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Labor supply under participation and hours constraints

An extended structural model for policy evaluations

Kai-Uwe Müller[‡], Michael Neumann[⋆], Katharina Wrohlich[♮]

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Abstract

The paper extends a static discrete-choice labor supply model by adding participation and hours constraints. We identify restrictions by survey information on the eligibility and search activities of individuals as well as actual and desired hours. This provides for a more robust identification of preferences and constraints. Both, preferences and restrictions are allowed to vary by and are related through observed and unobserved characteristics. We distinguish various restrictions mechanisms: labor demand rationing, working hours norms varying across occupations, and insufficient public childcare on the supply side of the market. The effect of these mechanisms is simulated by relaxing different constraints at a time. We apply the empirical framework to evaluate an in-work benefit for low-paid parents in the German institutional context. The benefit is supposed to increase work incentives for secondary earners. Based on the structural model we are able to disentangle behavioral reactions into the pure incentive effect and the limiting impact of constraints at the intensive and extensive margin. We find that the in-work benefit for parents substantially increases working hours of mothers of young children, especially when they have a low education. Simulating the effects of restrictions shows their substantial impact on employment of mothers with young children.

Keywords: labor supply; hours restrictions; involuntary unemployment; gender

JEL classification: J22; J23; J16; J64

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1 Introduction

In recent years optimization frictions and restrictions have regained interest (Chetty, 2012). This research has also influenced the literature on labor supply elasticities (Chetty et al., 2011), based on quasi-experimental variation (Kleven and Waseem, 2013) as well as structural frameworks (Beffy et al., 2016). Observed behavior on the labor market is not simply the result of utility optimization, but also reflects constraints and frictions prevalent on the labor market that might be related to regulations, institutions, or insufficient labor demand. The distinction is likewise relevant for economic policy analysis. Potential behavioral reactions to changing monetary incentives might be limited by various constraints (Stewart and Swaffield, 1997). Empirical models of the labor market used for evaluation purposes need to capture these different mechanisms.

We therefore augment a static discrete choice labor supply model by including different types of constraints. Instead of relying on actual working hours as revealed preferences (van Soest, 1995) we draw on Euwals and van Soest (1999) and estimate labor supply preferences based on stated desired working hours. The model features restriction probabilities for each positive hours choice that represent participation and hours constraints. One can think of *participation constraints* as labor demand rationing (Laroque and Salanié, 2002; Bargain et al., 2010). Individuals may lack the productivity to attract job offers and become involuntarily unemployed. In addition, specific *hours restrictions* (Euwals and van Soest, 1999) may arise because demand for specific numbers of hours is lacking in certain occupations or labor market sectors: employers might for example either favour, or are only able to offer full-time jobs, less part-time jobs and hardly anything in between. On the other hand, jobs with specific working hours might also not be viable for employees because, e.g., adequate childcare is either not available or affordable.

We apply this empirical framework to analyze an in-work benefit (IWB) for low-paid parents in the German institutional context. In-work credits as the Earned Income Tax Credit (EITC) in the US (Meyer, 2010) or the Working Tax Credit (WTC) in the UK (Costa Dias et al., 2012) imply small work incentives for low income households or adverse incentives for secondary earners, particularly under joint taxation and generous welfare. By contrast, the IWB especially targets incentives for secondary

earners: eligibility is conditional on hours of work exceeding 25 hours per week. Moreover, the benefit depends on individual wage rates and the number of children in the household.

The IWB is – as in-work credits in general are – designed to impact the labor market through financial incentives. To what degree this translates into actual behavioral adjustments depends, however, also on labor market restrictions. Modeling participation and hours constraints is thus crucial for the evaluation of such a policy proposal. Our model not only allows us to answer the research question of how mothers and fathers in couple households with young children would adjust their working behavior. Based on the model we can also disentangle the pure incentive effect on labor supply from the limiting impact of constraints. We can further analyze to what extent different types of labor market restrictions contribute to the low labor supply of secondary earners in households with young children. Effect heterogeneity is considered by distinguishing east and west Germany as well as different qualification levels.

