper, 61 (2011), 1653-1674.

[12] Hopenhayn, H., and Nicolini, J., "Optimal Unemployment Insurance and Employment History," *Review of Economic Studies*, 76 (2009), 1049-1070.

[13] Jones, S. "Job Search Methods, Intensity and Effects," *Oxford Bulletin of Economics and Statistics*, 51 (1989), 277-296.

[14] Jurajda, S., "Estimating the effect of unemployment insurance compensation on the labor market histories of displaced workers," *Journal of Econometrics*, 108 (2002), 227-252.

[15] Krueger, A., and Mueller, A., "Job search and unemployment insurance: New evidence from time use data," *Journal of Public Economics*, 94 (2010), 298-307.

[16] Krueger, A., and Mueller, A., "A Contribution to the Empirics of Reservation Wages," NBER Working Paper No. 19870, 2014.

[17] Krueger, D., Perri, F., Pistaferri, L. and Violante G., "Cross Sectional Facts for Macroeconomists," *Review of Economic Dynamics*, 13 (2010), 1-14.

[18] Marimon, R., and Zilibotti, F., "Unemployment vs. Mismatch of Talents: Reconsidering Unemployment Benefits," *Economic Journal*, 109 (1999), 266-291.

[19] McCall, J., "Economics of Information and Job Search," *Quarterly Journal of Economics*, 84 (1970), 113-126.

[20] Mehra, R., and Prescott, E., "The Equity Premium: A Puzzle," *Journal of Monetary Economics*, 15 (1985), 145-161.

[21] Sargent, T., and Ljungqvist L., "The European Unemployment Dilemma," *Journal of Political Economy*, 106 (1998), 514-550.

[22] Shavell, S., and Weiss, L., "The Optimal Payment of Unemployment Insurance Benefits over Time," *Journal of Political Economy*, 87 (1979), 1347-1362.

[23] Shimer, R., and Werning, I., "Reservation Wages and Unemployment Insurance," *Quarterly Journal of Economics*, 122 (2007), 1145-1185.

[24] Tatsiramos, K., "Unemployment Insurance in Europe: Unemployment Duration and Subsequent Employment Stability," *Journal of the European Economic Association*, 7 (2009), 1225-1260.

[25] Venn, D., "Eligibility Criteria for Unemployment Benefits: Quantitative Indicators for OECD and EU Countries," OECD Social, Employment and Migration Working Paper No. 131, 2012.

[26] Wadsworth, J., "Unemployment Benefits and Search Effort in the UK Labour Market," *Economica*, 58 (1991), 17-34.

[27] Werning, I., Repeated Moral-Hazard with Unmonitored Wealth: A Recursive First-Order Approach, MIT Working Paper, 2001.

Appendix A: Computation method

The model is solved numerically for a steady state equilibrium. In order to do this I use an iterative method of successive approximations. First a policy parameter $\hat{T}$ is chosen and a tax rate τ is guessed. Given the two, value function iteration is used to solve the functional equations (1) and (2) for optimal choices of consumption, search effort, reservation wages and quit decisions. Next, the invariant distribution G^* is computed using a transition matrix Γ for given optimal decisions. Finally, the invariant distribution is used to evaluate the government budget balance. If it is significantly different from zero, a bisection method is used to bracket the root and the steps described are repeated until an equilibrium is found.

In order to solve for optimal decision rules I use the standard technique of dynamic programming for infinite horizon case. The first step involves discretizing the action space by choosing a grid of feasible search efforts, it is chosen sufficiently fine such that adding more grid points does not affect the results. Thus, given the description of the model above, the whole model is discretized. Then, optimal decision rules for each state are computed by starting with an initial approximation of the value function[12] in (2) and computes the right hand side of it in order to obtain a subsequent approximation. This procedure is repeated until convergence of the value function is achieved.

Appendix B: Proof of the reservation wage property

Existence of such a reservation wage $\bar{w}(t,w)$ follows by the fact that being unemployed is associated with a continuation value which (given the distribution on wage draws) entails expectation about the wage draws in the future. If the wage draw today is low, then the value of declining it and being unemployed until tomorrow may yield greater value to the worker as the draw tomorrow is higher in expectation. Thus, it is optimal for the worker to decline such a wage offer. Note that, since I consider only benefits which are strictly smaller than recent wage and there is no disutility of working, there always exists a wage w in the support of wage distribution which the worker is willing to accept. By continuity there exists at least one wage at which the worker is indifferent between accepting and rejecting a job offer. Let me denote this value by $\bar{w}(t,w)$.

It remains to show that the gain from accepting a job is monotonic in the offered wage, and thus for $w' \geq \bar{w}$ it holds that $V_e(1,w') \geq V_e(1,\bar{w}(t,w)) = V_u(t,w)$ and

[12] Since the first state over which the program iterates is the employment for 1 period at w_1.

$V_e(1, w') < V_u(t, \bar{w}(t, w))$ for $w' < \bar{w}$.

