Optimal Monitoring and Sanction Systems

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Abstract

Many countries rely on monitoring of unemployment insurance and welfare recipients and impose benefit sanctions in case of noncompliance with job search requirements to encourage job search and to prevent abuse of the social insurance system. However, so far only little is known about the optimal design of monitoring and sanction systems. In a model with worker heterogeneity and endogenous policy choice for each period in the unemployment spell I analyze the optimal size of a benefit sanction and the optimal monitoring intensity as a function of worker characteristics, unemployment duration, monitoring costs and labor market conditions. I find that, in contrast to what most of the literature assumes when modeling monitoring and sanctions, the optimal sanction is in the majority of cases a temporary cut in benefits to zero. Moreover, the optimal monitoring intensity increases as reemployment wages and the exit rate to employment deteriorate during unemployment.

Keywords: Optimal unemployment insurance, monitoring and sanctions

JEL classification: J24, J65, J68

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1 Introduction

Many industrialized OECD countries facing increasing expenditures on unemployment insurance and/or welfare payments have reacted by imposing stricter job search requirements, tightening monitoring and more extensive use of benefit sanctions in order to encourage job search and to prevent abuse of the social insurance system. Benefit sanctions are imposed in case of noncompliance with benefit conditions such as job search requirements. They are usually temporary cuts in benefits that may become permanent or may lead to full suspension of benefits in case of repeated noncompliance. See e.g. OECD (2001).

The empirical literature makes a rather strong case for the ability of these measures to increase the exit rate from unemployment to employment by restoring search incentives and by boosting individual job search effort.[1] Experimental evidence for the U.S. reported by Johnson and Klepinger (1994), Benus et al. (1997) and Klepinger et al. (2002) shows that more stringent search requirements significantly reduce the length of benefit receipt. Dolton and O'Neill (1996) find in the RESTART experiments for the U.K. that exit rates from unemployment to employment were increased significantly and considerably when specific benefit conditions like attending interviews with caseworkers where imposed together with the threat of imposing a sanction in case of noncompliance. Boone et al. (2004) show in a laboratory experiment that the positive effect of benefit sanctions on the exit rate from unemployment happens through two channels: the risk of being sanctioned (the ex-ante effect), and the effect of actually imposing a sanction (the ex-post effect). They find that the ex-ante effect is substantial and dominates the ex-post effect. The importance of the ex-ante effect is confirmed in a non-experimental study by Lalive et al. (2005) for Switzerland. They, as well as van den Berg et al. (2004) and Abbring et al. (2005) for the Netherlands, and Müller and Steiner (2008) for Germany also provide rather strong non-experimental evidence for the existence of a positive ex-post effect of benefit sanctions.

[1] There are only two experimental studies that do not find positive effects. In a study for the U.S. Ashenfelter et al. (2005) find only negligible effects of job search verification on benefit payments. However, the intervention was rather small and only very short-term so that it is difficult to infer something about the effects of more intense monitoring. For the Netherlands van den Berg and van der Klaauw (2006) find no effects of counseling and monitoring on the exit rate from unemployment. Being able to distinguish formal from informal search channels they argue that monitoring of formal search rather induced a substitution away from informal search channels. Using non-experimental data no significant effects are also obtained by Keeley and Robins (1985) for the U.S. and by Schneider (2008) for Germany. However, in these studies there are some doubts about the causal nature of the estimated effects. See also the surveys by Meyer (1995) and Fredriksson and Holmlund (2006*a*). A related paper is also van der Linden and Dor (2001) who analyze the effect of a mixture of exhaustion of UI benefits and a permanent reduction in benefits due to noncompliance with benefit conditions.

The majority of the theoretical literature addressing these issues takes the following view on monitoring and sanctions (Abbring et al., 2005; Boone and van Ours, 2006; Fredriksson and Holmlund, 2006*b*; van der Linden, 2006; Boone et al., 2007). The fundamental problem is that the job search effort of an unemployed worker is unobserved by the insurer (or caseworker). By monitoring the worker it is possible to verify search effort at least to some extend. Sanctions, which are modeled as permanent reductions in benefits (but not full suspensions of benefits), are used to encourage higher search effort than individually optimal in the absence of monitoring and sanctions by punishing workers whose perceived search effort is deemed too low. The probability of being sanctioned depends positively on the probability of being monitored and negatively on job search effort. There is a positive probability of both type I errors (shirkers not being sanctioned) and type II errors (non-shirkers being sanctioned). With the exception of van der Linden (2006) there is no individual heterogeneity in the returns to search (e.g. in wages).[2]

Abbring et al. (2005), Boone and van Ours (2006), van der Linden (2006) and van den Berg and van der Klaauw (2006) take a positive perspective and study the effects of monitoring and sanctions on the workers' job search behavior. They show that monitoring and sanctions increase the exit rate from unemployment to employment.[3] On the other hand, Fredriksson and Holmlund (2006*b*), van der Linden (2006), and Boone et al. (2007) take a more normative perspective and compare social welfare under a monitoring and sanction system, under a uniform benefit system and under a two-tiered system with time-limits for high benefits. They find that the two-tiered system dominates the uniform system but is itself dominated by the monitoring and sanction system. Moreover, Boone et al. (2007) show that it is optimal to (i) use benefit sanctions i.e. to actually cut benefits and (ii) to make the imposition of sanctions dependent on job search effort. In addition, they use a simulation exercise to make statements about the optimal size of the sanction, the optimal monitoring intensity and an upper bound on the monitoring cost.

