MSc Economics

Subsidy to Search: Welfare Consequences of Benefit Entitlements for Quitters

A Master's Thesis submitted for the degree of
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Affidavit

I, Karol Mazur

hereby declare

that I am the sole author of the present Master's Thesis,

Subsidy to Search: Welfare Consequences of Benefit Entitlements for Quitters

31 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and that I have not prior to this date submitted this Master's Thesis as an examination paper in any form in Austria or abroad.

Vienna, 20.06.2014

Signature

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I assume all the responsibility for the remaining errors below.

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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 who quit their jobs voluntarily are entitled to benefits. 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 monetary search costs and different unemployment benefit eligibility requirements, the model provides an explanation for empirical observations about differences in unemployment rate and income inequality between the US and European labor markets.

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, 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 often sanctions 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. Thus this paper is trying to fill this gap.

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.

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 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 technology-specific 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). Moreover, there is some empirical evidence suggesting the importance of unemployment insurance in correcting the mismatch in labor markets. For example Tatsiramos (2009) 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.

Although, as argued by Feldstein (1976), it is clear that we should not always blindly believe in a dichotomy between lay-offs and voluntarily quits, it 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). This paper models the latter phenomenon where there is a clear distinction between the two groups. This approach is complementary to the one employed by 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 benefit eligibility on worker's employment history (the policy observed in reality). Moreover, the assumption mentioned generates an opportunistic worker behavior similar to the one imputed in my paper.

The approach I take below is similar to the one adopted by Marimon and Zilibotti (1999), i.e. I abstract from many important factors that could be equally likely to contribute to the differences in the labor markets and focus solely on one of them in order to find whether this particular factor may explain at least some of the empirical evidence. In particular, I 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 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 assumption of exogenous separations, generates (1) an *ex post* heterogeneity among the workers being reflected in different reservation wages, and (2) a welfare abusing behavior of workers in the model with a benefit entitlement for quitters.

The latter shows that there are some jobs 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, Baker and Rea (1998) found some empirical evidence in the Canadian labor market 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. Although they do not look explicitly at voluntary quits, as I discussed above, it is surely possible for many quitters to pass themselves off as being fired.

At the technical level, I adopt a discretized version of the McCall (1970) model and solve it numerically using dynamic programming methods. Importantly, there are two key assumptions employed in this paper: (1) a monetary search cost which effectively puts a search effort constraint upon the workers; and (2) a fixed firm side with wage dispersion. Moreover, for computational simplicity, I assume workers to be liquidity constrained, i.e. having no access to borrowing and saving technologies. The first assumption is discussed extensively in Section 2.1 and while discussing results in Section 4. Moreover, as has been shown by Acemoglu and Shimer (2000), relaxing the second assumption need not necessarily lead to qualitatively different conclusions. In their model with a two-sided heterogeneity both workers and firms benefit from a more generous unemployment insurance by allowing workers to search for more productive jobs and by enabling firms to increase their productivity by creating more productive jobs and employing the right type of workers.

This paper is organized as follows. The next section provides description of the theoretical model. In Section 3 I provide the algorithm of the numerical solution and 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 given by $g(q_t) = \alpha q_t^{\zeta}$, where $q_t \in [0,1]$. For simplicity of the analysis 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. The latter assumption is not too unrealistic, as nearly half of job losers in the United States report zero liquid wealth at the time of job loss (Chetty, 2008). If workers had access to capital markets, the optimal re-entitlement policy would probably be characterized by a requirement of a longer work experience.

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 net wages be represented by $w_i^\tau = w_i(1-\tau)$, where w_i is the ordered increasingly in i wage index of 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 suitable 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[1] $U(y - g(q_t))$. 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 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).

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 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 bet-

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

ter 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 head-hunters), 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 (see Section 4.1), however, that such a model is not able to match the time profile of search effort documented in Krueger and Mueller (2010). Obviously, it is possible to calibrate the $g(q_t)$ function so as to make effort very costly and consequently to generate a slight increase of search effort over time. However, this will not generate the observed drop after the benefit exhaustion and comes at the cost of implausibly high unemployment rate. On the other hand, the monetary cost of search can fully explain this behavior without the unemployment rate compromise.

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. 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). Any unemployed and eligible worker receives the value of $b_t = b(w) + h$ for T periods (exogenously given) and $b'_t = s(w) + h$ from T onwards until she finds a new job. Unemployment benefits are defined as a replacement ratio of worker's last wage, thus $b(w) = \nu_b w$ and $s(w) = \nu_s w$, 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 the model is endogenous and affects transition probabilities, the UI 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 suitable job offers or quitting such jobs endogenously.

