Preliminary

Welfare States and Unemployment

by

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This paper studies equilibrium unemployment in a search model where the government both provides liberal unemployment insurance and taxes labor at high progressive tax rates. It is shown how progressive income taxation can counteract a high unemployment rate under generous unemployment insurance. In particular, high marginal taxes reduce workers' incentives to switch jobs in response to changing economic opportunities. This lower labor mobility reduces unemployment but at the cost of a less efficient labor allocation.

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1. Introduction

The welfare states in Europe have experienced dramatically different unemployment rates. For example, the Netherlands has been plagued by high unemployment for a long period of time while the Swedish unemployment rate has historically been remarkably low.[1] High unemployment in these welfare states has commonly been attributed to the existence of generous benefits such as liberal unemployment insurance.[2] While acknowledging that unemployment insurance tends to increase the unemployment rate, this paper argues that the effects of particular schemes for *financing* extensive welfare programs can work in the opposite direction. High and progressive income taxes can reduce the unemployment rate for two reasons. First, unemployed workers may lower their reservation wage because progressive taxes reduce the dispersion of after-tax wage offers as shown by Pissarides [1983]. Second, high marginal taxes make it less advantageous for workers to switch jobs in response to changing economic opportunities. Lower labor mobility then tends to reduce unemployment as long as job searches are associated with frictional unemployment. It follows that any such tendency to lower unemployment is brought about at the cost of a less efficient labor allocation. The overall effect on the unemployment rate depends on the relative importance of generous unemployment compensation versus the tax disincentives on labor mobility.

Our approach is to build an equilibrium search model in the spirit of Stigler [1961] and McCall [1970] with features of the search environment designed to capture aspects of the situation that has prevailed in the welfare states of Europe. The search theoretic framework has been used extensively in the labor economics literature as reviewed by Mortensen [1986]. Among other things, it has been shown how unemployment compensation reduces the cost of job search and thereby increases the length of unemployment spells.

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[1] Björklund [1993] reports that the rate of open unemployment in Sweden during the last 25 years has been between 1.2–3.5 percent. After adding workers who participate in training programs and temporary relief jobs, the rate remains low, between 3.0–6.0 percent.

[2] Other explanations to high European unemployment have involved different forms of "hysteresis". For example, Blanchard and Summers [1986] and Lindbeck and Snower [1988] have argued that "insider-outsider" conflicts between employed and unemployed workers are likely to arise in the highly unionized economies of Europe. Another cause of hysteresis is costs of adjustment, e.g. hiring and firing costs, as explored by Bentolila and Bertola [1990].

In this paper, we will focus on the effects on incentives to search for jobs in an economy that *both* provides liberal unemployment insurance and taxes labor at high progressive tax rates. Pissarides [1983] demonstrates how progressive income taxes can be used to offset the disincentive effects of unemployment insurance when coupled with a search subsidy. Progressive taxes exert a downward pressure on the reservation wage by making it less desirable to hold out for high-paying jobs, which offsets the upward pressure put on it by unemployment insurance. In our analysis, we argue that the disincentive effects from high marginal taxes do not only affect the search behavior of unemployed but also the decisions of currently employed workers whether or not to quit in response to better outside opportunities. To model the idea that employed workers face changing economic opportunities, we assume that a job is represented by a Markov wage process. A fall in the wage of an employed worker need not be interpreted literally, but can also be interpreted in relative terms, e.g., as an improvement in outside opportunities rather than a demotion. Workers experiencing "wage cuts" may then choose to quit and search for new jobs.[3]

Unemployment insurance is usually behavior-contingent in one way or another. Our analysis assumes that a worker is eligible for unemployment compensation if he was fired, but not if he quits. Some governments impose additional constraints as pointed out by Jackman, Pissarides and Savouri [1990]; "In both the Swiss and the Swedish systems there is pressure on the unemployed, including possible denial of benefit, to both look for a work and accept suitable job offers." We model this by assuming a government stipulated "suitable" wage – a wage threshold level which, if offered and refused, triggers refusal of unemployment compensation to an unemployed worker.

The next section describes the model in detail. The laws of motion of employment and unemployment are shown in Section 3 while the resulting wage distributions are derived in Section 4. Section 5 considers a specialized setup with respect to the Markov process for the wage associated with ongoing employment. Our computational strategy for finding a stationary equilibrium is described in Section 6. The simulations of the model in Section 7 illustrates how the rate of unemployment and average productivity depend on the

[3] For an alternative assumption generating quits and job search, see Lucas and Prescott [1974] who model an "island economy" where a negative demand shock to an island reduces its equilibrium wage rate and induces its workers to search for new jobs on other islands.

progressiveness of income taxes and the unemployment insurance arrangement. The final section contains concluding comments.

2. The Economy

There is a continuum of workers on the unit interval with births equaling deaths. An unemployed worker chooses a search intensity $s \geq 0$ at a cost $c(s)$ which is increasing in s. With probability $\pi(s)$, the unemployed worker receives one wage offer per period from distribution $F(w) = \text{Prob}(w_t \leq w)$. With probability $(1 - \pi(s))$, the worker receives zero offers per period. We assume $\pi(s) \in (0, 1)$, and that it is increasing in s. After he has accepted a job offer, the worker receives w drawn from $F(w)$ the first period, and thereafter receives a Markov wage process $G(w'|w) = \text{Prob}(w_{t+1} \leq w'|w_t = w)$ for each period he is alive and not fired. At the beginning of each period, each previously employed worker is subjected to a probability $\lambda \in (0, 1)$ of being fired. In addition, all workers are subjected to a probability of $\alpha \in (0, 1)$ of dying between each period.

Newborn workers and workers who were fired are entitled to unemployment compensation of γ per period. However, unemployment compensation will be terminated if the worker turns down a wage offer that is greater than or equal to w_g, as determined by the government. Workers who have quit their previous job are not entitled to unemployment compensation. Both wage earnings and unemployment compensation are subject to income taxation. An income below I_τ is taxed at a rate τ while any income above this level is taxed at a rate $\rho\tau$. Note that $\rho = 1$ corresponds to a uniform tax τ on all income while the tax system is progressive for $\rho > 1$ and regressive for $\rho < 1$. The parameters γ, w_g, I_τ, τ and ρ must be set so that income taxes net of unemployment compensation generate a specified level of government revenues each period.

