How can the transfer system affect the working behavior of low skilled men?
Evidence from a dynamic structural life cycle model

Preliminary Version

Peter Haan* , Victoria Prowse† and Arne Uhlendorff‡

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Abstract

In this paper we develop a dynamic structural life cycle model of labor supply behavior which explicitly accounts for the effect of income taxation and the transfer system. Moreover, we model the demand-side driven rationing risk that prevents agents from realizing the labor supply state which is optimal according to life cycle maximization. This allows us to distinguish between voluntary and involuntary unemployment. This framework provides the possibility to rigorously evaluate life-cycle employment effects of tax reforms as it reveals structural estimates of preferences, a detailed depiction of the tax and transfer system and of potential welfare reforms and allows for constraints which might affect the optimal life cycle paths of employment. We use this framework to study the employment effect of transforming a traditional welfare state, as currently in place in Germany, towards a more Anglo-American system which explicitly transfers a large amount of transfers to the working population.

Keywords: Life cycle labor supply, Involuntary unemployment, In-work credits.

*DIW Berlin, PSE Paris, phaan@diw.de
†University of Oxford, victoria.prowse@economics.ox.ac.uk
‡IZA Bonn, uhlendorff@iza.org

1 Introduction

In this paper we develop a dynamic structural life cycle model of labor supply behavior which explicitly accounts for the effects of income taxation and the transfer system. In this model, we consider the demand-side driven rationing risk that prevents agents from realizing the labor supply state which is optimal according to life cycle maximization. This allows us to distinguish between voluntary and involuntary unemployment. We use this framework to study the employment effect of transforming a traditional welfare state, as it is currently in place in Germany, towards a more Anglo-American system which explicitly transfers a large amount of transfers to the working population. We focus on low skilled men, a group faced with relatively high unemployment rates and therefore a key target group for "Making Work Pay" policies.

Traditionally, governments have designed the transfer system and income support programs to provide assistance for the poor and thus to guarantee equity in a society. However, over the last two decades several governments have started to use the transfer system in addition as a policy instrument to increase work incentives by subsidizing work, so called in-work credits. The most prominent examples of in-work credits are the Earned Income Tax Credit (EITC) in the US and the Working Tax Credit (WTC) in the UK. The idea of these programs, often referred to as "Making Work Pay" policies, is to target working low-income families with an income supplement that is contingent on work. In today's political discussion, in-work credits are seen as an important program of increasing work incentives for groups with a high risk of non-employment.

For the United States and the UK, a large empirical literature has evaluated the effects of the EITC and the WTC on labor market behavior (for comprehensive surveys, see Hotz and Scholz (2003) and Blundell (2000)). These studies are either based on ex-post evaluation methods exploiting some quasi-natural experiment or use semi-structural estimation techniques to evaluate the policy reforms from an ex-ante perspective. So far, most of the literature has focussed on the effects of in-work credits on the labor market outcomes for women, in particular lone mothers. Initially in-work credits were targeted at this group. Moreover, as well documented in the literature, e.g. Blundell and MaCurdy (1999), labor supply effects for women tend to be much larger than the behavioral changes of men. Evidence on the labor market effects of in-work credits on men is therefore still scarce. Given the recent political debate surrounding the shifting of resources towards "Making Work Pay" policies, we think it is important to draw as well attention to the labor market effects of in-work credits for men. In particular, in this paper we focus on the labor market effects of in-work credits for men with a high probability of not working, namely men with little or no education.

We analyze the working behavior of men in a dynamic structural life cycle model of labor supply which accounts in detail for the effects of the tax and transfer system and distinguishes voluntary and involuntary unemployment. This rather complex modeling is necessary for several reasons. First, labor supply behavior is an intertemporal decision problem which is affected by human capital accumulation, intertemporally non-separable preferences and intertemporal budget constraints. Therefore, a life cycle model in which the agent accounts for the effect of his current behavior on his future utility and working behavior is required. This feature of the modeling framework contrasts to previous ex-ante evaluations of in-work credits or tax reforms which have been performed using semi structural static or myopic intertemporal frameworks (e.g. Blundell, Duncan, McCrae, and Meghir (2000) and Haan and Uhlendorff (2007)). Second, both demand side driven involuntary unemployment and preference based voluntary non-work are relatively common among low skilled men. Hence, a realistic model of the labor supply behavior of the low skilled must differentiate between these two reasons for non-work.

The model we propose builds on a large body of literature analyzing labor supply behavior over the life cycle. Blundell, MaCurdy, and Meghir (2008) classify the life cycle labor supply literature in two streams according to the channel through which dynamic effects enter the model. The first class of models account for saving and consumption and thus introduce dynamic effects in the behavior through the intertemporal budget constraint. Preferences, however, are assumed to be separable over time. This literature goes back to Heckman and MaCurdy (1980) and MaCurdy (1981). The resulting theoretical model predicts that individuals will reduce labor supply early and late in the life cycle while using the savings channel to maintain a constat marginal utility of consumption. Several studies have used this approach to estimate the labor supply effects of tax reforms over the life cycle. One example is Ziliak and Kniesner (1999) who model the effects of progressive income taxation on life cycle labor supply. The authors use their dynamic model and analyze income tax reforms occurring in the US during the 1980s. They find larger positive labor supply effects than those found in the evaluations based on static labor supply models.

In the second class of life cycle labor supply models, to which our approach belongs, the dynamics of labor supply enter through intertemporally non-separable preferences. Thus, these models capture intertemporal dependencies more directly by conditioning labor supply preferences on past labor supply behavior. Moreover, they allow the current employment decision to affect future labor supply behavior either through habit formation or through effects on the future budget constraint due to human capital accumulation or the dependence of benefit entitlement on the individual's working history. These dynamic labor supply models are part of the large literature on dynamic programming which was initiated by the contributions of Wolpin (1984), Pakes (1986) and Rust (1987).

To the best of our knowledge, the first study to use dynamic programming to estimate a life cycle labor supply model was Eckstein and Wolpin (1989) who focused on the labor force participation of married women. The key feature of their model specification is that accumulated experience is endogenous in the wage process and thus the labor supply decision affects future wages. Keane and Wolpin (1997) extended this model by treating schooling in addition to experience as an endogenous choice variable. Moreover, they allow for a very general specification of unobserved heterogeneity and stochastic effects which vary according to labor market choices. This methodology has strongly influenced the following literature and has been the reference model for numerous studies of life cycle labor supply including Adda, Dustmann, Meghir, and Robin (2006), Berkovec and Stern (1991), Eckstein and Wolpin (1999) and Klaauw (1996). The Adda, Dustmann, Meghir, and Robin (2006) study is notable because, in contrast to the previous literature which has used survey data, their analysis draws on administrative data from Germany to estimate the effect of vocational training on life cycle employment. Belzil (2007) provides an extensive survey of this literature and reviews the methodological advances and developments.

We build on some aspects of the contributions of Eckstein and Wolpin (1989) and Keane and Wolpin (1997) and address two central points which we believe have not previously been included in a life cycle model of labor supply: demand-side rationing of the labor supply choice through involuntary unemployment; and even more importantly, the effect of the tax and transfer system on life cycle labor supply behavior. In general, in dynamic discrete choice models agents choose their current actions to maximize the discounted expected value of their lifetime utility. In our framework, we additionally allow for rationing risk that prevents agents from realizing their optimal labor supply choice.[1]

The second central point addressed in this paper concerns the effects of the tax and transfer system on life cycle employment. In standard life cycle models, the rewards to work are taken to be the gross wage. Thus these models reflect neither progressive income

[1] For similar approaches in the context of static labor supply models see e.g. Ham (1982), Blundell, Ham, and Meghir (1987) and Bingley and Walker (1997).

taxation nor governmental transfers. Given the importance of the tax and transfer system in all developed countries, we argue that a detailed depiction of the tax and transfer system is necessary to describe choice specific rewards and thus to accurately capture work incentives. Rust and Phelan (1997) argue in the same way when analyzing the effect of social security on retirement behavior. To the best of our knowledge, so far this paper and the extensions pursued by inter alia Blau and Gilleskie (2006) and Heyma (2004), who also look only at labor supply around retirement, are the only attempts to model parts of the transfer system when describing choice specific utility in a dynamic programming setting. However, given their application, this strand of literature focuses only on specific programs for the elderly while not implementing income taxation or transfer programs relevant to the whole population. Similarly, in a recent working paper, Yamada (2007) accounts for parts of the tax and transfer system when modelling progressive income taxation to analyze the life cycle employment of Japanese women. In contrast, in this paper we argue that it is necessary to model in detail the whole tax and transfer system for the evaluation of welfare reforms. Through means-testing, all parts of the tax and transfer system are linked and interact. In order to obtain the precise work incentives provided by the tax and transfer system we draw on a detailed microsimulation model.