Besides largely neglecting worker heterogeneity and only considering permanent cuts in benefits, one drawback of the studies discussed so far is that they do not allow for switches between monitored and unmonitored search during unemployment. Pavoni and Violante (2007) and Wunsch (2007) study the optimal policy that chooses endogenously between different policy instruments, including

[2] In Ljungqvist and Sargent (1995) sanctions are used to punish refusal of suitable wage offers. In Boadway and Cuff (1999) monitoring and sanctions are used to distinguish voluntary from involuntary unemployment of the low-skilled, and both job search and acceptance of job offers are monitored.

[3] The paper by van den Berg and van der Klaauw (2006) distinguishes formal and informal search channels and shows that in such a model this effect only exists for formal search channels.

monitored and unmonitored search, for each period during the unemployment spell. They show that (i) the optimality of monitoring depends on worker characteristics, and that (ii) switches between unmonitored and monitored search during unemployment are optimal if the returns to search change during unemployment, for example because of human capital depreciation. However, Pavoni and Violante (2007) and Wunsch (2007) only consider perfect monitoring where job search effort is fully verified against payment of a monitoring cost. Consequently, there is no role for sanctions because the information asymmetry is removed in this case.

My paper also takes a normative perspective and considers endogenous policy choice over time as in Pavoni and Violante (2007) and Wunsch (2007), but allows for imperfect monitoring and sanctions. Monitoring is imperfect because only a signal of the true search effort is observed where the probability of the signal indicating high effort depends positively on search effort. Following the existing literature, a benefit cut is imposed when the signal indicates low search effort. In the model, worker heterogeneity is allowed for in a very general way and it affects both reemployment wages and the exit rates from unemployment to employment.

I use large and very informative administrative data for West Germany to parameterize the model. The objective is to derive more detailed insights into the characteristics of optimal monitoring and sanction systems on the basis of a simulation that is more than purely illustrative. To achieve this I estimate most parameters of the model from the data rather than just plugging in reasonable values. Moreover, I take into account that parameters might change if the optimal policy is implemented. In particular, the exit rates to employment are likely to change because search effort changes. To predict the exit rates that would prevail under the optimal rather than the actual policy an iteration procedure is used. Taking the estimated coefficients for the characteristics of the actual policy as given, the actual values are replaced by the optimal ones derived from the model given the actual ones. Then the optimal policy given these new values is derived. This process is repeated until the optimal policy derived no longer changes. Finally, for those parameters that cannot be estimated from the data, like the preference parameters, common choices are used but they are subjected to a thorough sensitivity analysis.

The simulation is used to characterize optimal monitoring and sanction systems as a function of worker characteristics, monitoring costs, unemployment duration and labor market conditions by looking at different scenarios. The baseline scenario is the one resembling the West German economy in the period 2001 with respect to the distribution of worker characteristics and labor market conditions as obtained from the data. First, I analyze how the optimal policy depends on job-relevant worker characteristics. Second, I study the implications of different monitoring costs: a linear, a weakly convex and a strongly convex cost function. Third, I analyze the optimal policy given current (2009) labor market conditions in West Germany. Finally, I investigate how the optimal policy would change for an economy like the U.S. with larger wage dispersion, more favorable labor market conditions because of more flexible labor markets, and higher monitoring costs because of strict anti-discrimination rules.

The remainder of the paper is organized as follows. Section 2 contains the details of the model and the theoretical results that can be derived from the model with respect to the optimal policy. Section 3 describes the details and results of the simulation including the sensitivity analysis. Section 4 concludes. An appendix provides further details on the data, the estimation and the simulation.

2 The model

2.1 The setup

The analysis is based on an adapted version of the framework developed by Pavoni and Violante (2007) and extended by Wunsch (2007) that is characterized as follows. A planner (the principal), e.g. the representative of the unemployment insurance (UI) or the welfare system, faces an unemployed worker (the agent) who is risk-averse and whose job search effort is unobservable to the planner. The objective of the planner is to design a contract which insures the worker against failure of job search by providing some income in case of unemployment and which, at the same time, ensures an appropriate level of search effort from the worker.

At the beginning of unemployment at time $t = 0$ the planner offers the unemployed worker a contract that maximizes expected discounted net fiscal revenue of the insurer (or equivalently minimizes expected discounted net expenditures) subject to providing the agent with at least an expected discounted utility level of $U_0 > 0$. From a policy perspective this is the more relevant case than the dual problem of utilitarian expected welfare maximization subject to a budget constraint. Moreover, it allows writing the optimal contract in a convenient recursive form (see Spear and Srivastava, 1987). The promised utility U_0 is exogenously given, e.g. the outcome of voting, and can be regarded as a measure of the generosity of the UI or the welfare system. Its level may depend on worker characteristics. Net fiscal revenue is tax revenue if the worker is employed, and expenditures on benefit payments and monitoring if the worker is unemployed.