Each worker wants to maximize the expected value $E_t \sum_{i=0}^{\infty} \beta^i (1-\alpha)^i y_{t+i}$ where E_t is the expectation operator conditioned on information at time t, β is the subjective discount factor and $1-\alpha$ is the probability of surviving between two consecutive periods; y_{t+i} is the worker's after-tax income from employment and unemployment compensation at time $t+i$ net of search costs.

Unemployed workers are divided into two categories; involuntarily unemployed and voluntarily unemployed. Involuntarily unemployed workers are those who are entitled to unemployment compensation, i.e., newborn workers and fired workers who have not yet turned down a wage offer greater than or equal to w_g. All other unemployed workers are said to be voluntarily unemployed. This category consists therefore of workers who have quit their previous jobs, and workers who have been fired and seen their unemployment compensation terminated when not accepting a "suitable" wage offer, w_g, as determined by the government.

Let $v(w)$ be the value of the optimization problem for an unemployed worker with new offer w in hand, and who was either fired from his job or involuntarily unemployed in the beginning of the period. Let $v_q(w)$ be the value of the problem for an unemployed worker with new offer w in hand, and who either quit his job or was voluntarily unemployed in the beginning of the period. These value functions are interrelated as follows. For notational convenience, let w_{net} and γ_{net} denote after-tax income from a wage w and an unemployment compensation γ, respectively.

For an involuntarily unemployed worker, Bellman's equations are

$$Q = \max_s \{-c(s) + \pi(s) \int v(w)dF(w) + (1-\pi(s))[\gamma_{net} + (1-\alpha)\beta Q]\}$$

$$v(w) = \begin{cases} \tilde{v}(w), & \text{if } w < w_g \\ v_q(w), & \text{if } w \geq w_g \end{cases} \tag{1}$$

where

$$\tilde{v}(w) = \max_{\text{accept,reject}} \{w_{net} + (1-\lambda)(1-\alpha)\beta \int v_q(w')dG(w'|w) + \lambda(1-\alpha)\beta Q \,, \\ \gamma_{net} + (1-\alpha)\beta Q\}.$$

For a voluntarily unemployed worker with wage w, Bellman's equations are

$$Q_q = \max_s \{-c(s) + \pi(s) \int v_q(w)dF(w) + (1-\pi(s))(1-\alpha)\beta Q_q\}$$

$$v_q(w) = \max_{\text{accept,reject}} \{w_{net} + (1-\lambda)(1-\alpha)\beta \int v_q(w')dG(w'|w) + \lambda(1-\alpha)\beta Q \,, \\ (1-\alpha)\beta Q_q\}. \tag{2}$$

Associated with the solution of equations (1)-(2) will be two numbers $(\bar{s}, \bar{w})$ giving an optimal search intensity and a reservation wage of an involuntarily unemployed worker; and two numbers $(\bar{s}_q, \bar{w}_q)$ giving an optimal search intensity and a reservation wage of a voluntarily unemployed worker.

3. Employment and Unemployment Motion

Let U_{It} be involuntary unemployment and U_{Vt} be voluntary unemployment at the end of period t. The measure of workers who gain new employment in period t is denoted L_t, and their initial wage distribution is given by the cumulative density function $H_{0t}(w)$ which will be derived in the following section. In order to study the laws of motion for unemployment and employment, we will have to compute measures of workers who quit their jobs at different tenures. A worker who quits his job will not receive any unemployment compensation so he will optimally quit whenever a wage draw in his current employment falls short of $\bar{w}_q$, i.e., the reservation wage of a voluntarily unemployed. The fraction of workers belonging to cohort L_t who quit after i periods at their work can be written as $(1-\alpha)^i(1-\lambda)^i A_{it}$ where

$$A_{1t} = \int G(\bar{w}_q|w)dH_{0t}(w)$$

$$A_{2t} = \int \int_{w^1 \geq \bar{w}_q} G(\bar{w}_q|w^1)dG(w^1|w)dH_{0t}(w)$$

$$A_{it} = \int \int_{w^1 \geq \bar{w}_q} \cdots \int_{w^{i-1} \geq \bar{w}_q} G(\bar{w}_q|w^{i-1})dG(w^{i-1}|w^{i-2}) \ldots dG(w^1|w)dH_{0t}(w)\,. \tag{3}$$

Given these measures of quitters and the unemployment at the end of period $t-1$, U_{It-1} and U_{Vt-1}, the measure of workers gaining new employment in period t is

$$\begin{aligned} L_t &= \pi(\bar{s})[1-F(\bar{w})] \\ &\qquad \cdot \left[\alpha + (1-\alpha)U_{It-1} + (1-\alpha)\lambda(1-U_{It-1}-U_{Vt-1})\right] \\ &\quad + \pi(\bar{s}_q)[1-F(\bar{w}_q)] \\ &\qquad \cdot \left[(1-\alpha)U_{Vt-1} + \sum_{k=-\infty}^{t-1}(1-\alpha)^{t-k}(1-\lambda)^{t-k}A_{t-k,k}L_k\right]. \end{aligned} \tag{4}$$

The first of the two terms in (4) is the total number of involuntarily unemployed who gain new employment in period t. With search intensity $\bar{s}$, their probability of obtaining a wage offer is $\pi(\bar{s})$ and the probability that this wage offer exceeds their reservation wage $\bar{w}$ is $1 - F(\bar{w})$. The product of these two probabilities determines the fraction of all involuntarily unemployed who accept a new offer. The involuntarily unemployed at the beginning of period t consist of newborn workers, α, surviving involuntarily unemployed from last period, $(1-\alpha)\,U_{It-1}$, and everyone that is fired at time t, $(1-\alpha)\lambda\,(1 - U_{It-1} - U_{Vt-1})$. A similar argument applies to the second term in (4) that refers to voluntarily unemployed. The fraction of them accepting a job at time t is $\pi(\bar{s}_q)[1 - F(\bar{w}_q)]$. The voluntarily unemployed at the beginning of period t are made up of all surviving voluntarily unemployed from last period, $(1-\alpha)\,U_{Vt-1}$, and everyone who quits his job at time t, given by the infinite sum over all possible tenure horizons.