In the empirical part we apply the proposed model to evaluate the the life-cycle employment effects of introducing work-contingent transfer programs in Germany. The estimation is based on panel data from the Socio Economic Panel (SOEP) for the years 2000 - 2006. In the empirical analysis we will focus on low- or no-educated men in working age (25-59) a group which is in particular affected by involuntary unemployment. Moreover the low- and no-educated are strongly dependent on the transfer system and in the political debate there exists numerous suggestions for welfare reforms targeted in particular to this group. An analysis for Germany is interesting for several reasons. The current German tax and transfer system can be characterized as a traditional welfare state in which the central purpose of the transfer system is to provide support for the non-working poor. However, due partly to the pressure of relatively high unemployment rates, there exists an ongoing debate about reforming the welfare state towards the Anglo-American system which emphasizes support for the working poor. Several changes in this direction have been introduced in the course of recent labor market reforms, however, the general design of the transfer system was hardly affected. Thus, in the political debate there is still demand for introducing in-work credits as in place in the US and the UK. Moreover, Germany is faced with relatively high rates of unemployment, especially for low skilled individuals. This makes a life cycle framework that distinguishes between voluntary and involuntary unemployment particularly important.

2 Life cycle Labor Supply with Involuntary Unemployment

2.1 An Overview of the Model

This section describes a discrete dynamic life cycle model of individual labor supply in the presence of labor market constraints which may prevent an individual from realizing his desired hours of work. This model explicitly accounts for the effects of the tax and transfer system on work incentives. Individuals are assumed to be rational forward-looking agents implying that every period each individual acts so as to maximize his discounted expected lifetime utility. In our model we focus on men of prime working age, defined as 25-59 years, with low levels of educational attainment. The low educated are particularly threatened by involuntary unemployment over the whole life cycle and this group is, in general, characterized by relatively low labor marked attachment. We focus on a sample of men older than 25 years to avoid the complexity of modeling the educational choice over the life cycle (Keane and Wolpin, 1997). When studying the male labor supply behavior, we simplify the utility maximization of the household to the individual decision process of the man and treat the working behavior and fertility of the female spouse, if present, as exogenous with respect to the man's current behavior. However, the female spouse's working behavior and fertility decisions may be influence by the man's previous labor supply choice and the associated net household income.

The model proceeds as follows. At ages $t = 25, ..., 59$ years individual i may seek a job with overtime hours (o), defined as 44 weekly working hours, full-time hours (f), defined as 38.5 weekly working hours, or may choose to be non-employed (n). In the following we denote these preferred labor market states with j*. This discrete distribution is motivated by the empirical distribution of working hours which is discussed in Section 3. Following Blundell, Ham, and Meghir (1987), we distinguish preference based non-employment from demand side driven involuntary unemployment (u). Our definition of involuntary unemployment is consistent with several sources of involuntary unemployment such as frictional unemployment, minimum wage or union wage setting. Specifically, irrespective of his previous employment behavior, an individual preferring a job with full-time or over-time hours may be unable to find or keep a job with his preferred hours of work, in which case he is involuntarily unemployed. The probability of being not rationed, i.e. of realizing the preferred employment state, is given by $\Gamma_{i,t}$ which depends on individual and household specific characteristics, regional labor market indicators and the individual's previous labor market state. The probability of not being rationed in t includes both, the job arrival rate for previously not working men, and the lay-off rate for the previously working. In this framework is not possible to distinguish the job arrival and separation rate, yet in the empirical specification we allow the effects of individual characteristics to be different for the employed, the involuntary unemployed and the voluntary non-working.

We define $j = o, f, n, u$ to be the desired labor market states j* and the state of involuntary unemployment. In each labor market state $j = o, f, n, u$ individuals receive a flow utility $U_{i,j,t}$ which is a function of leisure and net income in state j, the individual's demographic characteristics and the previous labor market state. These utilities determine current desired labor supply and consequently job search behavior. Incomes out of work are determined by non-labor income and the transfer system. Income in over-time and full-time jobs is derived from individual's gross market wage, the hours of work associated with over-time and full-time jobs and the tax and transfer system. Through the gross market wage, the distribution of in-work incomes is conditional on individual characteristics that affect wages. In our specification, consumption is assumed to equal current net income. As stated by Blundell, MaCurdy, and Meghir (2008) dynamic programming models of labor supply largely ignore households' saving and borrowing decisions. Rust and Phelan (1997) discuss this assumption in some detail and provide arguments in favor of equating saving with consumption, the main justification being the lack of reliable information on consumption, savings and assets in longitudinal data. Moreover, as we focus in our application on a sample of low educated men, ignoring the saving decision becomes less severe.

The individual's decision problem can be expressed in terms of the value function $V(s_{i,t}, Y_{i,t-1})$ which equals the discounted expected value of the individual's utility from time t onwards assuming that in each year from time t onwards the individual makes his job search decision so as to maximize the discounted expected value of his future utility. The value function depends on the individual's previous employment state, $Y_{i,t-1} = (Y_{i,o,t-1}, Y_{i,f,t-1}, Y_{i,n,t-1}, Y_{i,u,t})$ where $Y_{i,j,t}$ for $j = o, f, n, u$ are indicators of the agent i being in employment state j at time t, and the state variables $s_{i,t}$ which consist of all other variables entering the contemporaneous utilities and probability of successful job search at time t. The individual is assumed to know the current value of $s_{i,t}$ but, at time t, may not know the values of all or some elements of $s_{i,t+1}$. However, the distribution of $s_{i,t+1}$ is known to the individual at time t and is assumed to depend only on $s_{i,t}$ and $Y_{i,t}$.

The value function for this problem takes the following form

$$V_{i,t}(s_{i,t}, Y_{i,t-1}) = \max \begin{bmatrix} \Gamma_{i,t} V^o_{i,t}(s_{i,t}, Y_{i,t-1}) + (1-\Gamma_{i,t}) V^u_{i,t}(s_{i,t}, Y_{i,t-1}) \\ \Gamma_{i,t} V^f_{i,t}(s_{i,t}, Y_{i,t-1}) + (1-\Gamma_{i,t}) V^u_{i,t}(s_{i,t}, Y_{i,t-1}) \\ V^n_{i,t}(s_{i,t}, Y_{i,t-1}) \end{bmatrix}, \quad (1)$$

where $V^j_{i,t}(s_{i,t}, Y_{i,t-1})$ for $j = o, f, n, u$ are employment state specific value functions with the following recursive structure

$$V^o_{i,t}(s_{i,t}, Y_{i,t-1}) = U_{i,o,t} + \delta \mathbf{E}_t[V_{i,t+1} | s_{i,t}, Y_{i,t} = (1, 0, 0, 0)], \quad (2a)$$

$$V^f_{i,t}(s_{i,t}, Y_{i,t-1}) = U_{i,f,t} + \delta \mathbf{E}_t[V_{i,t+1} | s_{i,t}, Y_{i,t} = (0, 1, 0, 0)], \quad (2b)$$

$$V^n_{i,t}(s_{i,t}, Y_{i,t-1}) = U_{i,n,t} + \delta \mathbf{E}_t[V_{i,t+1} | s_{i,t}, Y_{i,t} = (0, 0, 1, 0)], \quad (2c)$$

$$V^u_{i,t}(s_{i,t}, Y_{i,t-1}) = U_{i,u,t} + \delta \mathbf{E}_t[V_{i,t+1} | s_{i,t}, Y_{i,t} = (0, 0, 0, 1)]. \quad (2d)$$

In the above δ is the discount factor which is assumed to be 0.95. Given these definitions, the first and second arguments of the right hand side of equation (1) represent the individual's discounted expected lifetime utility if he seeks a job with respectively over-time hours or full-time hours at time t and from time $t + 1$ onwards makes optimal labor supply decisions. Likewise, the last agrement of the right hand side of equation (1) is the man's discounted expected lifetime utility if he chooses to be non-employed today and from time $t + 1$ onwards makes optimal job search decisions.