2.3 Recursive Formulation

Given Sections 1.1 and 1.2, each worker's current state can be captured with a vector $s = (x, t, w)$ 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, $t \in \left\{-(T+1), \ldots, -1, 1, 2, \ldots, \hat{T}\right\}$, where e.g. $t = -1$ stands for the first period of unemployment. In particular, if a worker has been employed for less than $\hat{T}$ periods and decides to quit, she immediately jumps to the low benefit state, i.e. $t = -(T+1)$. However, if a match is separated exogenously or endogenously after $\hat{T}$ periods on the job, then the unemployed worker is entitled to benefits, i.e. $t = -1$.
3. Worker's most recent[2] wage $w \in \{w_1, \ldots, w_n\}$.

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

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

where $t' = \max\left\{-(t+1), -(T+1)\right\}$.

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

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

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

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 is characterized by the reservation wage strategy conditional upon worker's current state: the worker will accept a job if and only if the wage draw $w' \geq \bar{w}(t^u, t^e, w)$.

Proof. See the Appendix.

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 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 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, i.e. due to constraints on the feasible level of search effort).

2.4 Markov Transition Function

Given the description above, 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 1 presents example of transition probabilities for unemployed and employed workers.

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

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:

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

Figure 1: Transition function for workers in states $\{u, t, w_i\}$ and $\{e, t, w_j\} \forall j \in \{1, \ldots, n\}$

2.5 Steady State Equilibrium and Government

In the steady state the measure of workers in each of the states is constant over time. Moreover, revenue and expenditures of the government have to be balanced in each period. Let G_u and G_e be a cross sectional distributions over the states of all the (un)employed workers in the economy and let $g_u(t,w)$ and $g_e(t,w)$ be the mass of (un)employed workers currently in a given state with $\sum_t \sum_w (g_u(t,w) + g_e(t,w)) = 1$, i.e. the two are the associated probability mass functions. Steady state is characterized by an invariant cross sectional distributions G^* (and probabilities g^*) such that $G^*\Gamma = G^*$, i.e. G^* is a left eigenvector for Γ with eigenvalue 1.

I close the model with the balanced government budget condition which implies the following:

$$\left[\tau \sum_{t=1}^{\hat{T}} \sum_{w} w g_e^* (t,w)\right] = \left[\nu_b \sum_{t=-T}^{-1} \sum_{w} w g_u^* (t,w) + \nu_s \sum_{w} w g_u^* (-(T+1), w)\right] \quad (3)$$

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).

2.6 Welfare and Inequality 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 measure of individuals in each state:

$$Welfare = \sum_{t=-T}^{-1} \sum_{w} g_u^* (t,w) U (c(t,w) - g(q(t,w))) + \sum_{t=1}^{\hat{T}} \sum_{w} g_e^* (t,w) U (c(t,w)) \quad (4)$$

Furthermore, in order to measure inequality associated with each policy I use the Gini coefficient given by:

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

where $S_i = \Sigma_{j=1}^{i} \mathbb{P}(y_j) y_j$, $S_0 = 0$, $y_i < y_{i+1}$. A coefficient of 0 means perfect equality.

3 Solving the Model

3.1 Computation Method[3]

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[4] 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.

3.2 Calibration

I calibrate the model to the properties of the existing unemployment insurance system in the US. The calibration described below is later on referred to as a *base-line* calibration. I assume a bi-weekly periodicity of the model. Assuming yearly real interest rate $r = 0.04$, the implied discount factor is $\beta = 0.998$. I assume a 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 Job Openings and Labor Turnover Survey as in Hall and Milgrom (2008).