Workers are infinitely lived and maximize expected discounted lifetime utility. They have time-separable preferences over consumption $c \geq 0$ and disutility a from either work or job search effort. Agents discount the future at rate $\beta \in (0, 1)$, and period utility is given by $u(c_t) - a_t$ with $u(0) = 0$, $u'(c_t) > 0$, $u''(c_t) < 0$. It will be useful to assume that the first derivative of u^{-1} is convex which is satisfied by a large range of utility functions.[4] Effort is assumed to be e^w during work and either high ($a = e > 0$) or low ($a = 0$) during job search.[5] The latter underlines the role of fixed costs and the extensive margin of participation decisions.[6] When employed, workers earn a wage $w(x)$ which depends on their characteristics x. When unemployed, worker exit to employment with probability $\pi(x, a)$ which also depends on their characteristics x as well as on job search effort a. It is assumed that $\pi(x, 0) \equiv 0$ and that $\pi(x, e) \equiv \pi(x) \in (0, 1)$. Worker characteristics are allowed to change during unemployment, for example to accommodate negative duration dependence in wages and the exit rate to employment as has been shown in various empirical studies (see e.g. Pissarides, 1992; Blanchard and Diamond, 1994; Acemoglu, 1995; Machin and Manning, 1999).

The planner can observe the worker's employment status and the outcome $y \in \{s, f\}$ of the worker's job search activity, where s denotes success and f failure. But the planner cannot observe the worker's effort choice a, so that he faces a moral hazard problem. The planner can, however, use a monitoring technology that allows him to observe a signal about the worker's search effort. Monitoring is costly where the cost $\kappa(\mu)$ depends on the monitoring intensity $\mu \in [0, 1]$ with $\kappa' > 0$ and $\kappa'' \geq 0$. The probability of observing a signal that indicates high effort depends positively on the worker's job search effort: $\gamma(a) \in [0, 1]$ where $\gamma' > 0$. In the following, I will denote $\gamma(e) \equiv \gamma_e > \gamma(0) \equiv \gamma_0$.

For simplification it is assumed that workers do not have access to storage, insurance or credit markets. In particular, it is assumed that workers cannot self-insure against the random outcome $y \in \{s, f\}$ of their search or training activity, e.g. by saving. Pavoni and Violante (2005) show in

[4] This assumtpion is satisfied for the whole CARA class and for the CRRA class with the coefficient of relative risk aversion greater than one half.

[5] The disutility of effort during employment is generally not restricted to be the same as during unemployment, but it must be ensured that accepting a job offer always dominates staying unemployed.

[6] Moreover, this considerably simplifies the analysis. Since the planner chooses endogenously among policy instruments during the unemployment spell and since there is negative duration dependence the model is not stationary. Consequently, the first-order conditions for continuous search effort would have a very complex form. Note, however, that two levels of search effort are sufficient here to illustrate the main points. In particular note that under the optimal policy scheme, the planner will always implement his preferred level of the worker's search effort.

their baseline model that when workers can save through credit markets but still face a no-borrowing constraint, which is a reasonable assumption for unemployed workers, the same optimal contract can be implemented by introducing a linear, time-invariant interest tax.

2.2 The planner's problem

The objective of the planner is to design an insurance contract for the unemployed worker that implements a job search requirement that corresponds to the effort level e and that delivers the worker expected utility of U. The former is ensured by obeying an incentive compatibility (IC) constraint, and the latter by obeying a promise-keeping (PK) constraint. The planner endogenously chooses the benefit level c and the continuation utilities U^s and U^f in case of, respectively, success or failure of job search. The planner may choose to monitor the worker with probability $\mu \in [0,1]$ which delivers a signal of effort e with probability γ_e. If the signal does not indicate high effort, the planner imposes a benefit sanction of size $\sigma \in [0,1]$ which reduces the benefit c to $(1-\sigma)c$ where $\sigma = 1$ corresponds to full suspension of benefits. The optimization problem of the planner is formulated in the recursive form used by Pavoni and Violante (2007) and Wunsch (2007) which is based on Spear and Srivastava (1987). For a given monitoring intensity μ and benefit sanction σ the optimization problem under a monitoring and sanction system (MS) is given by

$$
\begin{aligned}
V^{MS}(U,x) &= \max_{c,U^f,U^s} -c - \kappa(\mu) + \beta\big[\pi(x)W(U^s,x^f) + \big(1-\pi(x)\big)V(U^f,x^f)\big] \qquad (1)\\
s.t. \quad U &= (1-\mu)u(c) + \mu[\gamma_e u(c) + (1-\gamma_e)u\big((1-\sigma)c\big)] - e + \beta\big[\pi(x)U^s + \big(1-\pi(x)\big)U^f\big]\\
U &\geq (1-\mu)u(c) + \mu[\gamma_0 u(c) + (1-\gamma_0)u\big((1-\sigma)c\big)] + \beta U^f.
\end{aligned}
$$

The planner pays benefits c and monitoring costs $\kappa(\mu)$. With probability $\pi(x)$ the worker finds a job in which case the planner's optimization problem is given by

$$
\begin{aligned}
W(U,x) &= \max_{c,U^e} \; w(x) - c + \beta W(U^e,x) \qquad (2)\\
s.t. \quad U &= u(c) - e^w + \beta U^e,
\end{aligned}
$$

and with probability $1-\pi(x)$ the worker remains unemployed facing promised utility U^f and potentially changed characteristics x^f. The value of continued unemployment $V(U^f,x^f)$ is the one associated with the policy instrument that is optimal given (U^f,x^f). The value of employment is determined by the wage tax or subsidy $w(x) - c$ that can be imposed on employed workers. To focus on the current unemployment experience employment is assumed to be absorbing.[7] Because of the absence of the information asymmetry in case of employment it is easy to show that the optimal solution is to set $U = U^e$ and to keep consumption constant. Applying Pavoni and Violante (2007) it can be shown that both V and W are concave in U.