Equations (1) and (2a)-(2d) implicitly define the individual's optimal job search decision at each time $t = 25, ..., 59$. For the purpose of subsequent analysis the individual's decision problem is restated in terms of the two following quantities

$$\Delta_{o,f} = V^o_{i,t}(s_{i,t}, Y_{i,t-1}) - V^f_{i,t}(s_{i,t}, Y_{i,t-1}), \quad (3a)$$

$$\Delta_{o,n} = V^o_{i,t}(s_{i,t}, Y_{i,t-1}) - \frac{V^n_{i,t}(s_{i,t}, Y_{i,t-1})}{\Gamma_{i,t}} + \frac{1-\Gamma_{i,t}}{\Gamma_{i,t}} V^u_{i,t}(s_{i,t}, Y_{i,t-1}). \quad (3b)$$

An individual will search for a job with over-time hours at time t if and only if $\Delta_{o,f} \geq 0$ and $\Delta_{o,n} \geq 0$. Similarly, the individual will search for a job with full-time hours at time t if and only if $\Delta_{o,f} < 0$ and $\Delta_{o,n} - \Delta_{o,f} \geq 0$, and will choose to be non-employed at time t if and only if $\Delta_{o,n} - \Delta_{o,f} < 0$ and $\Delta_{o,n} < 0$.

2.2 Discussion of the Model

Although only four labor market states are distinguished, the model is sufficiently general so as to allow an analysis of labor supply behavior at both the extensive (participation decision) and intensive (working hours decision) margins. Moreover, this model extends the previous literature in two important respects. First, the possibility of involuntary unemployment is recognized and the rationing process is modeled jointly with the discrete choice model of labor supply. We emphasize the importance of the demand side constraints as the population of interest, namely low skilled men, is characterized by a high risk of involuntary unemployment. Second, in contrast to Eckstein and Wolpin (1989) and the literature thereafter, we make the labor supply decision dependent on net household income rather than on gross earnings. Hence, we account in detail for income taxation and the transfer system. This is central to understanding how the government influences labor supply behavior, creates inefficiencies in the market through distortions of prices, and how policies can be designed to make work pay. When modeling the necessary details of tax and transfer system we apply a microsimulation model which requires not only information about the individual but also information concerning the household, including the number of children, marital status and the working behavior of the partner. This detailed modeling at the household level is necessary for our research questions because in nearly all developed countries most transfer schemes, as well as in several countries income taxation, depend on household level demographic variables.

These extensions, however, lead to several caveats of our modeling approach. Most importantly, we cannot estimate earnings and labor supply behavior jointly as in Eckstein and Wolpin (1989). This is because the microsimulation is too involved to be included in the overall dynamic likelihood estimation. Specifically, incorporating the microsimulation model into the dynamic programming problem implies a number of state variables that is computationally prohibitive. Instead we will develop a multi-step estimation procedure which is similar to the two-step estimation method in Rust and Phelan (1997) and will be discussed in detail below.[2]

A further limitation of our approach concerns the data used for the analysis. The required information on the household level demographics and sources of non-labor income prevents us from drawing on the administrative data for Germany which has been used by Adda, Dustmann, Meghir, and Robin (2006). Instead, we use panel data from the Socio Economic Panel Study (SOEP) which include the required family and income information. However, the structure of the SOEP is such that individuals are observed only in certain years in their working life. Therefore, as described below, the approach of Heckman (1981b) is used to control for selection effects in the initial observations.

2.3 Empirical Specification

For the purpose of the empirical analysis, the probability of being not rationed at time t is given by

$$\Gamma_{i,t} = \Lambda(\eta z_{i,t} + \eta_u z_{i,t} Y_{i,t-1} + \eta_v z_{i,t} Y_{i,t-1} + \lambda Y_{i,t-1} + c_{i,s}), \tag{4}$$

where Λ denotes the logistic distribution function, $z_{i,t}$ are observed variables affecting the probability of job search being successful or not being laid off and $c_{i,s}$ represents unobserved time-invariant individual specific random effects with a distribution described below. We allow for different effects of observable characteristics on the probability of being rationed for individuals being employed, the involuntary and voluntary unemployed in $t-1$. Moreover, for better identification we condition the rationing risk on regional labor market information,

[2] Yamada (2007) follows a different approach which highlights the trade of between the detailed depiction of the tax and transfer system and the estimation procedure. He models only parts of progressive income taxation yet this relatively simple structure does not prevent the joint estimation of earnings and labor supply.

most important the regional unemployment rate.[3]

The following specification of the contemporaneous utility functions is adopted

$$U_{i,j,t} \quad = \quad \gamma_j Y_{i,t-1} + \theta_j m_{i,j,t} Y_{i,t-1} + \beta_j x_{i,t} + \mu_j + c_{i,j} + \varepsilon_{i,j,t} \;\text{ for }\; j = o, f, n, u. \qquad (5)$$

The first term in the above represents the effect of the individual's previous employment state on his current flow utility which is unrelated to net income. The second term in the above expression denotes the effect of the individual's income **CRRA** in state j, $m_{i,j,t}$, on the individual's state specific flow utility at time t. The effect of income is allowed to vary according to the individual's previous employment state reflecting, for example, a higher marginal utility of income among individual's current in employment then among individual previous out of work.

The third term in Equation (5) reflects the effect of individual and household characteristics, $x_{i,t}$, on state specific flow utilities at time t. The alternative specific coefficients on individual characteristics, previous employment state and income allow the effects of these variables on state specific flow utilities to vary according to the chosen employment state. This reflects the interaction of leisure with these variables. This is more flexible than the alterative method of interacting an arbitrary function of leisure all of the explanatory variables and then imposing a common coefficient on the interacted variables across employment states. The random effects $c_{i,j}$ for $j = o, f, n, u$ allow individuals to have systematic differences in the unobserved components of their flow utilities, and are necessary to establish the extent to which persistence in labor market outcomes is due to the effect of previous employment outcomes rather than persistent unobserved individual characteristics (see Heckman (1981a), Hyslop (1999)). The last component of the flow utilities is the preference shock $\varepsilon_{i,j,t}$. This term captures the time-varying component of the individual's unobserved preferences. To

[3]Potential mobility between the different regions might cause an endogeneity problem for the estimation of the rationing risk. However, since over the observed period only 135 of the 2437 households move and only 12 of the movers change their employment status, mobility should not cause any inconsistency.

facilitate subsequent derivations, the following definition for $j = o, f, n, u$ is made

$$q_{i,j,t} \quad = \quad \gamma_j Y_{i,t-1} + \theta_j m_{i,j,t} Y_{i,t-1} + \beta_j x_{i,t} + \mu_j + c_{i,j} + \delta \mathbf{E}_t[V_{i,t+1}|s_{i,t}, Y_{i,t}]. \tag{6}$$

For the final period T, $\mathbf{E}_T[V_{i,T+1}|s_{i,T}, Y_{i,t}] = 0$, so the future expectation for $j = o, f, n, u$ are zero. Denote the probability of the individual realizing his desired employment state $j* = o, f, n$ at time t, conditional on $s_{i,t}$, $Y_{i,t-1}$ and c_i by $\Omega_{i,j*,t}(s_{i,t}, Y_{i,t-1}, c_i)$. Combining Equations (3a)- (3b) with the assumption that $\varepsilon_{i,j,t}$ are independent over time, individuals and employment states and to have a type I extreme value distribution and normalizing $\varepsilon_{i,u,t} = \varepsilon_{i,n,t}$, the probabilities for each desired employment state can be expressed as the following multinomial logit probabilities.