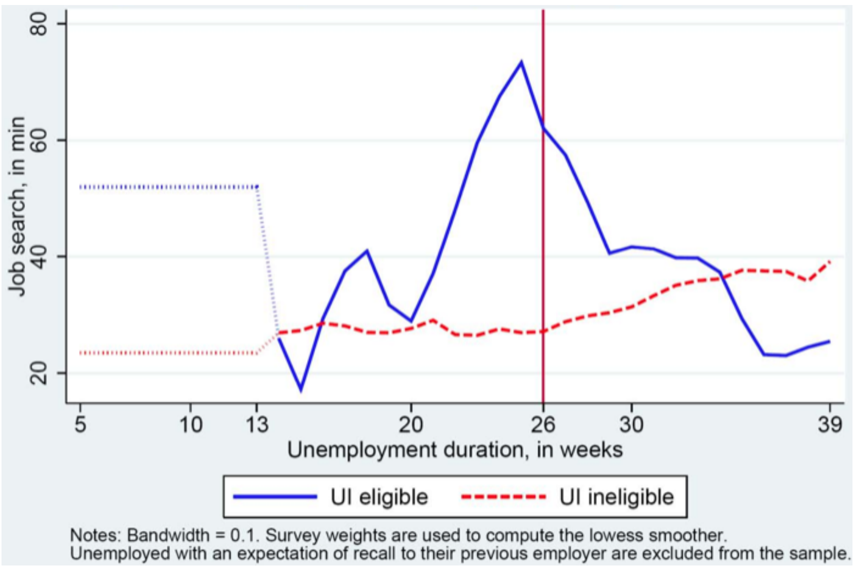
[3]For computing optimal decision rules I adapted to my own needs the toolkit of Michael Reiter and for computing distribution on wages I used a routine from the CompEcon toolkit.

[4]Since the first state over which the program iterates is the one of being employed for the first period at the lowest wage.

w_i	0.0437	0.0995	0.2091	0.4394	1
$\mathbb{P}(w_i)$	0.0113	0.2221	0.5333	0.2221	0.0113

Table 1: Wage distribution

The wage distribution F is assumed to be log-normal with a scale parameter $\mu = -1.5648$ (to have the support of wage distribution on $[0, 1]$) and a variance parameter $\rho = 0.3$ (as in Hall and Mueller (2013)). Also, I assume that there are $n = 5$ different wages in the market. I analyze the model with this relatively coarse wage grid in order to facilitate exposition of results. This comes at a cost of empirically implausible income inequalities shown in Section 4 below. Moreover, 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. The wage distribution implied is summarized in Table 1.



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)

Figure 2: Job search (in minutes) by unemployment duration

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[5] $\nu_b = 0.5$, $\nu_s = 0$ and $T = 13$. 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 $\hat{T}$.

parameter	interpretation	value	source/target
r	real yearly interest rate	4%	US data
β	discount factor	0.998	US data
θ	risk aversion coefficient	1	Mehra-Prescott (1985)
σ	exogenous separations rate	0.1/6	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_{UI}	periods of (high) UI entitlement	13	US data
n	number of productivity levels/wages	5	modeling choice
m	search effort grid parameter	50	modeling choice
F	distribution on productivity levels/wages	log-normal	modeling choice
μ	dist. log-scale parameter	-1.5648	support of F on $[0, 1]$
ϱ	dist. shape parameter	0.3	Hall and Mueller (2013)
h	value of home production	0.0375	target U and search profile
α	search cost parameter 1	0.172	target U and search profile
ζ	search cost parameter 2	1.4	target U and search profile

Table 2: Parameter values in the baseline calibration of the model

Finally, for the search effort I choose the grid to consist of $m = 50$ equidistant points from the $[0, 1]$ interval. More importantly, I choose the home-production value h and cost function parameters α and ζ such that: (1) the base-line 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 $w_i = 0.2091$ (which is the most common in the economy) resembles the one documented by Krueger and Mueller (2010) (shown in Figure 2). 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 differences in the search effort in different stages of unemployment. 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 benefit exhaustion and one period after) which

[5] In what follows I don't model benefit limits kicking in after surpassing some income threshold.

amount approximately to the counterpart ratios documented by Krueger and Mueller (2010). Also, I restrict the value of home production to be lower than the lowest wage in the market. Thus, I pick $\alpha = 0.172$, $\zeta = 1.4$ and $h = 0.0375$. Note that I use the same parameters for analyzing the model under the assumption of separable search cost. Although this leads to a degenerate (and so unrealistic) search effort, I argued in Section 2.1 that this need not be a serious miscalibration. In particular, in Section 4.3 I show that the implied unemployment rate for such a model is very close to the actual one. Table 2 summarizes the calibration.

4 Results

In this section I discuss the results from solving the calibrated model for different policy experiments. Although throughout the paper I used non-separable utility, I also provide results for the separable utility case as a robustness check of the model's predictions. 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, in Section 4.3 I present 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, in Section 4.4 I discuss some of differing features between European and US labor markets and attempt to reconcile them with predictions of the model.