The two types of unemployment follow laws of motion

$$\begin{aligned} U_{It} &= \left[\pi(\bar{s})\,F(\min\{\bar{w}, w_g\}) + (1-\pi(\bar{s}))\right] \\ &\qquad \cdot \left[\alpha + (1-\alpha)\,U_{It-1} + (1-\alpha)\lambda\,(1 - U_{It-1} - U_{Vt-1})\right], \end{aligned}$$

$$\begin{aligned} U_{Vt} &= \left[\pi(\bar{s}_q)\,F(\bar{w}_q) + (1-\pi(\bar{s}_q))\right] \\ &\qquad \cdot \left[(1-\alpha)\,U_{Vt-1} + \sum_{k=-\infty}^{t-1} (1-\alpha)^{t-k}(1-\lambda)^{t-k}\,A_{t-k,k}L_k\right] \\ &\quad + \pi(\bar{s})\,[F(\bar{w}) - F(\min\{\bar{w}, w_g\})] \\ &\qquad \cdot \left[\alpha + (1-\alpha)\,U_{It-1} + (1-\alpha)\lambda\,(1 - U_{It-1} - U_{Vt-1})\right]. \end{aligned} \tag{5}$$

The law of motion of involuntarily unemployed at the end of period t, U_{It}, is the product of the probability of remaining involuntarily unemployed throughout the period and the number of involuntarily unemployed at the beginning of the period. There are two events that prolong involuntary unemployment. The involuntarily unemployed either turns down a wage offer which falls short of the government stipulated "suitable" wage, or fails to obtain any wage offer at all. The probability of these two events is $\pi(\bar{s})\,F(\min\{\bar{w}, w_g\}) + (1-\pi(\bar{s}))$. The law of motion of voluntarily unemployed, U_{Vt}, consists of two terms. The first term is voluntarily unemployed at the beginning of the period who remains unemployed throughout the period. As before, there are two possibilities where the worker either turns down a wage offer, now with probability $\pi(\bar{s}_q)\,F(\bar{w}_q)$, or fails to receive a wage offer, with probability

$1-\pi(\bar{s}_q)$. The last term in the expression for U_{Vt} refers to workers who were involuntarily unemployed at the beginning of period t but who became voluntarily unemployed when turning down a wage offer exceeding the government stipulated "suitable" wage, w_g.

We will later study stationary equilibria, i.e., compute stationary solutions (L, U_I, U_V) to the difference equations (4) and (5).

4. Wage Distributions

The initial wage distribution of workers gaining employment in period t, $H_{0t}(w)$, depends on the workers' reservation wages and search intensities. In fact, the initial wage distribution for cohort L_t is a weighted average of two distributions; one for previously involuntarily unemployed and another one for previously voluntarily unemployed. It can be written as

$$
\begin{aligned}
H_{0t}(w) &= \pi(\bar{s})\left[F(w) - F(\min\{\bar{w}, w\})\right] \\
&\qquad \cdot \left[\alpha + (1-\alpha)U_{It-1} + (1-\alpha)\lambda(1 - U_{It-1} - U_{Vt-1})\right] L_t^{-1} \\
&\quad + \pi(\bar{s}_q)\left[F(w) - F(\min\{\bar{w}_q, w\})\right] \\
&\qquad \cdot \left[(1-\alpha)U_{Vt-1} + \sum_{k=-\infty}^{t-1} (1-\alpha)^{t-k}(1-\lambda)^{t-k} A_{t-k,k} L_k\right] L_t^{-1}.
\end{aligned}
\tag{6}
$$

This expression is similar to (4) and, once again, the first term refers to workers who were previously involuntarily unemployed while the second term refers to previously voluntarily unemployed. Ignoring the factor L_t^{-1}, expression (6) computes the number of new hires with a wage less than or equal to w. The wage distribution is then obtained after dividing by the total number of new hires, L_t, so that $H_{0t}(w)$ integrates to one.

Wages for workers employed more than one period will depend on the wage offers drawn at work from the distribution $G(w'|w)$. To compute the wage distribution for different tenure horizons, we must take into account that workers will quit whenever drawing a wage offer less than the reservations wage $\dot{w}_q$. Let $H_{it}(w)$ denote the cumulative density function for wages in period $t+i$ of workers who were hired in period t and still keep the same job. (That is, workers belonging to cohort L_t who have not died, quit or been fired up and until period $t+i$.) These wage distributions can be computed as follows,

$$H_{1t}(w) = \frac{\int \left[G(w|w^0) - G(\min\{w, \bar{w}_q\}|w^0)\right] dH_{0t}(w^0)}{\int \left[1 - G(\bar{w}_q|w^0)\right] dH_{0t}(w^0)}$$

$$H_{2t}(w) = \frac{\int \left[G(w|w^1) - G(\min\{w, \bar{w}_q\}|w^1)\right] dH_{1t}(w^1)}{\int \left[1 - G(\bar{w}_q|w^1)\right] dH_{1t}(w^1)}$$

$$H_{it}(w) = \frac{\int \left[G(w|w^{i-1}) - G(\min\{w, \bar{w}_q\}|w^{i-1})\right] dH_{i-1,t}(w^{i-1})}{\int \left[1 - G(\bar{w}_q|w^{i-1})\right] dH_{i-1,t}(w^{i-1})}. \tag{7}$$

The average wage in the economy at time t, $\bar{W}_t$, can then be computed as

$$\bar{W}_t = \frac{\sum_{k=-\infty}^{t}(1-\alpha)^{t-k}(1-\lambda)^{t-k}\left[1-\sum_{i=0}^{t-k} A_{ik}\right] L_k \int w \, dH_{t-k,k}(w)}{\sum_{k=-\infty}^{t}(1-\alpha)^{t-k}(1-\lambda)^{t-k}\left[1-\sum_{i=0}^{t-k} A_{ik}\right] L_k}, \tag{8}$$

where $A_{0k} \equiv 0$. Since labor is the only factor of production, the gross national product of this economy at time t is just the average wage, $\bar{W}_t$, times the employment level, $(1 - U_{It} - U_{Vt})$.