$$\Omega_{i,o,t}(s_{i,t}, Y_{i,t-1}, c_i) = \Pr\begin{pmatrix} V^o_{i,t} \geq V^f_{i,t} \\ V^o_{i,t} \geq \frac{V^n_{i,t}}{\Gamma_{i,t}} - \frac{1-\Gamma_{i,t}}{\Gamma_{i,t}} V^u_{i,t} \end{pmatrix} = \frac{\exp(q_{i,o,t})}{Q_{i,t}}, \tag{7a}$$

$$\Omega_{i,f,t}(s_{i,t}, Y_{i,t-1}, c_i) = \Pr\begin{pmatrix} V^f_{i,t} > V^o_{i,t} \\ V^f_{i,t} \geq \frac{V^n_{i,t}}{\Gamma_{i,t}} - \frac{1-\Gamma_{i,t}}{\Gamma_{i,t}} V^u_{i,t} \end{pmatrix} = \frac{\exp(q_{i,f,t})}{Q_{i,t}}, \tag{7b}$$

$$\Omega_{i,n,t}(s_{i,t}, Y_{i,t-1}, c_i) = \Pr\begin{pmatrix} V^o_{i,t} < \frac{V^n_{i,t}}{\Gamma_{i,t}} - \frac{1-\Gamma_{i,t}}{\Gamma_{i,t}} V^u_{i,t} \\ V^f_{i,t} < \frac{V^n_{i,t}}{\Gamma_{i,t}} - \frac{1-\Gamma_{i,t}}{\Gamma_{i,t}} V^u_{i,t} \end{pmatrix} = \frac{\exp\left(\frac{q_{i,n,t}}{\Gamma_{i,t}} - \frac{1-\Gamma_{i,t}}{\Gamma_{i,t}} q_{i,v,t}\right)}{Q_{i,t}}, \tag{7c}$$

where

$$Q_{i,t} = \exp(q_{i,o,t}) + \exp(q_{i,f,t}) + \exp\left(\frac{q_{i,n,t}}{\Gamma_{i,t}} - \frac{1-\Gamma_{i,t}}{\Gamma_{i,t}} q_{i,u,t}\right). \tag{8}$$

The probabilities associated with three desired labor market states and the statue of involuntary unemployment are therefore as follows

$$P_{i,o,t}(s_{i,t}, Y_{i,t-1}, c_t) = \Omega_{i,o,t}(s_{i,t}, Y_{i,t-1}, c_i)\Gamma_{i,t}(z_{i,t}, Y_{i,t-1}, c_{i,s}), \tag{9a}$$

$$P_{i,f,t}(s_{i,t}, Y_{i,t-1}, c_t) = \Omega_{i,f,t}(s_{i,t}, Y_{i,t-1}, c_i)\Gamma_{i,t}(z_{i,t}, Y_{i,t-1}, c_{i,s}), \tag{9b}$$

$$P_{i,n,t}(s_{i,t}, Y_{i,t-1}, c_t) = \Omega_{i,n,t}(s_{i,t}, Y_{i,t-1}, c_i), \tag{9c}$$

$$P_{i,u,t}(s_{i,t}, Y_{i,t-1}, c_t) = (1 - \Omega_{i,n,t}(s_{i,t}, Y_{i,t-1}, c_i))(1 - \Gamma_{i,t}(z_{i,t}, Y_{i,t-1}, c_{i,s})). \tag{9d}$$

Identification

In order to ensure identification of the model, several normalizations are necessary. In the equation describing the utility from involuntary unemployment, the intercept is excluded ($\mu_u = 0$) and the coefficients of the previous employment state are normalized to zero ($\gamma_u = 0$). Additionally, the random effect is excluded from the utilities from both non-employment and involuntary unemployment ($c_{i,n} = c_{i,v} = 0$). Following these normalization, it is possible to identify μ_j* and γ_j* for $j* = o, f, n$ due to variation in the probability of involuntary unemployment across individuals (see equation (3b)).

It is further assumed that the effects of income and individual and household specific characteristics on an individual's utility from non-employment are the same as the effect of these variables on the individual's utility from involuntary unemployment ($\beta_n = \beta_u$). This restriction improves the identification of the model. The different effects of individual and household specific characteristics on the utilities from non-employment and involuntary unemployment are identified via variation in the probability of involuntary unemployment. However, as the probability of involuntary unemployment is close to zero for many individuals there is limited identifying variation relevant to the coefficients of $x_{i,t}$.

The amount of identifying variation is further reduced by estimating μ_j* and γ_j* for $j* = o, f, n$. The effects of individual and household characteristics on the utilities from non-employment and involuntary unemployable are constrained to be equal and normalized

Table 1: Distribution of the Random Effects

Random Parameter			Probability (α)
$c_{i,o}$	$c_{i,f}$	$c_{i,s}$	
$c_{i,o}^1 + c_{i,o}^2$	$c_{i,f}^1 + c_{i,f}^2$	$c_{i,s}^1 + c_{i,s}^2$	A^1A^2
$c_{i,o}^1 - c_{i,o}^2$	$c_{i,f}^1 - c_{i,f}^2$	$c_{i,s}^1 - c_{i,s}^2$	$A^1(1-A^2)$
$-c_{i,o}^1 + c_{i,o}^2$	$-c_{i,f}^1 + c_{i,f}^2$	$-c_{i,s}^1 + c_{i,s}^2$	$(1-A^1)A^2$
$-c_{i,o}^1 - c_{i,o}^2$	$-c_{i,f}^1 - c_{i,f}^2$	$-c_{i,s}^1 - c_{i,s}^2$	$(1-A^1)(1-A^2)$

to zero. The coefficients β_o and β_f then have the interpretation as the effects of changes in individual and household characteristics on, respectively, the utilities from over-time work and full-time work relative to his utility from non-employment or involuntary unemployment.

Unobserved Heterogeneity

When estimating the model, the individual specific unobserved components of the utilities from non-employment and involuntary unemployment are constructed to be identical $c_{i,n} = c_{i,u}$). Differences in individual specific unobservables between the involuntary unemployed and voluntary non-employed enter through the specification of the labor market constraints in Equation (4). The model is estimated using distributional assumptions on $c_{i,j}$ for $j = o, f, s$. In the spirit of Heckman and Singer (1984), the random effects have a non-parametric discrete distributions. Specifically, the random effects are constructed using factor loadings:

$$c_{i,o} = c_{i,o}^1 v^1 + c_{i,o}^2 v^2, \tag{10a}$$

$$c_{i,f} = c_{i,f}^1 v^1 + c_{i,f}^2 v^2, \tag{10b}$$

$$c_{i,s} = c_{i,s}^1 v^1 + c_{i,s}^2 v^2, \tag{10c}$$

where $(c_{i,o}^1, c_{i,o}^2, c_{i,f}^1, c_{i,f}^2, c_{i,s}^1, c_{i,s}^2)$ are unknown parameters and $v^1, v^2 \in \{0, 1\}$. v^1 and v^2 are assumed to occur independently with Prob$(v^1 = 1) = A^1$ and Prob$(v^2 = 1) = A^2$. This specification yields four values of the random effect c_i, denoted (c^1, c^2, c^3, c^4). The associated probabilities are denoted by $(\alpha_1, \alpha_2, \alpha_3, \alpha_4)$. Table 1 provides a full description of the distribution of the random effects.

Likelihood function

Given a sample of N individuals whose labor market outcome is observed for $t = \pi_i, ..., \Pi_i$, the likelihood function is given by

$$\mathcal{L} = \prod_{i=1}^{N} \sum_{k=1}^{4} \alpha_k \left(\left[\prod_{t=\pi_i+1}^{\Pi_i} \prod_{j=o,f,n,u} P_{i,j,t}(s_{i,t}, Y_{i,t-1}, c^k)^{Y_{i,j,t}} \right] \times \prod_{j=o,f,n,u} p_{i,j}(m_{i,o,\pi_i}, m_{i,f,\pi_i}, m_{i,n,\pi_i}, x_{i,\pi_i}, z_{i,\pi_i}, c^k)^{Y_{i,j,\pi_i}} \right). \quad (11)$$

In the above, the term in parenthesis is individual i's likelihood contribution conditional on a particular value of c_i with $p_{i,j}$ denoting the probability associated with the initial observation for individual i. The individual's unconditional likelihood contribution is obtained by forming an appropriately weighted average of the conditional likelihood contributions. When implementing the model $p_{i,j}$ is derived from a reduced form specification of utilities and the probability of successful job search at $t = \pi_i$.[4]

2.4 Multi-Step Estimation Procedure

As mentioned above, in order to empirically estimate the dynamic programming model of life cycle labor supply we adopt a multi step procedure similar to Rust and Phelan (1997). In the first step we derive the wage distribution for the working and non-working population. For each individual, we draw from this wage distribution and according to the hourly wage and the defined working hours we assign gross earnings for each individual. This is the key input for the microsimulation model which derives the labor market state specific net income for

[4]Utilities at $t = \pi_i$ are assumed to take the form

$$U_{i,j,\pi_i} = \vartheta_{j,1} m_{i,j,\pi_i} + b_j x_{i,\pi_i} + \kappa_j + v_j c_{i,j} + \varepsilon_{i,j,\pi_i} \quad \text{for } j = o, f, \quad (12a)$$

$$U_{i,n,\pi_i} = = \vartheta_{n,1} m_{i,n,\pi_i} + \kappa_n + \varepsilon_{i,n,\pi_i}, \quad (12b)$$

$$U_{i,v,\pi_i} = = \vartheta_{n,1} m_{i,n,\pi_i} + \varepsilon_{i,n,\pi_i}, \quad (12c)$$

where m_{i,j,π_i},x_{i,π_i}, $c_{i,j}$ and ε_{i,j,π_i} are as described above. The probability of successful job search at $t = \pi_i$ is given by

$$\Gamma_1(z_{i,pi_i}, v_s c_{i,s}) = \frac{\exp(\eta_1 z_{i,\pi_i} + v_s c_{i,s})}{1 + \exp(\eta_1 z_{i,\pi_i} + v_s c_{i,s})}. \quad (13)$$

each household. Agents' expectations about future net incomes are obtained from reduced form equations relating net incomes to gross incomes, recent local labor market conditions and a set of household level demographic variables. Combining expectations concerning net household income with equations of motion for gross income, demographic variables and local labor market conditions completely describes agents' expectation regarding all variables relevant to their current labor supply decision. Based on this information we can derive the expected lifetime utility for each household and each employment state and thus we can estimate the dynamic life cycle model by using maximum simulated likelihood. This methodology provides a reduced-form procedure to account for the endogeneity of experience Eckstein and Wolpin (1989).