The problem of hours restrictions has been acknowledged already by Moffitt (1982) who extends a Tobit model to account for institutional restrictions on part time work. van Soest et al. (1990) augment a Hausman (1980) type labor supply model with hours constraints by letting individuals choose between a finite set of wage-hours packages. Similar approaches are followed by Tummers and Woittiez (1991), Dickens and Lundberg (1993), Aaberge et al. (1995) and Bloemen (2000). In terms of participation constraints we draw on a similar tradition. Meyer and Wise (1983) took a first step towards this direction distinguishing involuntary unemployment from other sources of non-employment. Blundell et al. (1987) set up a continuous labor supply model complemented by a rationing risk equation. Laroque and Salanié (2002) estimate a static structural labor supply model and distinguish different types of non-employment.

The general challenge in this literature is to separately identify preferences and the job offer distribution from observed hours of work. Beffy et al. (2016) exploit situations when individuals face non-convex budget sets and are observed to work an irrational amount of hours. Bargain et al. (2010) use a discrete choice household labor supply model and specify a latent rationing equation for the extensive margin utilizing information on desired hours. Bloemen (2008) introduces stated desired

hours of work into a job search model in order to separately identify preferences and the job offer distribution.

We follow here an approach by Euwals and van Soest (1999) and exploit survey information on the eligibility and search activities of individuals as well as actual and desired hours to identify preferences and restrictions within a labor supply model with participation and hours constraints. Our contribution to the literature is twofold. First, we extent this framework to couple households allowing for restrictions at the extensive and intensive margin for both partners. Second, we allow the constraints to vary across individuals by observed and unobserved characteristics. Our model accounts for a differential impact of restrictions for men and women, across regions, and for different education levels. We further link the explanatory factors to various underlying mechanisms: We consider labor demand rationing as well as working hours norms that vary across occupations. Restrictions which do not originate from the labor market are also covered. Insufficient formal childcare might, for instance, prevent parents from accepting jobs with many hours. Having explanatory variables representing different mechanisms allows us to simulate their effect by relaxing different kinds of constraints at a time. Preferences and restrictions are jointly estimated which facilitates correcting selection by way of unobserved characteristics in the equations for the different hours restriction probabilities.

Focusing on a representative sample of couple households with children we find that the IWB for Germany would increase the mothers' participation rate by 0.3 percentage points and their average working hours by two percent. Behavioral effects of fathers are negligible. A simulation of the effects of restrictions shows their substantial impact on employment. Working hours of mothers would increase by 24% and their participation rate by ten percent when constraints could be removed completely. Removing only restrictions due to the lack of formal childcare shows that supply side restrictions make out a crucial part of mothers' restrictions. These exercises also reveal the heterogeneous impact of restrictions on men and women. Fathers face the largest constraints in part-time employment. Mothers are primarily constrained in categories with large working hours. Removing constraints thus allows men to reduce their working hours.

The remainder of the paper is in four parts. Section 2 describes our data set and presents some descriptive findings on the discrepancy of desired and actual working

hours for couples in our sample. We discuss the econometric model in section 3. Empirical results are presented in section 4. After presenting parameter estimates, the selection correction in the estimation of restrictions and the model fit, we compare labor supply elasticities of our model with a standard labor supply model. Then we describe the design of the IWB and apply our model to evaluate the employment effects. Section 5 discusses the findings and concludes.

2 Data and descriptive results

The empirical analysis is based on the German Socio-Economic Panel (GSOEP), a representative survey of German households conducted since 1984 (Wagner et al., 2007), and its add-on "Families in Germany" (FiD, see Schröder et al., 2009). Both surveys contain compatible information on different sources of income, working time, the previous labor market experience as well as detailed socio-demographic characteristics of the individual and the household.

We exploit the period 2010 to 2013 comprising the first four waves available of the FiD survey. We restrict the analysis to households with children. We include the FiD survey in order to maximize the sample size of households with young children for who we expect the largest effects of an in-work benefit for parents[1]. The FiD subsample we use focuses on families with children born between 2007 and 2010. Joint sample weights for GSOEP and FiD though ensure that our sample is representative for all households with children.