5. Specialized Setup

When computing an equilibrium, it is necessary to keep track of all workers quitting at different tenures as shown in (3) and the wage distributions of employed workers given by (7). These computations can be greatly simplified by assuming the following Markov process for the wage associated with ongoing employment. With probability $1-\phi$, the wage will be the same as in the previous period, and, with probability $\phi \in (0,1)$, the wage is drawn from the distribution $\tilde{G}(w) = \text{Prob}(w_t \leq w)$.

The fractions of workers quitting from different cohorts are then time invariant and depend only on the length of the workers' tenure. Specifically, the time subscript can be dropped from $\{A_{it}\}$, and

$$A_i = \sum_{k=0}^{i-1} \binom{i-1}{k} (1-\phi)^{i-1-k} \left[\phi(1-\tilde{G}(\bar{w}_q))\right]^k \phi \tilde{G}(\bar{w}_q). \tag{9}$$

For example, conditional on being alive and not fired, the fraction of quitters among the workers employed three periods ago is given by

$$A_3 = (1-\phi)^2\phi\tilde{G}(\bar{w}_q) + \binom{2}{1}(1-\phi)\phi(1-\tilde{G}(\bar{w}_q))\phi\tilde{G}(\bar{w}_q) + \left[\phi(1-\tilde{G}(\bar{w}_q))\right]^2\phi\tilde{G}(\bar{w}_q).$$

All these workers have drawn a wage in the third period of employment which falls short of the reservation wage $\bar{w}_q$. The first term singles out the workers who have not drawn any new wage in the first two periods. The second term describes workers who have drawn exactly one more wage, either in the first or the second period. Workers who have drawn a new wage in all periods is captured by the third term. Of course, any new wage drawn in the first and/or second period must have been greater than or equal to $\bar{w}_q$ since the workers did not quit earlier.

The wage distributions for different tenure horizons can then be written as

$$(10)\quad H_{it}(w) = \frac{(1-\phi)^i H_{0t}(w) + \left[1-(1-\phi)^i - \sum_{k=1}^{i} A_k\right]\dfrac{\tilde{G}(w)-\tilde{G}(\min\{w,\bar{w}_q\})}{1-\tilde{G}(\bar{w}_q)}}{1-\sum_{k=1}^{i} A_k}.$$

That is, the wage distribution for a given tenure horizon is a weighted average of the initial distribution that still pertains to workers who have not yet drawn a new wage at work, $H_{0t}(w)$, and the wage distribution of workers who have drawn at least one new wage at work without quitting. The wage distribution of the latter workers is just the wage offer distribution $\tilde{G}(w)$ above the reservation wage $\bar{w}_q$.

6. Computational Strategy

The parameters of the model are $\beta, \alpha, \lambda, \phi, \gamma, w_g, \tau, I_r, \rho$, the government's expenditures (net of unemployment compensation), the distributions $\tilde{G}, F$, and the functions $\pi(\cdot)$ and $c(\cdot)$. We will model the distributions as discrete: $\tilde{G} \approx \{\tilde{g}_i\}, F \approx \{f_i\}$, where $\sum f_i = 1, \sum \tilde{g}_i = 1, \tilde{g}_i \geq 0, f_i \geq 0$. We will restrict search levels to the grid $s_1, \ldots, s_m$, and represent the functions $\pi(\cdot)$ and $c(\cdot)$ each as $m \times 1$ vectors.

The steps of our solution algorithm are as follows.

1. Solve the functional equations (1) and (2) for $(\bar{s}, \bar{w}, \bar{s}_q, \bar{w}_q)$.
2. Solve (9) for the $\{A_i\}_{i=1}^{\infty}$. In practice, it will be necessary to truncate the infinite sequence.
3. Solve (4) and (5) for stationary values of L, U_I and U_V.
4. Solve (6) for the stationary wage distribution $H_0(w)$ at the stationary values for L, U_I and U_V, and then compute the wage distributions for different horizons, $H_i(w)$, in (10).
5. We can iterate on steps 1–4 in order to establish a balanced government budget, as done by Hansen and Imrohoroglu [1992].

7. Simulations

Numerical simulations are used in this section to illustrate how the equilibrium rate of unemployment depends on the progressiveness of income taxes and the unemployment insurance arrangement. After a description of the model's calibration, we focus first on the effects of the progressiveness of the tax system by varying the parameter I_τ, i.e., the income level at which the higher tax rate becomes effective. Thereafter, we study how the equilibrium is affected by the level of unemployment compensation, γ. Finally, we explore what the effects are when the government imposes a "suitable" wage offer, w_g, which disqualifies a worker for unemployment compensation. It should be mentioned that the qualitative results in this section are robust and would not change for reasonable variations in the parameters.

Calibration

The model period is chosen to be a month. An annual interest rate of 4 percent is then obtained by selecting a discount factor $\beta = 0.9967$. The probabilities of dying, being fired and drawing a new wage offer at work are $\alpha = 0.002$, $\lambda = 0.01$, and $\phi = 0.04$, respectively. The working life of an individual is then geometrically distributed with an expected duration of 41.7 years. Similarly, the average time before being fired (given that the worker has not quit) is 8.3 years, and the average period between wage offers at work is 2.1 years.

The exogenous wage offer distributions that the workers are drawing from are assumed to be truncated normal distributions. Specifically, the wage offer distribution that unemployed workers are drawing from is a normal distribution with a mean of 0.5 and a variance of 0.1 that has been truncated to the unit interval (and then normalized to integrate to one). The wage offer distribution from which employed workers are drawing is selected to have a higher mean but a lower variance. The idea is that workers should on average be able to do better at their current work than drawing randomly from the general economy. Moreover, the variance of future wage offers are less at the current employment than for a worker quitting his job and drawing randomly from the general economy. The wage offer distribution from which employed workers are drawing is therefore chosen to be a normal distribution with a mean of 0.6 and a variance of 0.01 that has been truncated to the unit interval (and then normalized to integrate to one).

The search-cost function and the function mapping search intensities into probabilities of obtaining a wage offer are assumed to be

$$\begin{aligned} c(s) &= 0.1\, s^{1.1}\,, \\ \pi(s) &= s^{0.3}\,, \qquad \text{where } s \in [0,1]\,. \end{aligned}$$

The parameters are chosen so as to obtain "reasonable" outcomes.