Gross Earnings

For couple households, gross earnings consist of the observed labor earnings of the wife and the employment-state specific labor earnings of the husband. The latter define the labor earnings of single men. Moreover, if present income from all other sources than labor income, such as income from capital or renting, are added to the household gross earnings. These non-labor earnings are assumed to be exogenously determined.

For the computation of the gross labor earnings of the men, it is necessary to derive the gross wage distribution for the working and non-working populations. This is the distribution of the offered marked wages which people expect to receive when working. For individuals in the working population in period t we define their observed wage as their draw from the offered wage distribution. By definition, the offered wage for the working satisfies that inequalities $\Delta_{o,f} \geq 0$ and $\Delta_{o,n} \geq 0$ hold (Equation 3a and 3b).

For individuals belonging to the non-working population in period t we cannot observe their draw from the offered wage distribution. Therefore, it is necessary to estimate their expected gross hourly wages that is, the person specific distribution of offered wages W_{it}. As we do not observe W_{it} we estimate $\hat{W}_{it}$, a measure of the mean of the distribution of offered wages. We estimate a standard Mincer wage equation using the information of the working population and interpret the predicted hourly wages of the non-working individuals as the mean of the distribution of offered wages. The wage estimation is performed separately for East and West Germany, see Appendix for the specification and the estimation results.

The expected draw from the offered wage distribution has a different interpretation for the involuntary unemployed and the voluntary non-employed. To be consistent with our definition of voluntary and involuntary unemployment we need to assume that for the involuntary unemployed the offered market wage implies that inequalities $\Delta_{o,f} \geq 0$ and $\Delta_{o,n} \geq 0$ hold while for the voluntary non-working the offered wage make non-employment the optimal employment state, i.e. $\Delta_{o,n} - \Delta_{o,f} < 0$ and $\Delta_{o,n} < 0$.

Net Household Income

In theory, the German income tax is based on the principle of comprehensive income taxation. That is, the sum of a household's incomes from all sources is taxed at a single rate after several deductions have been applied to arrive at the tax base. In our application the gross household income consist of the alternative specific gross earnings of the man, the exogenous gross earnings of the other household members, and further non labor income, such as rental and capital income.[5]. The income tax is computed by applying the income tax function to either the taxable income of each person in the household or of the spouses' joint taxable income, depending on marital status.[6] Income tax and employee's social security contributions are deducted from gross income, and social transfers are added to derive net household income. Social transfers include child benefits, child-rearing benefits, education benefits for

[5]For the sample of low educated men, labor income is by far the largest component of the gross household income

[6] In Germany there exists the principle of joint taxation of households, whereby the income tax of a married couple is calculated by applying the tax function to half of the sum of the spouses' incomes; this amount is then doubled to determine the tax amount of the couple.

students, unemployment compensation, housing benefits and social assistance. To calculate the net household income we use the microsimulation model STSM which includes all relevant components of the German tax and transfer system.[7]

Households Expectations

Evaluating the likelihood requires the expected value functions $\mathbf{E}_t[V_{i,t+1}|s_{i,t}, Y_{i,t}]$ to be computed, which in turn requires the distribution of the state variables $(s_{i,t+1}|s_{i,t}, Y_{i,t})$. In the empirical implementation, value functions are computed by exploiting the structure of the problem and appropriate distributional assumptions combined with the simulation method of Rust (1997).

The distribution of $(s_{i,t+1}|s_{i,t}, Y_{i,t})$ is specificated by first partitioning $s_{i,t}$ into four elements $[s^p_{i,t}, s^{uc}_{i,t}, s^{ud}_{i,t}, \varepsilon_{i,t}]$. $s^p_{i,t}$ contains all of the elements of $s_{i,t}$ that are complectly predictable over time. $s^p_{i,t}$ includes time-invariant characteristics, such as school leaving quantifications, nationality and the random effect c_i, and variables that vary over time in a deterministic fashion, such as age. $s^{ud}_{i,t}$ and $s^{uc}_{i,t}$ contain, respectively, all discrete and continuous elements of $s_{i,t}$ that vary over time and whose movements are not complectly predictable. $\varepsilon_{i,t}$ denotes $\varepsilon_{i,j,t}$ stacked over $j = o, f, n$.[8]

When the individual makes his employment decision at time t he knows the values of all elements of $s_{i,t}$. The individual also knows the values of $s^p_{i,t}$ for $t = 25, ..., 59$. At time t the individual does not know the exact values of $[s^{uc}_{i,t+1}, s^{ud}_{i,t+1}]$ but does know the conditional probability $\Phi(s^{uc}_{i,t+1}, s^{ud}_{i,t+1}|s^p_{i,t+1}, s^{uc}_{i,t}, s^{ud}_{i,t}, Y_{i,t})$, assumed to have the following structure

$$\begin{aligned}\Phi(s^{uc}_{i,t+1}, s^{ud}_{i,t+1}|s^p_{i,t+1}, s^{uc}_{i,t}, s^{ud}_{i,t}, Y_{i,t}) &= f(s^{uc}_{i,t+1}|s^p_{i,t+1}, s^{uc}_{i,t}, s^{ud}_{i,t+1}, Y_{i,t}) \times \\ &\quad \Theta(s^{ud}_{i,t+1}|s^p_{i,t+1}, s^{ud}_{i,t}, s^{uc}_{i,t}, Y_{i,t}) \qquad (14)\end{aligned}$$

This specification limits the number of parameters in the transition matrix of the unpre-

[7] See Steiner, Haan, and Wrohlich (2005) for a detailed description of the microsimulation model.

[8] Recall that $\varepsilon_{i,n,t} = \varepsilon_{i,u,t}$.

dictable variables while still allowing large subsets of the variables to be determined jointly.

The empirical specification is such that the unpredictable discrete variables consist of whether the man has a spouse and, if applicable, spouse's level of education (high or low) and employment state (non-employed, working part-time or working full-time) and the number of dependent children under 18 years of age (zero, one, two or three or more). After excluding single men with children, there are 25 different combinations of these discrete variables. The probability of any one of these outcomes is estimated from a multinomial logit model in which the choice probabilities are conditioned on lagged dependent variables indicating which of the 25 discrete combinations of the unpredictable discrete variables applied to the household in the previous year, the man's nationality and educational attainment, living in east Germany, age terms, previous household income and previous local labor market conditions. The specification thus imposes that current fertility and the spouses working decision do not depend on current household income or current local labor market, but may depend on previous income and previous previous local labor market conditions.

The unpredictable continuous variables correspond to net and gross household income if the man is working overtime, working full-time or does no have a job and two measures of the tightness of the local labor market. The three state specific gross incomes are assumed to be jointly normally distributed with means that depend on the contemporaneous realization of the discrete random variables, age, the man's education and nationality, living in East Germany, previous local labor market conditions and previous state specific gross income. Since the state specific gross earnings depend on age and earnings in the previous labor market state, this specification captures the effect of human capital accumulation over the life cycle. This is similar to the approach Eckstein and Wolpin (1989) where years of experience directly enter the earnings equation.