GSOEP and FiD respondents are not only asked about their (effective) actual working time, but also how many hours they desire to work. The exact wording is: "If you could choose your own number of working hours, taking into account that your income would change according to the number of hours: How many hours would you want to work?"[2]. For non-employed individuals the question on desired hours

[1]The FiD has also another advantage. In comparison to other household data sets (including the SOEP), the FiD provides more detailed information on potential restrictions. FiD respondents are not only asked about their (effective) actual working time and their desired working hours but also about the reason for a potential deviation.

[2]In the FiD survey, the wording is slightly different: "If you could choose your own number of working hours, taking into account that your income would change according to the number of hours: Would you prefer to decrease, increase or maintain your number of working hours?". If they prefer a change, they will be asked for their exact desired working hours. As this might impact the response we control for the survey an observation comes from.

of work differentiates only between non-work, part-time and full-time. According to their preferences we assign them randomly a specific hours category, e.g. different lengths of part-time, with the probability weights given by the observed shares for employed people.

There are two possible interpretations to the question on desired hours of work (Callan et al., 2007): Respondents might choose their desired hours of work conditional on their partners' actual working hours (constrained optimization). We deviate from this view and assume here that both spouses can freely choose their desired labor supply (unconstrained optimization of family utility).

As we are mainly interested in the effects of introducing a policy which aims at increasing work incentives for secondary earnings, our sample is restricted to couple households only. Moreover, we exclude observations with negative net income and couples with more than three children. Further, we only consider couples where both spouses are 'flexible' with respect to their labor supply, i.e. are neither in full-time education, on maternity leave, fully disabled, nor retired. Overall 11,327 choice situations of 4,984 households are used in the estimation. The descriptive statistics are given in table A2 in the Appendix E.

Cross-tabulating the distributions of desired and actual hours for men and women in our sample reveals some basic patterns (table 1). For men the by far most desired hours categories are full-time and overtime. Most of these men actually seem to be able to work their desired amount of hours. This changes significantly for men who desire to work 25 to 35 hours whereof almost 75% are restricted in the sense that desired and actual hours deviate. Virtually all of them are over-employed. Men do generally not desire to or actually work in the lower two hours categories. Approximately 8% of the male sample does not work, half of them voluntarily.

By contrast, non-participation is the dominating alternative for women. Almost one third of the female sample prefers not to work. The great majority of employed women actually works and desires to work in one of the three part-time categories. 60% of women desire to work less than 25 weekly hours. Less than 15% prefer the full-time categories. The scope for increasing incentives for women to work more is thus fairly high.

Preferences and incentives are not the only reasons for women working few hours or not at all. Roughly 13% of non-working women are involuntarily unemployed.

Table 1: Joint frequency distribution of desired and actual hours of work

Desired \ Actual	0	1-14	15-24	25-35	36-40	>40	Total
Men							
0	429	0	0	3	4	3	439
1-14	7	41	2	2	9	9	70
15-24	4	3	57	13	32	25	134
25-35	93	8	26	499	802	503	1931
36-40	234	38	35	202	3833	1753	6095
>40	102	2	5	18	309	2222	2658
Total	869	92	125	737	4989	4515	11327
Women							
0	3390	1	3	0	1	0	3395
1-14	43	817	87	24	0	0	971
15-24	112	458	1627	230	45	9	2481
25-35	260	137	448	1564	442	162	3013
36-40	66	36	69	212	723	185	1291
>40	6	4	4	4	18	140	176
Total	3877	1453	2238	2034	1229	496	11327

Notes: No weights used. Desired hours of involuntary unemployed discriminate only between part-time, full-time and *both*. Finer categories are allocated randomly and proportionally by considering the crude information.
Source: Own calculations based on GSOEP and FiD, waves 2010-2013.

Under-employment also concerns employed women, though. While 56% of them desire to work more than 25 hours, only about 47 % actually do. Supply side reasons like child care duties are stated to be similarly responsible for not being able to increase hours of work as labor demand rationing. This is however only true for women. For under-employed men supply side reasons are of minor importance.