Note that due to the UI design, the value of being unemployed is clearly monotone in wage, i.e. $V_u(1, w') \geq V_u(1, w)$. By this and the fact that once accepted the wage is constant over the employment time until separated, it follows that the value of being employed V_e, which includes the value of being unemployed at some point in the future, is also monotone in wage, i.e. $V_e(1, w') \geq V_e(1, w)$ if and only if $w' > w$. Therefore $V_e(1, w') \geq V_e(1, \bar{w}(t, w)) = V_u(t, \bar{w}(t, w))$ for $w' \geq w$ and conversely $V_e(1, w') < V_u(t, \bar{w}(t, w))$ for $w' < \bar{w}$, where the monotonicity and definition of the reservation wage is used. This establishes the reservation property.

Appendix C: Markov transition function

Given the model, the worker's employment opportunities state, s, follows a $n \times \left(\hat{T} + T + 1\right)$-state Markov chain. If $s = \{u, t, w_i\}$ $i \in \{1, 2, ..., n\}$, she remains unemployed for that period, receives unemployment benefit according to the benefit payment path (pinned down by t and w_i) and may receive a wage offer w' after setting optimal search effort q_t. After having received a wage offer she makes a decision about her reservation wage $\bar{w}$ and thus pins down her transition probabilities to states tomorrow. Furthermore, she can be employed on a job with the one of the n possible wages: if $s = \{e, t, w_i\}$ she is still employed and has worked for a wage w_i for t periods so far. While on the job, based on comparison of V_u and V_e, the worker makes a decision about quitting the job or staying in it which determines her transition probabilities to other states in the next period.

Therefore, the transition function for the employment opportunities state given worker's decision function is a $\left[n\left(\hat{T} + T + 1\right)\right] \times \left[n\left(\hat{T} + T + 1\right)\right]$ matrix $\Gamma = [\Gamma_{ij}]$, where $i, j \in \left\{1, 2, ..., n\left(\hat{T} + T + 1\right)\right\}$.

For instance, $\Gamma_{\hat{T}+1, 2\left(\hat{T}+T+1\right)+1} = \mathbb{P}\{s_{t+1} = \{e, 1, w_3\} \mid s_t = \{u, 1, w_1\}\}$ is the transition probability to employment with wage w_3 conditional on being unemployed for 1 period, receiving unemployment benefits tied to the most recent wage w_1. As there is no on the job search, the effort exerted will only affect probabilities of transition from unemployment to employment. Figure III presents example of transition probabilities for unemployed and employed workers.

Figure III: Transition function for workers in states $\{u,t,w_i\}$ and $\{e,t,w_j\}$

State	$\{u,t',w_i\}$	$\left\{e,t^{\dagger},w_1\right\}$	$\cdots$	$\left\{e,t^{\dagger},w_n\right\}$
$\{u,t,w_i\}$	$1-f\left(q_t\right)\sum_{w\geq\bar{w}}\mathbb{P}\left(w\right)$	$\begin{cases} f\left(q_t\right)\mathbb{P}(w_1) & w_1\geq\bar{w} \\ 0 & otherwise \end{cases}$	$\cdots$	$\begin{cases} f\left(q_t\right)\mathbb{P}(w_n) & w_n\geq\bar{w} \\ 0 & otherwise \end{cases}$
$\{e,t,w_1\}$	$\begin{cases} 1 & V_u\left(t',w_1\right)>V_e\left(t^{\dagger},w_1\right) \\ \sigma & otherwise \end{cases}$	$\begin{cases} 0 & V_u\left(t',w_1\right)>V_e\left(t^{\dagger},w_1\right) \\ 1-\sigma & otherwise \end{cases}$	$\cdots$	0
$\vdots$	$\vdots$	$\vdots$	$\ddots$	$\vdots$
$\{e,t,w_n\}$	$\begin{cases} 1 & V_u\left(t',w_n\right)>V_e\left(t^{\dagger},w_n\right) \\ \sigma & otherwise \end{cases}$	0	$\cdots$	$\begin{cases} 0 & V_u\left(t',w_n\right)>V_e\left(t^{\dagger},w_n\right) \\ 1-\sigma & otherwise \end{cases}$

Note: Each row contains probability of transition from current row-state to a possible column-state.
Notation: $\{e,t,w_i\}$ - employed for t periods at wage w_i, $\{u,t,w_i\}$ - unemployed for t periods so far and the most recent wage w_i. Also:

$$t^{\dagger}=\begin{cases} \min\left\{\hat{T},t+1\right\} & \text{if previously } x=e \\ 1 & \text{if previously } x=u \end{cases} \qquad t'=\begin{cases} 1 & \text{if previously } x=e \text{ and } t=\hat{T} \\ T+1 & \text{if previously } x=e \text{ and } t<\hat{T} \\ \min\left\{T+1,t+1\right\} & \text{if previously } x=u \end{cases}$$