Shirking is prevented by obeying the IC constraint (third line of (1)). Shirkers remain unemployed for sure and are sanctioned with probability $\mu(1 - \gamma_0)$ implying a probability of type I error of $1 - \mu(1 - \gamma_0)$. From the PK constraint (second line of (1)) it can be seen that non-shirkers are sanctioned with probability $\mu(1 - \gamma_e)$ which is therefore the probability of type II error. Note that if the signal is perfect, i.e. $\gamma_e = 1$, then this probability is zero and the sanction is never actually imposed in the optimal policy that implements e. Finally note that (1) nests what Pavoni and Violante (2007) and Wunsch (2007) label unmonitored search or unemployment insurance by setting $\mu = 0$ as well as perfect monitoring by setting $\mu = 1$, $\gamma_e = 1$ and $\gamma_e = 0$.[8]

Because wages and the exit rate to employment may deteriorate with increasing unemployment duration because of changes in worker characteristics x, it may become too costly for the planner to incentivize the worker to provide positive search effort. In this case he would release the worker from the search requirement and just pay benefits that ensure promised utility U. This policy will be called social assistance (SA)in the following and is characterized as follows

$$\begin{aligned} V^{SA}(U, x) \quad &= \quad \max_{c, U^f} \ -c + \beta V(U^f, x^f) \\ s.t. \quad & U = u(c) + \beta U^f. \end{aligned} \tag{3}$$

It is easy to show that because of the absence of the IC constraint the optimal transfer is constant. Moreover, Pavoni and Violante (2007) and Wunsch (2007) show that SA is an absorbing policy. Consequently, the optimal transfer is given by $c^{SA}(U) = u^{-1}\big((1 - \beta)U\big)$.

In contrast to part of the existing literature on monitoring and sanctions (Boone and van Ours, 2006; van der Linden, 2006; Boone et al., 2007), the model abstracts from general equilibrium con-

[7] Qualitative results for the same unemployment spell do not change as long as the job separation rate is exogenous. Optimal contracts with endogenous job separation are studied by Zhao (2000) and Hopenhayn and Nicolini (2005) who show that in this case the optimal contract has to take into account the worker's full employment history.

[8] Setty (2009) implements the sanction in terms of randomized continuation utilities in case of failure of job search rather than the benefits directly. Intuitively, because of the concavity of V in U, the additional randomization in the planner's objective function should make such a policy ceteris paribus more costly than sanctions implemented directly on current benefits.

siderations. Because of worker heterogeneity and the non-stationary nature of the model following from potential negative duration dependence and endogenous policy choice both for a given period and over time the model is already very complex. Further endogenizing wages and job finding probabilities would reduce the tractability of the model considerably, and it would imply a huge additional computational burden for the simulation. subsectionOptimal size of the sanction The optimal size of the sanction σ can be characterized by looking at the derivative of (1) with respect to σ:

$$\frac{dV}{d\sigma} = [(1-\gamma_0)\lambda_{IC} - (1-\gamma_e)\lambda_{PK}]\mu c u'\big((1-\sigma)c\big), \tag{4}$$

where $\lambda_{IC} \geq 0$ and $\lambda_{PK} \geq 0$ are the multipliers associated with the IC and the PK constraint, respectively. Moreover, the first-order conditions for (1) imply that $(1-\gamma_0)\lambda_{IC} - (1-\gamma_e)\lambda_{PK} = (1-\gamma_0)V_U(U,x) - (\gamma_e - \gamma_0)W_U(U^s, x^f)$. The marginal benefit of increasing the sanction is a relaxation of the IC constraint at the marginal cost of tightening the PK constraint. It is obvious that if the IC constraint is not binding ($\lambda_{IC} = 0$) the optimal sanction is zero.

The marginal benefit is decreasing in γ_0 and the marginal cost decreasing in γ_e. If the signals are perfect, i.e. $\gamma_e = 1$ and $\gamma_0 = 0$, then $\frac{dV}{d\sigma} > 0$ for all $\sigma \in [0,1]$ if $\lambda_{IC} > 0$ nd $\mu > 0$, which are the only relevant cases, and $c > 0$, which is always the case if $U > 0$. Consequently, the optimal sanction is full suspension of benefits for the current period, i.e. $\sigma^* = 1$, because the marginal cost of increasing the sanction is zero. Note that in this case monitoring is still imperfect as long as $\mu < 1$ because search effort can only be verified with probability $\mu < 1$. With perfect signals and $\sigma^* = 1$ the planner's optimization problem simplifies considerably. The PK constraint reduces to $U = u(c) - e + \beta\big[\pi(x)U^s + \big(1-\pi(x)\big)U^f\big]$ and the IC constraint to $U \geq (1-\mu)u(c) + \beta U^f$. The sanction is never actually imposed in the optimal policy because the IC constraint ensures that the worker complies with high effort and the probability of type II errors is zero. Sanctions are imposed in case of noncompliance with probability μ and are used in the IC constraint to implement high effort in the optimum.