4.1 Optimal Decisions

Figure 3 presents optimal decision under different specifications. Note that I also provide results for the risk aversion coefficient[6] $\theta = 2$. The first row shows the optimal policy functions in the base-line model with no re-entitlement policy in place for a worker eligible for benefits who was recently employed with wage $w = 0.2091$ and for a worker currently on the job. The search effort increases over time, peaks in period 13 with effort of approx. 0.8 when the benefit entitlement expires and

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

then goes down below 0.3 for the remaining periods when the worker's search is constrained by the amount of resources available from the home production.

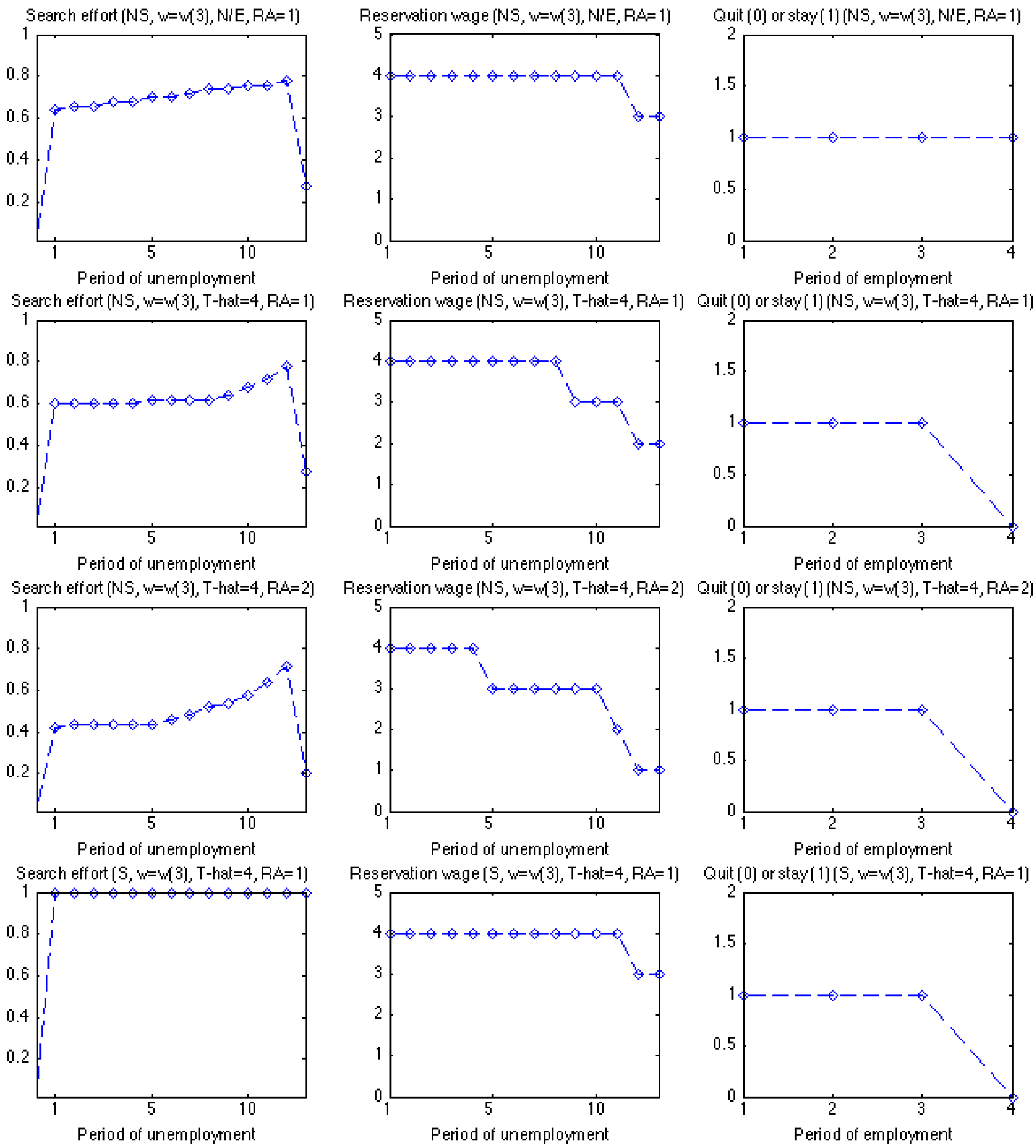
Note that although workers have no access to saving and borrowing, with monetary search cost they still manage to smooth their consumption. In particular, immediately after the transition from employment to unemployment state risk-averse workers do not want to experience a huge drop in consumption and 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 time of benefit exhaustion. The last plot shows that once the worker enters a job paying $w = 0.2091$, 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 periods (i.e. 8 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[7] only to quit them after having worked for $\hat{T} = 4$ periods when she regains an 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.