The three state specific net incomes and the two measures of local labor market conditions are also assumed to be jointly normally distributed but unobservables affecting these variables are assumed to be independent of those affecting gross incomes. The means of the net incomes in full-time and over-time work depend on man's gross income interacted with the discrete variables indicating the number of children, being single and the spouse's employment state. Net income in non-employment is assumed to depend on gross household income if the man is non-employed and characteristics of the household. Due to the large number of households with zero gross income in non-employment, gross income is not interacted with household characteristics in this equation. Hence, for the calculation of the expected state specific net household incomes we do not apply the microsimulation model because the large number of state variables would make the dynamic programming problem computationally too intensive. Instead we estimate reduced form equations which relating net incomes to gross earnings and other variables in a very flexible way. This is consistent with agents having a very detailed understanding of the tax and transfer system in the current year, bet relying on the reduce form when forming expectation about future years.

The two measures of local labor market conditions are assumed to follow a vector autoregressive process with all terms interacted with an East Germany indicator to capture structural differences between the labor markets of east and west Germany.

Having specified the conditional distribution of the state variables, it is possible to approximate the expected value functions. Combining equations (1) and (6)) and taking expectations yields[9]

$$
\begin{aligned}
&\mathbf{E}_t[V_{i,t+1}(s_{i,t+1},Y_{i,t})|s^{p}_{i,t+1},s^{uc}_{i,t+1},s^{ud}_{i,t+1},Y_{i,t}] = \\
&\Gamma(z_{i,t+1},Y_{i,t},c_{i,s})\mathbf{E}_t\left[\max\left[\begin{array}{c} q_{i,o,t+1}+\varepsilon_{i,o,t+1}+\frac{1-\Gamma(z_{i,t+1},Y_{i,t},c_{i,s})}{\Gamma(z_{i,t+1},Y_{i,t},c_{i,s})}q_{i,u,t+1} \\ \\ q_{i,f,t+1}+\varepsilon_{i,f,t+1}+\frac{1-\Gamma(z_{i,t+1},Y_{i,t},c_{i,s})}{\Gamma(z_{i,t+1},Y_{i,t},c_{i,s})}q_{i,u,t+1} \\ \\ \frac{q_{i,n,t+1}}{\Gamma(z_{i,t+1},Y_{i,t},c_{i,s})}+\varepsilon_{i,n,t+1} \end{array}\right]\right]+ \\
&(1-\Gamma(z_{i,t+1},Y_{i,t},c_{i,s}))\mathbf{E}_t[\varepsilon_{i,n,t+1}], \qquad (15)
\end{aligned}
$$

and the above distributional assumptions imply[10]

$$
\begin{aligned}
&\mathbf{E}_t[V_{i,t+1}(s_{i,t+1})|s^{p}_{i,t+1},s^{uc}_{i,t+1},s^{ud}_{i,t+1},Y_{i,t}] = \\
&\Gamma(z_{i,t+1},Y_{i,t},c_{i,s})\left(\Upsilon+\log\left(\exp\left(q_{i,o,t+1}+\frac{1-\Gamma(z_{i,t+1},Y_{i,t},c_{i,s})}{\Gamma(z_{i,t+1},Y_{i,t},c_{i,s})}q_{i,u,t+1}\right)\right.\right. \\
&+\exp\left(q_{i,f,t+1}+\frac{1-\Gamma(z_{i,t+1},Y_{i,t},c_{i,s})}{\Gamma(z_{i,t+1},Y_{i,t},c_{i,s})}q_{i,u,t+1}\right) \\
&\left.\left.+\exp\left(\frac{q_{i,n,t+1}}{\Gamma(z_{i,t+1},Y_{i,t},c_{i,s})}\right)\right)\right)+(1-\Gamma(z_{i,t+1},Y_{i,t},c_{i,s}))\log(\Upsilon), \qquad (17)
\end{aligned}
$$

where Υ is Euler's constant.[11]

The quantity of interest is

$$
\begin{aligned}
&\mathbf{E}_t[V_{i,t+1}(s_{i,t+1})|s^{p}_{i,t+1},s^{uc}_{i,t},s^{ud}_{i,t},Y_{i,t}] \\
&=\int \mathbf{E}_t[V_{i,t+1}(s_{i,t+1},Y_{i,t})|s^{p}_{i,t+1},s^{uc}_{i,t+1},s^{ud}_{i,t+1},Y_{i,t}]d\Phi(s^{uc}_{i,t+1},s^{ud}_{i,t+1}|s^{p}_{i,t+1},s^{uc}_{i,t},s^{ud}_{i,t},Y_{i,t}), \qquad (18) \\
&=\int \mathbf{E}_t[V_{i,t+1}(s_{i,t+1})|s^{p}_{i,t+1},s^{uc}_{i,t+1},s^{ud}_{i,t},Y_{i,t}]f(s^{uc}_{i,t+1}|s^{p}_{i,t},s^{uc}_{i,t},s^{ud}_{i,t+1},Y_{i,t})ds^{uc}_{i,t+1}, \qquad (19)
\end{aligned}
$$

[9] See Appendix I.

[10] Suppose ϵ_j for $j=1,...,K$ are identically and independent distributed with a type I extreme value distribution. It follows that

$$
\mathbf{E}\max[a_1+\epsilon_1,a_2+\epsilon_2,...,a_K+\epsilon_K]=\Upsilon+\log(\exp(a_1)+\exp(a_2)+...+\exp(a_K)). \qquad (16)
$$

[11] Υ=0.577215665...

where

$$\mathbf{E}_t[V_{i,t+1}(s_{i,t+1})|s^p_{i,t+1}, s^{uc}_{i,t+1}, s^{ud}_{i,t}, Y_{i,t}] =$$

$$\sum_{s^{ud'}_{i,t+1} \in S^{ud}_{i,t+1}} \mathbf{E}_t[V_{i,t+1}(s_{i,t+1}, Y_{i,t})|s^p_{i,t+1}, s^{uc}_{i,t+1}, s^{ud'}_{i,t+1}, Y_{i,t}]\Theta(s^{ud'}_{i,t+1}|s^p_{i,t}, s^{ud}_{i,t}, Y_{i,t}). \quad (20)$$

It remains to evaluate the integral over $s^{uc}_{i,t+1}$ occurring in Equation (19). In this application the integral is evaluated using a form of Monte Carlo integration as introduced by (Rust, 1997). Specifically, the integral occurring in equation (19) is approximated by

$$\sum_{r=1}^{R} \mathbf{E}_t[V_{i,t+1}(s_{i,t+1})|s^p_{i,t+1}, s^{uc,r}, s^{ud}_{i,t}, Y_{i,t}] \frac{f(s^{uc,r}|s^p_{i,t+1}, s^{uc}_{i,t}, s^{ud}_{i,t+1}, Y_{i,t})}{\sum_{k=1}^{R} f(s^{uc,k}|s^p_{i,t+1}, s^{uc}_{i,t}, s^{ud}_{i,t+1}, Y_{i,t})}, \quad (21)$$

where each of the 8 elements of $s^{uc,r}$ for $r = 1, ..., R$ are *iid* draws from a uniform distribution with lower and upper bounds equal to the lowest and highest values possible values of the corresponding state variable.

3 Data and Descriptive Statistics

This study draws on data from the SOEP which is a representative sample of over 12,000 households living in Germany which contains yearly information about working behavior and socio-economic variables on the individual and household level.[12] For this analysis, we construct an unbalanced panel of men with consecutive observations in at least two years between 2000 - 2006 inclusive. This yields retrospective information for the fiscal years 1999 - 2005. The regional labor market indicators, which are necessary for identification of involuntary unemployment, are collected by the Employment Office separately for 438 geographical regions.[13] This information is matched exactly to each household in the sample.[14]

In our analysis we focus on men of prime working age with low education. We restrict the sample to men older than 25 and younger than 59 years, with either no, a low or a medium

[12] For a detailed description of the data set, see Haisken De-New and Frick (2005).
[13] Source: Arbeitslose nach Kreisen, Bundesagentur für Arbeit.
[14] Data on regional labor market indicators are collected monthly. However, as the interviews of the SOEP are mainly conducted in the first quarter of the year we use regional labor market indicators in April of each year.

school degree, and at most the lowest vocational degree. Further, we exclude self-employed men as well as men in full-time education as their labor supply behavior differs substantially from that of the rest of the population of interest. These exclusions yield a sample with 11,626 person year observations corresponding to 2,437 different men.