The optimal size of the sanction are characterized in more detail as a function of the generosity of the system, U, worker characteristics x and unemployment duration in the results section.

2.3 Optimal monitoring intensity

Analogously to the sanction σ, the optimal monitoring intensity μ can be characterized by looking at the derivative of (1) with respect to μ:

$$\frac{dV}{d\mu} = -\kappa'(\mu) + [(1-\gamma_0)\lambda_{IC} - (1-\gamma_e)\lambda_{PK}][u(c) - u\big((1-\sigma)c\big)]. \tag{5}$$

As for the sanction, the marginal benefit of increasing monitoring is a relaxation of the IC constraint which is decreasing in γ_0, at the marginal cost of tightening the PK constraint which is decreasing in γ_e. However, there is also an additional direct marginal cost of monitoring $\kappa'(\mu)$. Obviously, if the IC constraint is not binding ($\lambda_{IC} = 0$) the optimal monitoring intensity is zero.

It is again interesting to consider the case with imperfect monitoring but perfect signals ($\gamma_e = 1$, $\gamma_0 = 0$) for which it has been shown that the optimal sanction is $\sigma = 1$. In this case (5) simplifies to $\frac{dV}{d\mu} = -\kappa'(\mu) + \lambda_{IC}u(c)$ and it can be shown that at an interior solution for the optimal monitoring intensity, $\mu^* \in (0,1)$, μ^* is increasing in promised utility U. Using the optimality of c, U^f, U^s, W and V, implicit differentiation yields

$$\left.\frac{d\mu^*}{dU}\right|_{\mu^*\in(0,1)} = [\kappa''(\mu^*)]^{-1}\left[\lambda_{IC}u'(c)\frac{dc}{dU} + \big(V_{UU}(U,x) - W_{UU}(U^s,x^f)\big)u(c)\right] \geq 0. \tag{6}$$

The sign follows on the one hand from $\lambda_{IC} \geq 0$, the convexity of the monitoring cost and the concavity of the utility function. Moreover, it is easy to show that $\frac{dc}{dU} > 0$. To show that $V_{UU}(U,x) - W_{UU}(U^s,x^f) \geq 0$ note the following: The first-order conditions for (1) imply that $V_{UU}(U,x) - W_{UU}(U^s,x^f) = \big(1-\pi(x)\big)[V_{UU}(U^f,x^f) - W_{UU}(U^s,x^f)] = \big(1-\pi(x)\big)[V_{UU}(U^f,x^f) - V_{UU}(U^s,x^f)]$. The sign then follows from the assumption that the derivative of u^{-1} is convex.

More results for the evolution of the optimal monitoring intensity with U, worker characteristics x and unemployment duration are presented in the results section.

3 Simulation

The objective of the simulation is to characterize optimal monitoring and sanction systems as a function of worker characteristics, monitoring costs, unemployment duration, and labor market conditions by looking at different scenarios. The baseline scenario is the one resembling the West

German economy in the period 2001 with respect to the distribution of worker characteristics and labor market conditions as obtained from the data. West Germany is an interesting case to study because it is comparable to most industrialized OECD countries. Moreover, in the course of substantial reforms of the German unemployment insurance and welfare system, considerable emphasis has been put on search requirements, monitoring and sanctions.

Departing from the baseline scenario I look at the following cases. First, I analyze how the optimal policy depends on job-relevant worker characteristics like education. Second, I study the implications of different monitoring costs: a linear, a weakly convex and a strongly convex cost function. Third, I analyze the optimal policy given current (2009) labor market conditions in West Germany. Finally, I investigate how the optimal policy would change for an economy like the U.S. with larger wage dispersion, more favorable labor market conditions because of more flexible labor markets, and higher monitoring costs because of strict anti-discrimination rules.

3.1 Data and population of interest

With the exception of the preference parameters and the monitoring cost, all parameters of the model are estimated using an administrative database, which has been built up by the German Institute for Employment Research. The database is a 2% random sample from all individuals who have been subject to German social insurance at least once since 1990. It covers the period 1990-2007 and combines spell information from social insurance records, program participation records and the benefit payment and jobseeker registers of the PES. It provides detailed information on employment status (employed, registered unemployed with or without program participation) on a daily basis for the period 1990-2007.

The database comprises very detailed information in several dimensions. Personal characteristics include education, age, gender, marital status, number of children, profession, nationality and health. The benefit payment register provides information on type and amount of benefits received, remaining benefit claims and imposition of sanctions. The jobseeker register includes information on the desired form of employment. The social insurance records comprise information on employments including form of employment, industry, occupational status and wages. Detailed regional information, which include federal state, local unemployment rate, migration, demographic and industry structure, infrastructure and urbanity, complement the database.

For the simulation, the model is parameterized to resemble the population of West German workers who entered unemployment from regular full-time employment in 2001 and who received benefits from the unemployment insurance system. Moreover, to focus on the prime-age part of the population and to avoid issues of tertiary education and early retirement the sample is restricted to individuals of age 20-55. To estimate the parameters of the model, a corresponding sample is drawn from the database described above. This sample is called the reference population of interest in the following and it consists of 18,479 individuals.