The unemployment compensation is initially set equal to 0.3 which corresponds to a replacement ratio around 40 percent in an equilibrium. In the first simulations, the government is assumed not to exert any control over the unemployed. Government expenditures excluding unemployment compensation are chosen to be 0.35 which translates into roughly 50 percent of equilibrium GNP. The progressiveness of the tax system is parametrized so that the higher tax rate is 50 percent higher than the lower tax rate ($\rho = 1.5$).

Progressiveness of income taxes

Given the calibration above, the only remaining parameters in the model are τ and I_τ, i.e., the lower tax rate and the income level at which the higher tax rate becomes effective. For any given value of I_τ, we can compute the equilibrium value of τ that balances the government's budget as described in Section 6. Using I_τ as an index, these stationary equilibria can be compared by plotting endogenous variables against I_r. Thus, our main finding in Figure 1 is that the unemployment rate is a U-shaped function of I_r.

That unemployment is a U-shaped function of I_r reflects the effects of the tax system on workers' search behavior. First, as shown in Figure 2, tax rates are increasing in I_r because a larger I_r means that the higher tax rate applies to a smaller income range, necessitating an increase of tax rates to finance the government's expenditures. Second, income taxes reduce workers' rewards from successful job searches and thereby reduce their incentives to search. This is illustrated in Figure 3, depicting the chances of a worker to further increase his disposable income, given a current wage offer of 0.5. As shown, the distribution of potential increases in the disposable income from further job search is shifted towards zero when the value of I_r goes from 0 to 0.3 and then to 0.5.[4]

As can be seen in Figures 4 and 5, equilibrium taxes associated with mid-range values of I_r have especially negative effects on workers' search behavior as manifested in lower search intensities (for involuntary unemployed) and lower reservation wages. Lower search intensities tend to increase the length of unemployment spells while lower reservation wages have the opposite effect. A lower $\bar{w}$ means that involuntarily unemployed workers are more likely to accept a wage offer which tends to shorten the duration of their job searches. The same is true for voluntarily unemployed workers with a lower $\bar{w}_q$. Moreover, a lower $\bar{w}_q$ means also that employed workers are less willing to quit their jobs in response to a bad wage draw at work (or, in other words, less willing to respond to good outside opportunities). Figure 1 shows how the lower unemployment rate for mid-range values of I_r are primarily due to a drop in voluntary unemployment. We can conclude that the effects of lower reservations wages which tend to reduce unemployment outweigh the opposite effects of lower search intensities.

It is worth noting in Figures 1, 4 and 5 that $I_r = 0$ and $I_r = 1$ give rise to the same rate of unemployment, the same search intensities and the same reservation wages. This is because these two parameter values correspond to exactly the same tax system with a flat rate tax levied on all income. In particular, $I_r = 0$ means that the higher tax rate applies

[4] The truncated right-hand tails of the distributions in Figure 3 follow from the fact that the underlying wage offer distribution is itself truncated at one.

to all income while $I_r = 1$ means that all income is subject to the lower tax rate. Since the higher tax rate is parameterized to be 50 percent higher than the lower tax rate ($\rho = 1.5$), we would then expect to see a 50 percent higher tax rate τ for the equilibrium with $I_r = 1$ compared to the equilibrium with $I_r = 0$. This can also be verified in Figure 2.

Figure 6 shows how the rate of unemployment is reduced at the expense of GNP. The lower unemployment rate is not sufficient to compensate for the lower average wage in the economy as also depicted in Figure 6. In other words, a lower equilibrium unemployment rate can be achieved but only at the cost of a less efficient labor allocation. GNP is therefore also a U-shaped function of I_r.

Level of unemployment compensation

Figures 7 through 11 depict various economic variables as functions of the unemployment compensation γ. In all these figures, I_r is held constant at 0.5, i.e., the higher tax rate becomes effective at an income of 0.5. Since a higher unemployment compensation reduces the private cost associated with unemployment, it is hardly surprising that the rate of involuntary unemployment is increasing in γ as shown in Figure 7. In Figures 8 and 9, these involuntarily unemployed workers eligible for unemployment compensation are seen to both reduce their search intensity, $\bar{s}$, and choose a higher reservation wage, $\bar{w}$, when γ rises. In contrast, the rate of voluntary unemployment in Figure 7 is eventually a decreasing function of γ. Higher unemployment compensation puts an upward pressure on the tax rates in Figure 10 which makes it less advantageous to switch jobs in response to changing economic opportunities, as reflected by a falling reservation wage, $\bar{w}_q$, in Figure 9. There are two reasons for why a higher γ leads to higher tax rates. First, higher unemployment compensation means higher government expenditures. Second, more generous unemployment compensation raises involuntary unemployment which translates into a smaller tax base, i.e., fewer employed workers are asked to bear a larger tax burden. According to Figure 10, the disincentive effects from higher tax rates will finally become so large that even voluntarily unemployed workers are reducing their search intensity, $\bar{s}_q$.

The welfare costs of a generous unemployment compensation is depicted in Figure 11 in form of a sharply declining GNP for γ greater than 0.4. (Recall that workers are assumed to be risk neutral which means that GNP is the appropriate measure of welfare.) Curiously enough, the average economy-wide wage is kept more or less constant. The lower reservation wage of voluntary unemployed (and currently employed) is outweighed by the increasing reservation wage of involuntary unemployed who become more and more choosy in response to a rising unemployment compensation.

Government control over unemployed

As mentioned in the introduction, some countries like Sweden have tried to control the labor market behavior of unemployed by stipulating a "suitable" wage – a wage threshold level which, if offered and refused, triggers refusal of unemployment compensation to an unemployed worker. Figure 12 explores the effects when the government sets this parameter w_g equal to 0.6. It is shown how such a policy enables the economy to provide the involuntary unemployed with generous unemployment compensation while keeping the total unemployment rate at a relatively low level. As a consequence, the drop in GNP associated with a given γ becomes much smaller even though there is hardly any improvement in the inefficiently low search intensity of involuntary unemployed (not shown in the figures).