3.1 Working Behavior of Men

Figure 1 shows the distribution of weekly working hours in our sample of men. We find that roughly 15% of the men in out sample do not work. This group includes both voluntary non-participants and those who are involuntarily unemployed. Only 3% of men in employment work less than 35 hours per week and hence we define men working up to 40 hours per week as being in full-time employment while men working more than 40 hours per week are classified as working over-time. The pronounced peaks in the distribution of male working hours justify why we choose to model the labor supply behavior of men on the extensive and intensive margins in a discrete framework rather than assuming a continuous specification of working hours.

[**Figure 1: about here**]

Voluntary and Involuntary Unemployment

The SOEP yields information to identify the involuntary unemployed as defined above. Each non-working individual is asked (i) whether he has actively searched for a job within the last four weeks; and (ii) whether he is ready to take up a job within the next two weeks. We follow the ILO definition and treat those who answer both questions positively as involuntarily unemployed.

Table 2 shows that around half of the non-working men, or 10% of the overall population, are involuntarily unemployed according to the above definition.[15] The majority of sampled

[15]Note that these rates differ from official unemployment statistics since their denominators contain some of the inactive population (precisely the voluntary unemployed) and also because of selection criteria.

Table 2: Discrete Working Hours of Men with Rationing

	Share	Median Hours	Mean Age	Share East	Mean U. Rate
Vol. Non-Participation	.06	-	47.04	.36	13.82
Inv. Unemplyment	.08	-	42.07	.53	15.88
Full-time	.57	38.5	42.39	.20	11.11
Over-time	.29	44	41.34	.27	11.91
Average		38.5	42.34	0.26	11.88

The following (weekly) working hours classification used: 0, 0-40 (full-time), >40 (over-time).
Unemployment rate is the regional unemployment rate measured at county level.
Source: SOEP 2000 - 2006 and Bundes Agentur für Arbeit.

men work full-time, close to 30% work more than 40 hours per week, 6% are involuntary unemployed and the remaining 6% are classifies as voluntary non-employed. As expected, the voluntary non-participants tend to be older than the average. We find an interesting regional difference in employment behavior. Given the economic difficulties in the eastern part of Germany, it is hardly surprising that the share of east Germans is above average for both voluntary and involuntary unemployment. However, we also find that the share of east Germans working over-time is 27%, above the sample average.

The involuntarily unemployed are rationed by the demand side of the labor market. In the empirical analysis we identify an individual's probability of rationing using aggregate variables describing the situation on the regional labor market, individual characteristics and the individual's previous labor market state. The regional labor market indicators are collected at a county level, 438 for Germany, and display a high level of variation.[16] The distribution of the regional unemployment rate by working status can be found in the last column of Table 2. The involuntarily unemployed tend to live in regions with higher unemployment rates, while for the other three labor market states the regional unemployment rates hardly differ.

[16]The key variable, the regional unemployment rates varies between about 2% to more than 30% with an average rate of 11.68 and a variance of 33.34.

Table 3: Persistence in Working Behavior

	Vol. Non-Part.	Inv. Unemp.	Full-Time	Over-Time
Vol. Non-Part. t-1	59.53	23.98	9.85	6.64
Inv. Unemp. t-1	17.42	54.43	18.00	10.16
Full-Time t-1	2.06	3.36	79.54	15.05
Over-Time t-1	2.16	3.59	30.16	64.09

The following working hours classifications (weekly) are used: 0, 0-40, >40.
All numbers are in %.
Source: SOEP, wave 2000-2006.

Persistence and Employment over the life cycle

Table 3 shows the high persistence of the labor market states over time which has been well-documented in the previous literature. With close to 80% persistence is highest for full-time work, similarly high for over-time (64%) and still present for the non-working states with over 50%. Further, there is an even stronger persistence on the extensive margin. Only 5% of men who were working in period t-1, are voluntary or involuntary unemployed in period t and the probability of the non-working to stay in a labor market status out of work are far higher. As shown by previous studies, this persistence can be explained by unobservable and observable characteristics and by the effect of state dependence in labor supply behavior. This motivates our empirical specification which models the current payoff from the different labor market status conditional on the previous employment state.

4 Estimation Results

[TO BE COMPLETED]

4.1 Performance of the Model

In-Sample Prediction of the Model

[TO BE COMPLETED]

Out-of-Sample Prediction of the Model

[TO BE COMPLETED]

4.2 Labor Supply Elasticities

5 The life cycle Employment Effects of In-Work Transfers

The German welfare system can be characterized as a traditional welfare system with relatively generous out-of-work transfers that are withdrawn at high rates when people start working. In the political discussion this has often been criticized and the low working incentives have been identified as one central reason for the relative high unemployment. This is in particular true for the low skilled as the system generates in particular low incentives for this group. Drawing on the international experience, mainly from the US and the UK, there is an ongoing debate about changing the German welfare system towards shifting more transfers to the working poor and thus increasing work incentives. One prominent example in the political discussion is the UK Working Tax Credit (WTC). Conditional on a minimal amount of working hours, workers receive a transfer that is means tested against the gross family earnings. Blundell (2000) and more recently Brewer and Browne (2006) discuss the British experience with in-work credits and survey the labor market effects of recent changes in the design of the WTC. Another international example which is present in the German debate is the Employment Bonus, as implemented in Belgium. This transfer program is conditioned on individual full-time equivalized earnings and differs therefore from the WFTC in several important points. First, it is not conditional on a minimal amount of weekly working hours but increases proportionally with working hours. Second, the entitlement is based on individual rather than on household earnings. That implies that the Employment Bonus avoids the well understood negative secondary earner effects of programs similar to the WFTC. Lastly, as the Employment Bonus depends on equivalized earnings, individuals with earnings above a defined threshold, here about 11.5 Euro per hour, do not receive any transfer, thus this program is strongly targeted at the low-wage people.

5.1 Effects on work incentives

The following figures shows the effects of changing the German welfare system by introducing i) a program similarly designed as the UK-style WFTC and ii) the Employment Bonus following the Belgian example. As mentioned above, in the UK, the WFTC has been targeted in particular to families with children and therefore, a sizable component of the transfers are contingent on having children. For the hypothetical policy experiment for Germany we assume that all household independent of children are eligible for the full tax-credit.[17] The only criteria are the benefit receipt are the minimum working condition and the means-testing based on the joint gross household earnings. We introduce these reforms on top of the legislation of the tax and transfer system as implemented in the year 2005. A more detailed description of the transfer programmes is provided in the Appendix. To better understand the implied work incentives of these transfer programs we present several stylized budget lines, i) for a single man without children, ii) for a married household where the woman is not working, thus the man is the first-earner, and ii) for a married household with a full time working woman, here the man is the second earner. We assume in both scenarios that the household has no children and the spouses have an hourly wage of 8.50 Euro.

[Figure 2-4: about here]

For a single man, we assume out-of work benefits of nearly 600 Euro per month. Due to the high withdrawal rate of the benefits when starting to work the work incentives are relatively low for a single with a low hourly wage of 8.50 Euro. Only when working more than 30 hours the benefits are completely withdrawn. Both, the WFTC and the Employment Bonus markedly increase work incentives. When the minimum working hours restriction are met, 15 hours and for the full-time bonus, 30 hours, net-household income significantly increase. However, due to the withdrawal of the WFTC the incentives for full-time work decrease. In

[17] We exclude the child component of the WFTC which is not means-tested.

contrast, the Employment bonus has positive work incentives only for higher working hours. At the beginning the Employment Bonus is completely withdrawn due to the means-testing of the social assistance. The positive effects become evident at about 25 weekly working hours and in contrast to the WFTC they are increasing with working hours. This is because the Employment bonus is conditional on the full-time equivalent of individual earnings.

The work incentives of the transfer reforms for a couple household strongly dependent on the working behavior of the partner. In a household where only one spouse is working, the incentives of the reforms are very similar as for the single. The effects for a secondary earner however, are fundamentally different for the WFTC and the Employment Bonus. Since the WFTC is based on the joint gross household earnings, it provides negative work incentives for the secondary earner Blundell, Duncan, McCrae, and Meghir (2000). The Employment Bonus however provides higher work incentives even for the secondary earner, as it is based on individual earnings.

The work incentives of the transfer programs strongly depend on the characteristics of all household members, such as children or individual wages. This is in particular true for the Employment Bonus as only low-wage people are eligible for this program.