3.2 Unemployment insurance in West Germany in 2001

Before discussing how the model is parameterized, the West German policy scheme that was in place 2001 is briefly described. In Germany, unemployment insurance is mandatory. In 2001, employees who had contributed for at least 12 months within the 3 years preceding unemployment were eligible for unemployment benefits (UB) if they registered with the public employment service (PES). The minimum UB entitlement was 6 months and the maximum claim increased stepwise with total contribution time in the 7 years before becoming unemployed, and age, up to a maximum of 32 months at age 54 or above with previous contributions of at least 64 months. Since 1994, the replacement rate was 67% (60%) of previous average net earnings from insured employment with (without) dependent children.

After exhaustion of UB unemployed could become eligible for unemployment assistance (UA). In contrast to UB, UA was means-tested and potentially indefinite. However, like UB, UA was proportional to previous earnings but with lower replacement rates than UB (57% and 53% with and without dependent children, respectively). Unemployed who were ineligible for UB and UA could receive social assistance, which was a fixed monthly payment unrelated to previous earnings, means-tested and administered by local authorities.

Actual payment of benefits was conditional on availability to the labor market, willingness to take up any job, active job search, regular show-up at the PES and participation in labor market programs. In case of noncompliance with benefit conditions, sanctions, i.e. reductions in or suspensions of benefits, could be imposed. However, due to severe capacity constraints within the PES monitoring was only very weak in the period under consideration and sanctions were imposed only in rare cases (sanction rate below 2%).

3.3 Parameterizing the model

In the simulation, time units are defined by months and the model is simulated for 48 months of unemployment. The level of initial utility $U_0(x)$ that is promised to a worker with characteristics x is chosen to resemble the one implied by the actual policy scheme that was in place in 2001. It is obtained by plugging into the model the parameter values of the actual policy (benefit levels, sequence of policy instruments, etc.) obtained from the data and solving backwards for $U_0(x)$.

Preferences are parametrized as follows. The monthly discount factor β is chosen to match an interest rate of 4% per annum, which prevailed in the EURO area in the period of interest. Period utility over consumption is assumed to be of the constant-elasticity-of-substitution type, i.e. $u(c) = \frac{c^{(1-\alpha)}}{1-\alpha}$. This utility function satisfies all assumptions made in Section 2.1. In the baseline specification α is set to 0.6 but specifications with different inter-temporal elasticities of substitution are tested as well. To parameterize the disutility of effort e, an approach that originates from common practice in calibrating macroeconomic models is used. Let the disutility of time n spent working be logarithmic as well, and denote by ϕ the relative weight on leisure versus consumption. Assuming a standard Cobb-Douglas production function, the static optimality condition of the worker yields a value of $\phi = 2.35$ given a labor share of 0.73 (BMAS, 2003), a consumption-income ratio of 0.72 (Statistisches Bundesamt, 2000-2002) and a fraction of time spent working of $n = 0.3$. This implies a value for the disutility of work effort of $e = \phi[\ln(1) - \ln(1 - n)] = 0.84$ (Chari et al., 1995). For the baseline case it is assumed that the disutility of effort during unemployment equals the one during work. Yet, as a sensitivity check, the case where only half of the time spent on work is spent on search and program participation is considered as well.

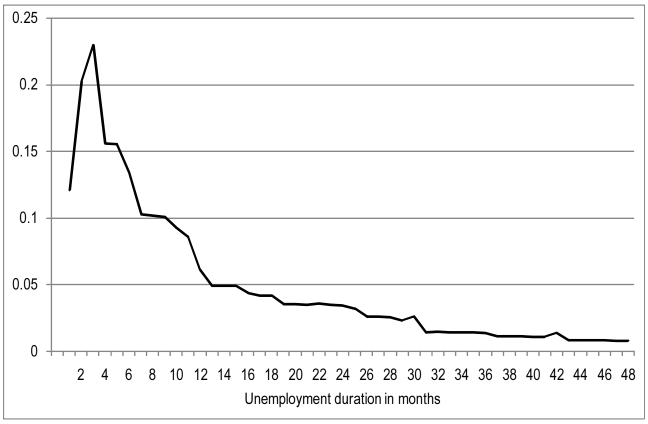
The exit rates from unemployment to employment are estimated using a logistic discrete-time hazard rate model with fully nonparametric specification of the baseline hazard that captures potential duration dependence. The estimation is based on 211,791 observations. Individuals are followed from entering unemployment in 2001 until the end of 2004, thus covering up to 48 months.[9] Dummies indicating the calendar month are included to capture seasonality effects. The explanatory variables further include the features of the actual policy like type, amount and duration of benefits that affect job search effort, as well as various indicators of local labor market conditions. The final set of variables captures other sources of heterogeneity like gender, age, health, marital status,

[9] This is done to avoid picking up the major structural break implied by one of the largest reforms of the German unemployment insurance that became effective in January 2005.

presence and age of children as well as a variety of measures of past performance in the labor market as indirect measures of motivation and the ability and willingness to take up a job. See Appendix A for the exact specification and the estimation results. The specification has been tested extensively for omitted variables (including interaction terms with duration which where not significant).