8. Concluding Discussion

Our paper explores the role of incentives in explaining the different unemployment experiences of European welfare states. In particular, we focus on the incentive effects of progressive income taxation and liberal unemployment insurance. While unemployment insurance tends to increase the unemployment rate, high and progressive income taxes are shown to have the opposite effect when "locking in" labor at their current employment. The reason is that high marginal taxes reduce the private rewards from searching for better employment opportunities. The reluctance to quit a job is further compounded by the fact that quitters are not entitled to unemployment compensation. This lower labor mobility then tends to reduce unemployment as long as job searches are associated with frictional unemployment. Any such reduction in the unemployment rate is brought about at the cost of a less efficient labor allocation. While earlier studies of the welfare effects of income taxation have generally focused on the labor-leisure tradeoff, our analysis brings out its effects on the allocation of labor across jobs.

When the generosity of unemployment insurance increases, the upward pressure on the unemployment rate must eventually dominate any reduction in labor mobility due to high marginal income taxes. The higher unemployment rate is caused by unemployed workers with unemployment compensation who find it optimal to reduce their search intensity and increase their reservation wage. Higher unemployment puts stress on government finances by both increasing expenditures on unemployment compensation and reducing the tax base which necessitates an increase in tax rates. This forms a vicious cycle which is conspicuously present in the simulations of our model. Higher unemployment pushes taxes upward which in turn increases the unemployment rate further, and so on.

A possible remedy to the adverse effects of unemployment compensation is to replace the distorted market incentives with government controls. Countries differ a lot in their attempts to influence the labor market behavior of unemployed. For example, besides the quote in the introduction, it is widely recognized that a country like Sweden has exerted considerable control over the unemployed (OECD [1991, 1992]). This is captured in our analysis by the parameter w_g, i.e., a government stipulated "suitable" wage offer that disqualifies a worker for unemployment compensation. It is then shown how our equilibrium search model provides one possible explanation for why a welfare state such as Sweden has experienced a remarkably low rate of unemployment despite generous unemployment insurance. The Swedish rate of unemployment may even have fallen below any laissez-faire "natural" rate of unemployment due to lower labor mobility caused by highly progressive income taxation.

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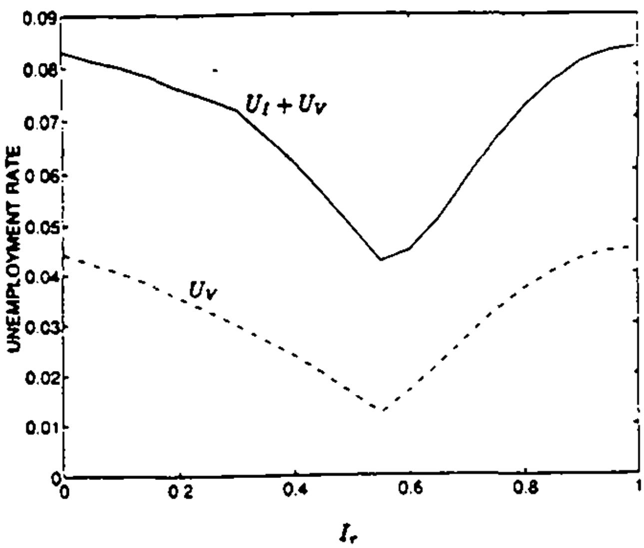

Figure 1. Unemployment rates as functions of I_r. The solid line is total unemployment, $U_I + U_V$; the dashed line is voluntary unemployment, U_V. (γ is set equal to 0.3.)

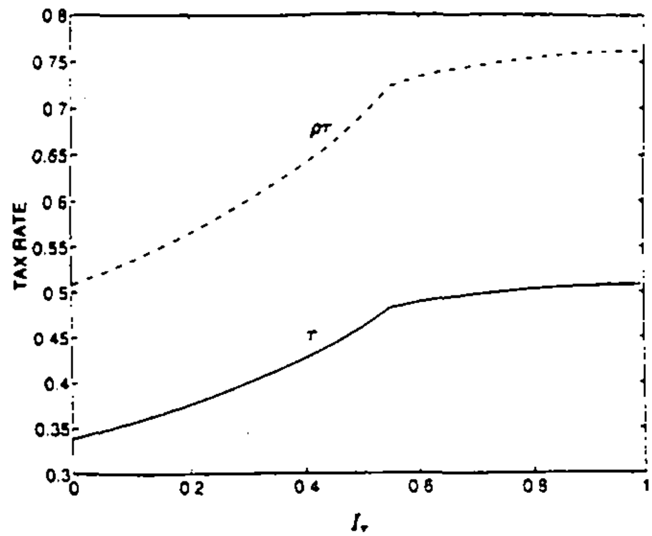

Figure 2. Tax rates as functions of I_r. The solid line is the base tax rate, τ; the dashed line is the top-bracket tax rate, $\rho\tau$. The base tax rate is chosen to balance the government's budget. (γ is set equal to 0.3.)

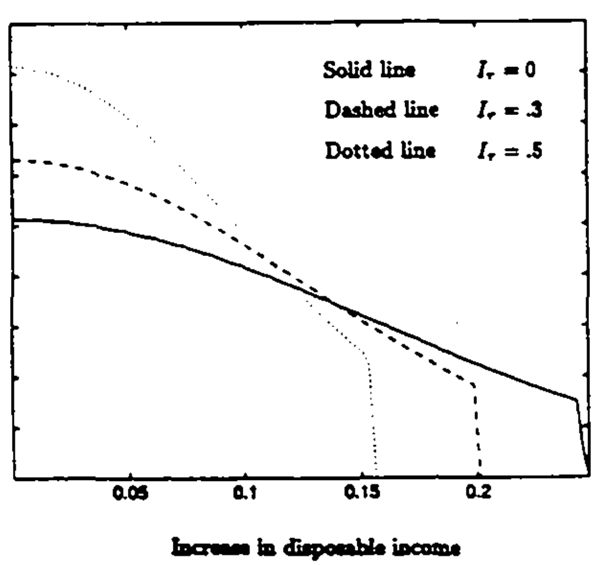

Figure 3. Probability density functions for potential increases in disposable income from further job search, given a current wage offer of 0.5. That is, each distribution represents the right-hand tail of the underlying wage offer distribution, $F(w)$, net of taxes. (γ is set equal to 0.3.)