5.2 Effects on life cycle employment

[**TO BE COMPLETED**]

6 Conclusion

[**TO BE COMPLETED**]

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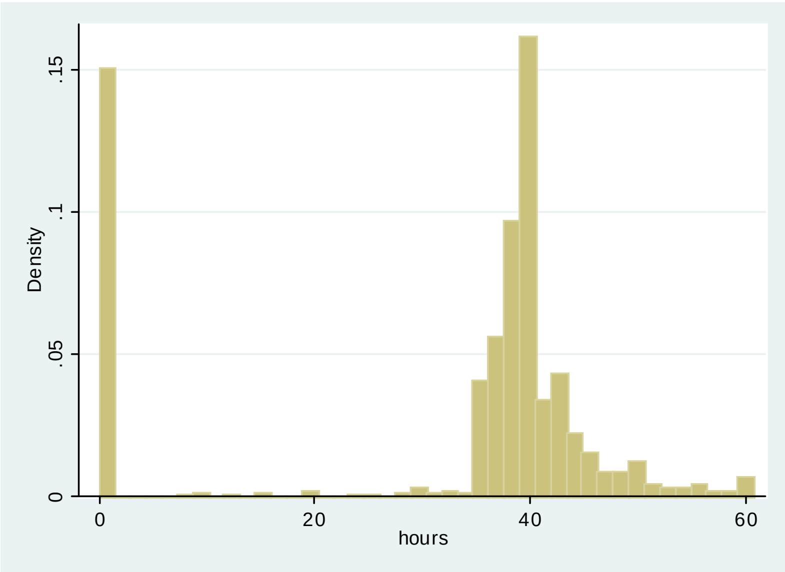
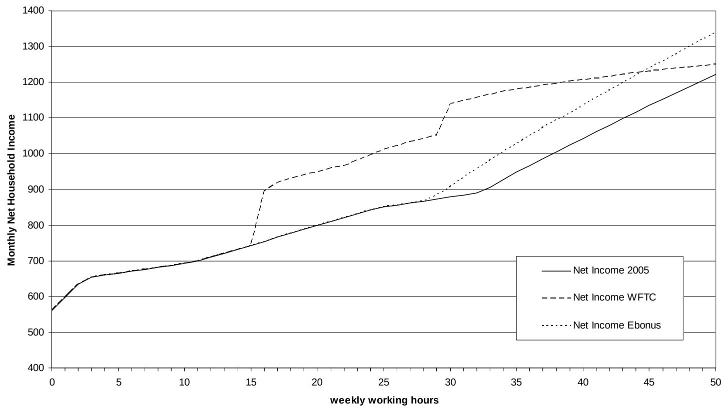
Figure 1: Working behavior of men



Notes: Weekly working hours are reported contractual hours plus reported paid over-time. Men are aged between 25 and 59. The distribution is censored at 60 hours per week which excludes about 2% of the relevant population.

Source: SOEP, 2000 - 2005.

Figure 2: Budget constraint Single Man - Hourly wage 8.5 Euro



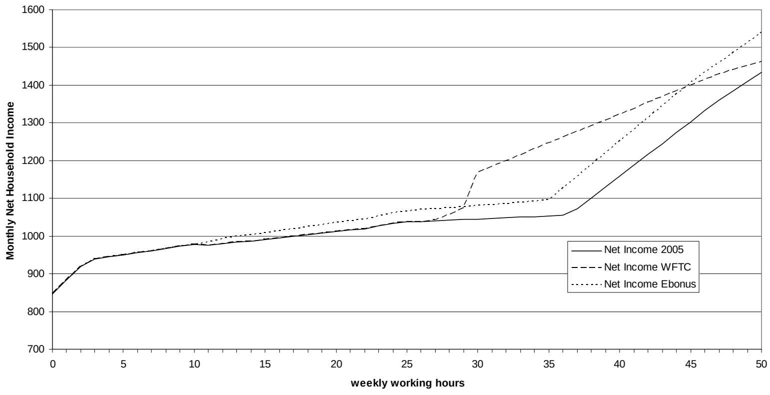
Notes: Budget line for a stylized hh

Appendix I: The Value Function

Substituting equation (6) into equations (1) and adding and subtracting $\Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s})\varepsilon_{i,n,t+1}$ from line 3 gives of this expression gives

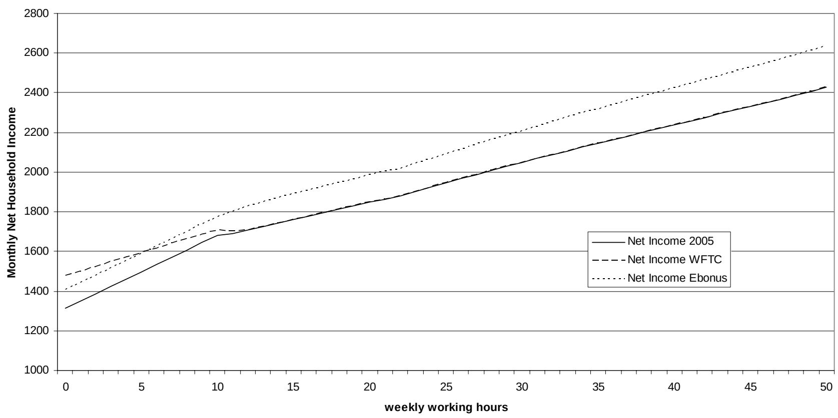
$$V_{i,t+1}(s_{i,t+1}, Y_{i,t}) = \max \begin{bmatrix} \Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s})(q_{i,o,t+1} + \varepsilon_{i,o,t+1}) + (1 - \Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s}))(q_{i,u,t+1} + \varepsilon_{i,n,t+1}) \\ \Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s})(q_{i,f,t+1} + \varepsilon_{i,f,t+1}) + (1 - \Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s}))(q_{i,u,t+1} + \varepsilon_{i,n,t+1}) \\ q_{i,n,t+1} + \Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s})\varepsilon_{i,n,t+1} + (1 - \Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s}))\varepsilon_{i,n,t+1} \end{bmatrix}. \quad (22)$$

Figure 3: Budget constraint Single Earner No Kids - Hourly wage 8.5 Euro



Notes: Budget line for a stylized hh

Figure 4: Budget constraint Two Earner - Hourly wage 8.5 Euro



Notes: Budget line for a stylized hh

The above can be separated as follows

$$V_{i,t+1}(s_{i,t+1}, Y_{i,t}) = \max\begin{bmatrix} \Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s})(q_{i,o,t+1} + \varepsilon_{i,o,t+1}) + (1 - \Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s}))q_{i,u,t+1} \\ \\ \Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s})(q_{i,f,t+1} + \varepsilon_{i,f,t+1}) + (1 - \Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s}))q_{i,u,t+1} \\ \\ q_{i,n,t+1} + \Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s})\varepsilon_{i,n,t+1} \end{bmatrix}$$

$$+ \max\begin{bmatrix} (1 - \Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s}))\varepsilon_{i,n,t+1} \\ \\ (1 - \Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s}))\varepsilon_{i,n,t+1} \\ \\ (1 - \Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s}))\varepsilon_{i,n,t+1} \end{bmatrix} \tag{23}$$

$$= \max\begin{bmatrix} \Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s})(q_{i,o,t+1} + \varepsilon_{i,o,t+1}) + (1 - \Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s}))q_{i,u,t+1} \\ \\ \Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s})(q_{i,f,t+1} + \varepsilon_{i,f,t+1}) + (1 - \Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s}))q_{i,u,t+1} \\ \\ q_{i,n,t+1} + \Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s})\varepsilon_{i,n,t+1} \end{bmatrix}$$
$$+(1 - \Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s}))\varepsilon_{i,n,t+1}. \tag{24}$$

Factoring $\Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s})$ from the first part of Equation (24) yields

$$V_{i,t+1}(s_{i,t+1}, Y_{i,t}) = \Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s}) \max\begin{bmatrix} q_{i,o,t+1} + \varepsilon_{i,o,t+1} + \frac{(1-\Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s}))}{\Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s})} q_{i,u,t+1} \\ \\ q_{i,f,t+1} + \varepsilon_{i,f,t+1} + \frac{(1-\Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s}))}{\Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s})} q_{i,u,t+1} \\ \\ \frac{q_{i,n,t+1}}{\Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s})} + \varepsilon_{i,n,t+1} \end{bmatrix}$$
$$+(1 - \Gamma(z_{i,t+1}, Y_{i,t}, c_{i,s}))\varepsilon_{i,n,t+1}. \tag{25}$$

Taking the expectation of both sides of Equation (25) conditional on $(s^p_{i,t+1}, s^{uc}_{i,t+1}, s^{ud}_{i,t+1}, Y_{i,t})$ yields Equation (15).