Figure 1 displays the predicted hazard rate as a function of unemployment duration at the median characteristics of the sample in each month. The median person at the beginning of unemployment is a 35 year-old unmarried male without children, with completed apprenticeship training, without health problems, a fraction of unemployment in the last 10 years before becoming unemployed of 8%, a remaining UB claim of 11 months and who earned a gross wage of about 1,900 EUR in his last job. The hazard rates strongly increase during the first 3 months of unemployment which can be explained by labor market frictions. Afterwards the exit rate falls rapidly during the next 9 months. After the first year of unemployment the hazard rate lies below 5% and approaches zero at unemployment durations of 4 years.

Figure 1: Predicted hazard rates



Note: The predicted hazard rates are calculated at the median characteristics of the sample in each month.

The reemployment wages are calculated from the wage earned directly before becoming unemployed and the wage depreciation rate that is estimated as follows. Individuals who find employment in months 11-13 after entering unemployment are matched to the reference population of interest to take into account sample selection using the estimator proposed and applied by Lechner et al. (2006). The wage depreciation rate is the difference between their last wage before unemployment and their reweighed reemployment wage as a fraction of the former which yields a rate of 0.0112 per month.

To parameterize the cost of monitoring, the average gross salary of a caseworker per month (about 2600 EUR according to BA, 2001-2005) and administrative costs are taken into account. Consider a caseworker that monitors with intensity $\mu = 1$. Assuming that such a caseworker works 20 days per month and spends twice per week one hour on one case yields personnel costs of 130 EUR per case and month. Allowing for some administrative cost, the baseline value is set to $\kappa(1) = 200$ EUR. Different functional forms for the monitoring costs are considered, starting with a linear case $\kappa(\mu) = 200\mu$. The baseline values of the signal parameters are set to $\gamma_e = 0.9$ and $\gamma_0 = 0.1$ but different values are considered as well.

3.4 Accounting for parameter instability

One important problem with calibration-based normative analyses that has been ignored so far is the implicit assumption that the calibrated parameters remain constant under the optimal policy. However, in the case of optimal unemployment insurance this assumption is particularly problematic when considering the exit rates from unemployment to employment. They are estimated for the actual policy which implies a particular set of job search incentives. Yet, the whole point of the normative analysis is to find the set of incentives that implements the optimal policy and this usually differs from the actual incentives. Consequently, different incentives will usually imply different exit rates to employment.

To address this issue I propose the following iteration procedure to predict the exit rates that would prevail under the optimal rather than the actual policy. In the first step, using the estimated coefficients for the variables capturing the features of the actual policy (type, amount,duration of benefits), new values for the exit rates are calculated based on the values implied by the optimal policy derived from the model given the actual ones. Then the optimal policy given the new exit rates is derived. This process is repeated until the optimal policy derived no longer changes. The assumption is that the underlying behavioral parameters captured by the estimated coefficients do not change, which is reasonable and much weaker than the assumptions that the exit rates are constant. Note that this procedure also provides a means to evaluate the impact of implementing the optimal policy on the exit rate to employment.

To make the iteration procedure computationally feasible, the model is solved backwards in the simulation rather than using for example Chebychev polynomials to approximate the value functions (which would have to be repeated for any new value of the exit rates). It is assumed that the exit rate to employment at an unemployment duration of 49 months is zero, which is reasonable given that the estimated exit rate at 48 month is only 0.0078. This implies that in month 49 social assistance (SA) is the optimal policy and we know that SA is absorbing. The model can then be solved backwards for any value of promised utility U.

4 Results

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5 Conclusion

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Appendix

A Estimation results for the hazard rates

Table 1: Logit estimates of the hazard rates

Variable	Coefficient	Standard error	P-value in %
Constant	-3.7724	0.2618	0.0000
Unemployed for 1 month	1.0371	0.0924	0.0000
Unemployed for 2 months	1.7745	0.0901	0.0000
Unemployed for 3 months	1.9428	0.0893	0.0000
Unemployed for 4 months	1.9857	0.0893	0.0000
Unemployed for 5 months	1.9605	0.0900	0.0000
Unemployed for 6 months	1.7479	0.0915	0.0000
Unemployed for 7 months	1.4713	0.0941	0.0000
Unemployed for 8 months	1.4406	0.0959	0.0000
Unemployed for 9 months	1.4009	0.0971	0.0000
Unemployed for 10 months	1.3016	0.0996	0.0000
Unemployed for 11 months	1.1877	0.1022	0.0000
Unemployed for 12 months	1.0906	0.1022	0.0000
Unemployed for 13-15 months	0.9352	0.0892	0.0000
Unemployed for 16-18 months	0.8171	0.0910	0.0000
Unemployed for 19-21 months	0.6652	0.0935	0.0000
Unemployed for 22-24 months	0.6934	0.0942	0.0000
Unemployed for 25-30 months	0.6699	0.0841	0.0000
Unemployed for 31-36 months	0.1620	0.0937	8.3950
January	-0.5303	0.0485	0.0000
February	-0.3026	0.0452	0.0000
March	0.1535	0.0416	0.0228
April	0.2975	0.0413	0.0000
May	0.1212	0.0439	0.5776
June	0.0600	0.0456	18.8779
August	-0.0950	0.0469	4.2793
September	0.0143	0.0461	75.7071
October	-0.3352	0.0497	0.0000
November	-0.4821	0.0504	0.0000
December	-0.8345	0.0544	0.0000
Age/100	-4.0489	0.4369	0.0000
Age 20-25	-0.5641	0.0772	0.0000
Age 26-30	-0.3713	0.0569	0.0000
Age 31-35	-0.1181	0.0393	0.2629
Age 36-40	0.1496	0.0376	0.0068
Age 46-50	0.1192	0.0541	2.7677
Age 51-55	0.0673	0.0741	36.3952
Female	0.1090	0.0250	0.0013
Foreigner	-0.1347	0.0294	0.0005
Married	0.0421	0.0308	17.1062
Single	-0.0708	0.0322	2.8040
At least one child	0.0015	0.0255	95.2305
Child of age below 3	0.0138	0.0474	77.0997
Child of age 3-6	-0.0714	0.0379	5.9434
Has health impairments	-0.2641	0.0393	0.0000
Health impairments affect employability	-0.1851	0.0560	0.0945
No schooling degree	-0.1461	0.0344	0.0022
No vocational degree	-0.1421	0.0241	0.0000
Looking for fulltime job	0.2649	0.0382	0.0000
Replacement rate	-0.0875	0.0512	8.7600
Replacement rate 1-20%	0.3467	0.0810	0.0019
Replacement rate 21-35%	-0.0747	0.0314	1.7157
Replacement rate 41-45%	-0.0545	0.0291	6.1219
Replacement rate higher than 45%	-0.1791	0.0290	0.0000
Receives unemployment benefits	0.5345	0.0475	0.0000
Receives unemployment assistance	-0.3248	0.0553	0.0000