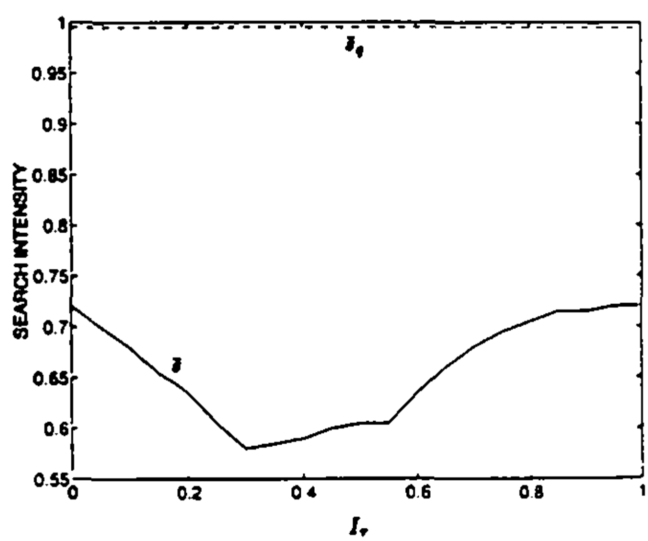

Figure 4. Search intensities as functions of I_r. The solid line is the search intensity of involuntary unemployed, $\bar{s}$; the dashed line is the search intensity of voluntary unemployed, $\bar{s}_q$. (γ is set equal to 0.3.)

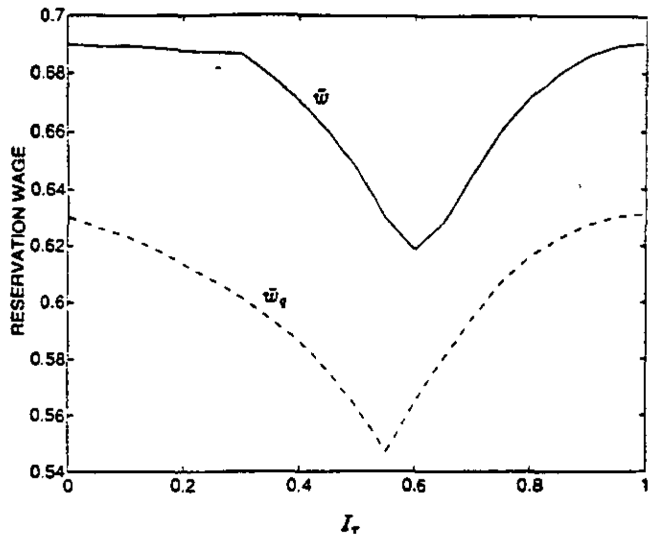

Figure 5. Reservation wages as functions of I_τ. The solid line is the reservation wage of involuntary unemployed, $\bar{w}$; the dashed line is the reservation wage of voluntary unemployed, $\bar{w}_q$. (γ is set equal to 0.3.)

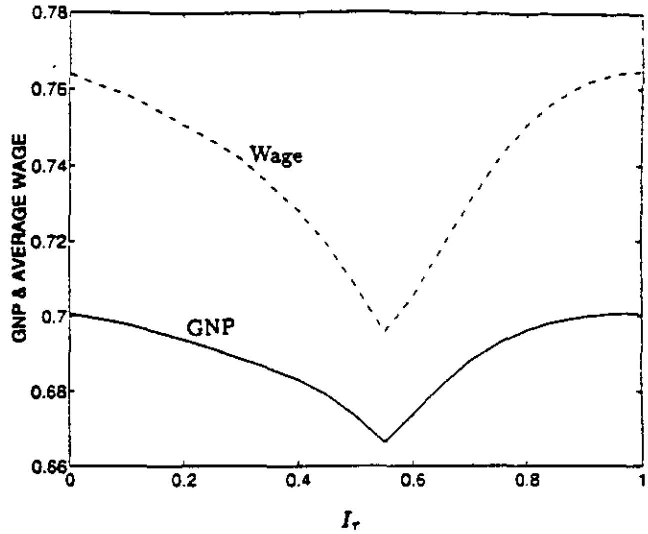

Figure 6. GNP and the economy-wide average wage as functions of I_τ. GNP is the solid line. (γ is set equal to 0.3.)

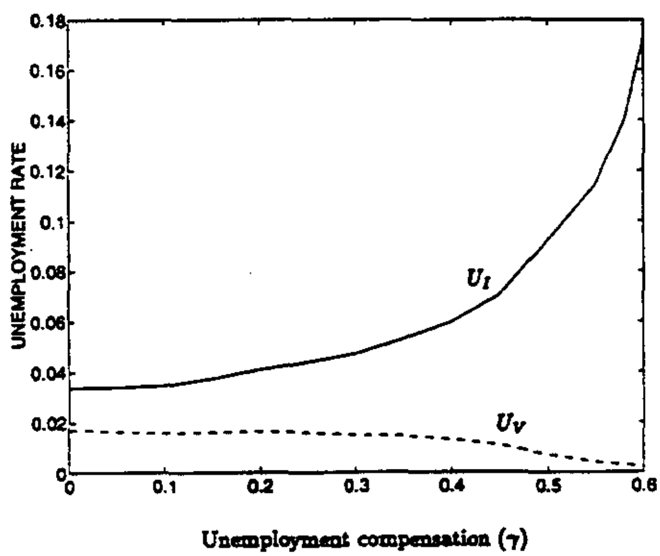

Figure 7. Unemployment rates as functions of γ. The solid line is involuntary unemployment, U_I; the dashed line is voluntary unemployment, U_V. (I_τ is set equal to 0.5.)

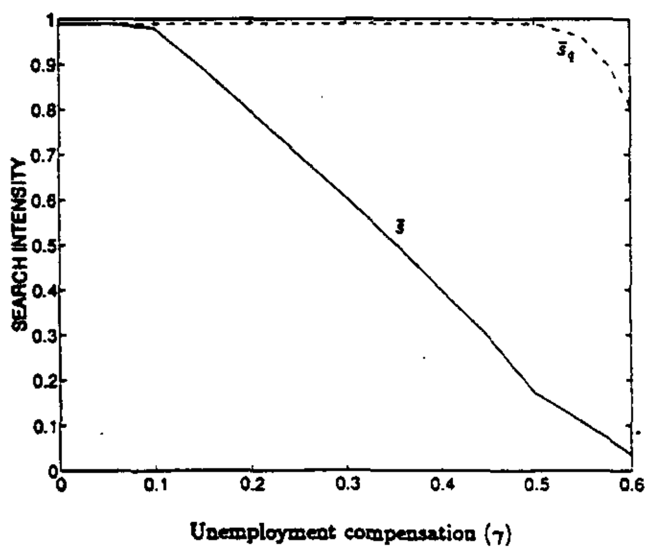

Figure 8. Search intensities as functions of γ. The solid line is the search intensity of involuntary unemployed, $\bar{s}$; the dashed line is the search intensity of voluntary unemployed, $\bar{s}_q$. (I_τ is set equal to 0.5.)