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

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



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.

Figure 3: Optimal policy

Finally, as a robustness check, Figure 3 also shows the optimal policy functions for a separable utility case which implies no binding constraint for the effort chosen. Thus, once the worker becomes unemployed, she moves immediately to a maximum search effort possible so that her chances of finding a decent job are maximized. Importantly, there is no decline in search effort after the decline in benefit payments. Moreover, the possibility of exercising a significant amount of effort implies that the worker is much choosier about the job offers. Nevertheless, also in this case workers are taking advantage of the re-entitlement policy.

4.2 Scenario Comparison

Since the model is not solved analytically I cannot make any statements about behavior of the model in any ϵ-neighborhood of a parameter of interest. Therefore, 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 3 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.

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

Table 3: Scenario comparison: total changes in key statistics on impact of change in parameters

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 increase 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 effects outweigh the possibly opposite effect of a lower unemployment rate, and so the tax rate has to be increased in order to balance the government budget.

For parameter ν_b small enough[8], 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 large enough, 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 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 the 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. As a result, the unemployment rate increases. For similar reasons as above, the tax rate on employed workers increases and so does the welfare

[8]Under the base-line calibration this threshold is very high at the level above 0.9

as the benefit entitlement period is prolonged.

However, the effect on inequality is ambiguous. For T_{UI} 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_{UI} 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. Therefore, the worker searches less and is more 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

Table 4 and 5 summarize results of solving the model 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 2 weeks 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. Interestingly, although with the parameters above I targeted the unemployment rate in the model with non-separable utility, the implied unemployment rate in the counterpart model with separable utility is very little off the target.

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. Moreover, the shorter is the re-entitlement requirement for the worker the greater is the welfare improvement[9]. Effectively the benefits of providing the search subsidy to

[9]Notice some non linear effects in the separable utility case for $\theta = 1$. Note in the Figure 3 that an unemployed worker exercises full search effort regardless of her state (under this calibrations this is true for every unemployed worker in the economy). In such a case there is a point for the parameter value $\hat{T}$ above which the workers do not find it worthwhile to take up the job and stay

the workers outweigh the costs generated by the moral hazard of rejecting/quitting suitable jobs. This can be interpreted in terms of an indirect job-search monitoring in environment where search effort is unobservable: by taking up a job, the unemployed workers are sending the government a credible signal that they are actually searching for a job and not using benefits purely for consumption purposes. Thus, when a worker quits a job voluntarily, 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. Nevertheless, as 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 base-line model with $\hat{T} = 1$ only 0.75% of the whole population takes advantage of the welfare system (i.e. only 7.33% of unemployed and 0.13% of employed are in wage categories which workers quit after regaining eligibility for the unemployment insurance).

Policy $\hat{T}$	$\theta = 1$							
	τ		Unemployment Rate		Welfare		Inequality	
	Non-Sep.	Sep.	Non-Sep.	Sep.	Non-Sep.	Sep.	Non-Sep.	Sep.
1	4.58%	4.18%	8.49%	7.29%	-0.9388	-0.8716	0.0658	0.0621
2	4.55%	4.12%	8.42%	7.21%	-0.9394	-0.8715	0.0664	0.0617
4	4.49%	4.11%	8.30%	7.20%	-0.9405	-0.8723	0.0673	0.0626
6	4.38%	4.04%	8.15%	7.13%	-0.9409	-0.8725	0.0675	0.0625
13	4.28%	3.99%	8.00%	7.15%	-0.9432	-0.8726	0.0686	0.0625
26	4.11%	3.99%	7.72%	7.15%	-0.9455	-0.8726	0.0704	0.0625
N/E	3.75%	3.99%	7.11%	7.15%	-0.9557	-0.8726	0.0792	0.0599

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

Table 4: Results of the model with $\theta = 1$

Following an (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.

on it for this many periods in order to reset their unemployment benefits, i.e. they prefer to remain unemployed (even in the low benefit state), continue exercising very high search effort and enter a good job as soon as possible. However, in the case $\theta = 2$, where the demand for insurance is higher, this is not the case anymore.

Furthermore, under the preferred assumption of monetary search cost, 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 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. Secondly, due to higher unemployment the implied tax rate increases bringing the income of employed individuals closer to the income of unemployed.