Continued on next page

Table 1 - continued from previous page

Variable	Coefficient	Standard error	P-value in %
Log(daily benefits)/10	7.5352	1.0275	0.0000
No benefits	0.3054	0.1581	5.3397
Remaining UB claim in days/1000	-0.9884	0.1813	0.0000
No UB claim	0.6059	0.0479	0.0000
Remaining UB claim 1-90 days	-0.2397	0.0429	0.0000
Remaining UB claim 181-270 days	0.2536	0.0383	0.0000
Remaining UB claim more than 270 days	0.6870	0.0499	0.0000
Employed	0.7464	0.0234	0.0000
In employment program	0.3569	0.0670	0.0000
In labor market program	-1.1641	0.0610	0.0000
Duration of current program	0.0148	0.0049	0.2371
Total duration in program	0.0457	0.0038	0.0000
North-Rhine-Westphalia	-0.1149	0.0248	0.0004
Schleswig-Holstein-Hamburg	-0.1033	0.0365	0.4595
Rural area	0.1398	0.0553	1.1523
Local unemployment rate	-2.7564	0.3566	0.0000
Distance to next agglomeration/1000	1.2520	0.3011	0.0032
Fraction of foreigners in region	1.2622	0.2373	0.0000
Last job in manufacturing or technical occupation	-0.2090	0.0465	0.0007
Last job in service occupation	-0.1482	0.0478	0.1942
Last job in manufacturing industry	-0.1229	0.0246	0.0001
Last job in public, education, health sector	-0.0710	0.0305	1.9903
Last job as unskilled worker	-0.1037	0.0248	0.0029
Last job as clerk	-0.1043	0.0313	0.0862
Last daily gross wage 1-25 EUR	0.1550	0.0651	1.7269
Last daily gross wage 26-40 EUR	0.1062	0.0362	0.3310
Fraction unemployed in past 10 years 1-5%	0.2755	0.0429	0.0000
Fraction unemployed in past 10 years 6-15%	0.1370	0.0407	0.0772
Fraction unemployed in past 10 years 16-30%	0.0810	0.0501	10.6154
Fraction unemployed in past 10 years more than 30%	0.1104	0.0742	13.7181
Fraction out of labor force in past 10 years 1-10%	-0.0249	0.0235	28.8025
Fraction out of labor force in past 10 years 11-25%	-0.0255	0.0302	39.7865
Fraction out of labor force in past 10 years more than 25%	-0.1087	0.0317	0.0610
Duration of last employment 1-6 months	-0.0478	0.0393	22.4057
Duration of last employment 7-12 months	0.1213	0.0331	0.0242
Number of unemployment spells in past 12 months/10	0.9129	0.3369	0.6741
Number of unemployment spells in past 10 years/10	0.7774	0.0663	0.0000
Participated in labor market program in past 10 years	-0.1339	0.0378	0.0398
Number of months employed in past 3 years	0.0079	0.0018	0.0009
Average daily wage over past 10 years	-0.0037	0.0009	0.0037
Average daily wage over past 10 years 1-35 EUR	-0.0156	0.0432	71.7309
Average daily wage over past 10 years 36-50 EUR	0.0033	0.0306	91.5442
Unemployed in month 12 before unemployment	0.1613	0.0374	0.0016
Unemployed in month 24 before unemployment	0.0832	0.0287	0.3751
Unemployed in month 36 before unemployment	0.0753	0.0287	0.8793
Unemployed in month 48 before unemployment	0.1108	0.0292	0.0147
Months unemployed in past 10 years/100	-1.1249	0.1414	0.0000
Observed in data for less than 10 years before unemployment	0.0660	0.0255	0.9760
Months since last unemployment spell	-0.0024	0.0006	0.0096
Observations		211791	
Log-likelihood		-661018	

Note: All variables referring to the employment history are calculated at the beginning of unemployment.