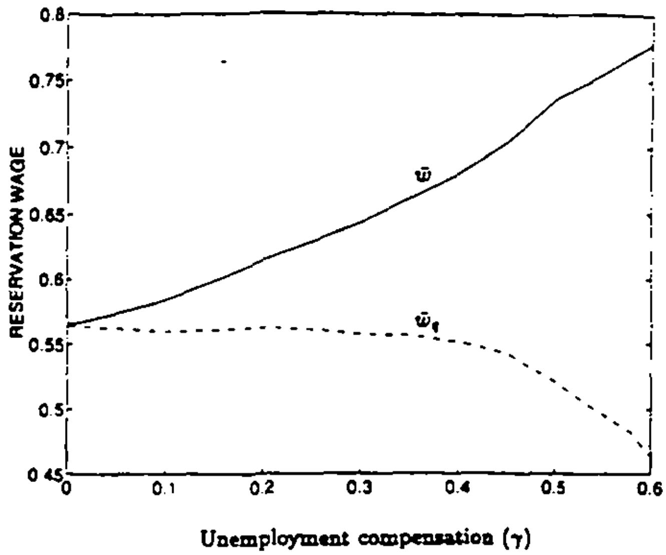

Figure 9. Reservation wages as functions of γ. The solid line is the reservation wage of involuntary unemployed, $\bar{w}$; the dashed line is the reservation wage of voluntary unemployed, $\bar{w}_q$. (I_r is set equal to 0.5.)

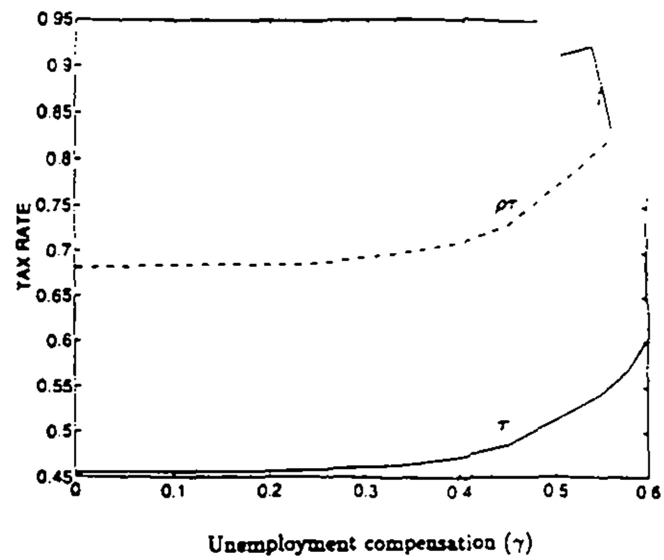

Figure 10. Tax rates as functions of γ. The solid line is the base tax rate, τ; the dashed line is the top-bracket tax rate, $\rho\tau$. The base tax rate is chosen to balance the government's budget. (I_r is set equal to 0.5.)

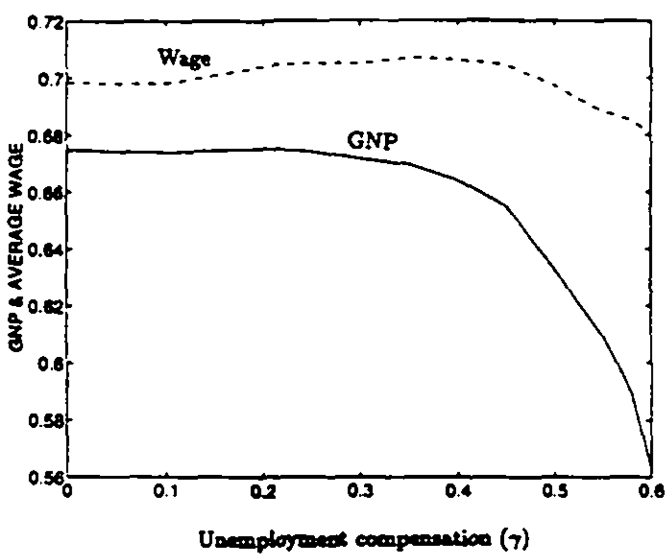

Figure 11. GNP and the economy-wide average wage as functions of γ. GNP is the solid line. (I_r is set equal to 0.5.)

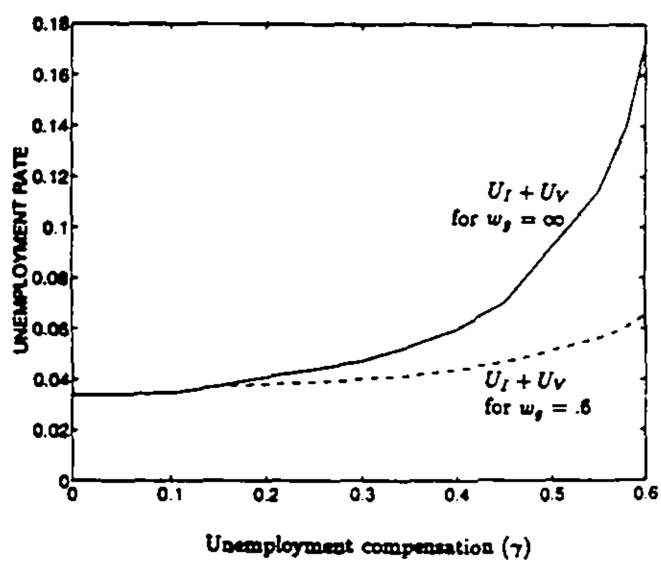

Figure 12. Total unemployment rates, $U_I + U_V$, as functions of γ. The solid line is unemployment without any government control over unemployed, i.e., $w_g = \infty$; the dashed line is unemployment for $w_g = 0.6$. (I_r is set equal to 0.5.)