Note that under the alternative of the separable utility the efficiency-equity trade-off kicks in. As unemployed workers are able to exercise very high effort and thus are very picky about the job offers they receive, they only accept high paying jobs on which they want to work until exogenously separated. However, once the re-entitlement policy is in place, there are some lower paying jobs which become acceptable for those who have been unemployed for longer and thus the steady state distribution is characterized by a new wage category of workers and unemployed.

The implied budget balancing tax rate 3.75% for the base-line model of 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.

Policy $\hat{T}$	$\theta = 2$							
	τ		U		Welfare		Inequality	
	Non-Sep.	Sep.	Non-Sep.	Sep.	Non-Sep.	Sep.	Non-Sep.	Sep.
1	4.99%	3.98%	9.81%	7.07%	-2.8623	-2.4324	0.0730	0.0598
2	4.89%	3.97%	9.65%	7.07%	-2.8653	-2.4347	0.0736	0.0605
4	4.79%	3.90%	9.43%	7.00%	-2.8733	-2.4363	0.0752	0.0600
6	4.76%	3.90%	9.35%	6.99%	-2.8821	-2.4387	0.0771	0.0607
13	4.60%	3.81%	8.97%	6.90%	-2.9034	-2.4443	0.0810	0.0607
26	4.45%	3.65%	8.60%	6.73%	-2.9335	-2.4518	0.0868	0.0607
N/E	4.15%	3.54%	7.87%	6.73%	-3.0192	-2.4621	0.1000	0.0554

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

Table 5: Results of the model with $\theta = 2$

In the case of more risk averse workers, the conclusions are qualitatively the same. Note that due to the consumption smoothing mentioned in Section 4.1 which lowers the level of search effort exercised, the unemployment rate in the non-separable utility case is uniformly higher for all choices of policy parameter $\hat{T}$. However, under separability, apart from being more likely to accept lower wages due to higher risk aversion, workers are still exercising very high search effort which works in the opposite direction. Thus, per saldo the unemployment rate is lower than in the case of $\theta = 1$. As a consequence, implied tax rates go in the same directions as the unemployment rate. The same reasoning as above holds true for the influence of policy parameter $\hat{T}$ on inequality.

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[10] 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, 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. Thus, it turns out that the model presented in this paper 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 base-line case and various re-entitlement policy cases varies between 0.6% and 1.4%. Thus, the prevalent in Europe policy of paying benefits after voluntary quits allowing for improvement upon the match quality may account for some but not all of the observed difference

[10]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.

in employment rates.

Also, following a 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 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[11].

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 at least 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. 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

[11] I do not pursue this extension of the model as it wouldn't change the main conclusions and would only lead to greater income inequality and possibly a slightly higher difference in unemployment rates.

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 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 they may be rather ad hoc and may be a source of welfare inefficiencies. Furthermore, upon following the optimal policy the implied welfare and unemployment rate are higher and the 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 latter two results are in a position to explain empirical observations about 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 of effects similar to these described in Marimon and Zilibotti (1999). Moreover, worker's opportunism was found in Hopenhayn and Nicolini (2009). I show that this opportunistic and seemingly inefficient behavior of workers quitting suitable jobs and the associated higher unemployment rate may be in fact welfare improving. 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, in terms of policy this paper sheds some light on the policies followed in the real world. Finally, the results presented here hint at the need of new direction of economic research concentrated on (1) the welfare consequences of 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.

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6 Appendix

Proof of the reservation wage property. Existence of such a reservation wage $\bar{w}\left(t^u, t^e, w\right)$ 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 $\bar{w}\left(t^u, t^e, w\right)$.

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 $V_e(1, w') \geq V_e(1, \bar{w}(t^u, t^e, w)) = V_u(t^u, t^e, w)$ and $V_e\left(1, w'\right) < V_u\left(t^u, t^e, \bar{w}(t^u, t^e, w)\right)$ for $w' < \bar{w}$.

Note that due to the UI design, the value of being unemployed is clearly monotone in wage, i.e. $V_u(1, t^e, w') \geq V_u(1, t^e, w)$. 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 $V_e\left(1, w'\right) \geq V_e\left(1, \bar{w}\left(t^u, t^e, w\right)\right) = V_u\left(t^u, t^e, \bar{w}\left(t^u, t^e, w\right)\right)$ for $w' \geq w$ and conversely $V_e\left(1, w'\right) < V_u\left(t^u, t^e, \bar{w}(t^u, t^e, w)\right)$ for $w' < \bar{w}$, where the monotonicity and definition of the reservation wage is used. This establishes the reservation property.