There is evidence that the deviation between actual and desired hours as stated in a survey is informative about working hours constraints. Blundell et al. (2008), for example, show that desired hours have predictive power for next year's working hours. Euwals (2005) comes to the same conclusion based on SOEP data. Bryan (2007) finds that local labor market conditions only affect hours of work for individuals whose actual deviate from their desired hours.

The labor demand variables measured at the regional level are taken from a data set called "Indicators and Maps on the Spatial Development" ("Indikatoren und Karten zur Raumentwicklung", INKAR, see Helmcke, 2008). It includes indicators

at different regional levels for Germany. We use data at the county level which can be matched based on regional identifiers in the FiD.

3 Econometric model

The model is based on a discrete choice specification (van Soest, 1995) of a standard labor supply framework (Blundell and Macurdy, 1999). Given their expected wage employees choose among job offers with different hours of work. Households maximise their aggregate utility which is determined by income and leisure. We go beyond a purely neoclassical conception of the labor market by considering participation and working hours constraints that individuals face when choosing their labor supply (Stewart and Swaffield, 1997). Observed and unobserved heterogeneity at the household level is allowed in preferences and constraints which are estimated jointly to control for selection in the restriction part.

Following Euwals and van Soest (1999) the model consists of two main building blocks. First, *labor supply preferences* are modeled within a standard discrete-choice labor supply framework (van Soest, 1995). We consider cohabiting partners with young children who are assumed to decide collectively on job offers. Estimation of preferences is based on stated desired, rather than actual working hours (van Soest et al., 2002; van Soest and Das, 2001). Desired working hours are assumed not to be affected by actual hours or potential restrictions and thus indicate the undistorted labor supply of both partners.

Second, choice restrictions are modeled representing *participation and hours constraints*. Participation constraints accrue from labor demand rationing (Laroque and Salanié, 2002; Bargain et al., 2010) as certain individuals are not productive enough to receive any job offers and are involuntarily unemployed. Conditional on participation, hours restrictions might arise either when jobs with preferred working hours are not offered by employers (Euwals and van Soest, 1999). Working hours norms might, e.g., vary between occupations or sectors. Or jobs with specific hours might not be viable for certain employees because adequate childcare is not available or affordable. Note that hours constraints can also lead to observed involuntary unemployment: people might choose zero hours with their preferred hours choice(s) not being available. The constraints covered here are more comprehensive than

adjustment costs for hours of work or informational frictions on the labor market that are commonly captured in job search frameworks (Rogerson et al., 2005). We, however, do not structurally model the restriction mechanisms. We further abstract from dynamic considerations in both model parts (Keane et al., 2011).

Constraints are specified as restriction probabilities on individual employment states with positive working hours. Estimation is based on survey information about stated desired and observed actual working hours. Assuming that constraints are not directly dependent on the spouse's restrictions, the deviation between desired and actual hours is informative about individual restrictions.

This approach comes with potential selection problems, though. Information on a given hours category is only available, if an individual desires to or actually works in this state. Since certain groups of people are less or more likely observed to desire or to work in specific categories, the identification of hours constraints is based on groups of individuals that are not representative for the whole population. It is conceivable that a couple's propensity for consumption is systematically related to its restriction probabilities. This is similar to the standard selection problem in labor economics (Heckman, 1979). In our model preferences and choice restrictions are therefore related through observed and unobserved factors and estimated jointly. Unobserved heterogeneity in constraints is modeled non-parametrically by two latent types for men and women. The combination of types within couples results in four latent household types differing in their preference for consumption.

In the remainder of this section we first discuss preferences (sub-section 3.1) and then the constraints part of the model in greater detail (sub-section 3.2). After presenting the likelihood function (sub-section section 3.3) we explain how we model unobserved heterogeneity and selection issues (sub-section section 3.4).

3.1 Preferences for work

Couples choose a labor supply arrangement from $j = 1, 2, \ldots, J$ different labor market states[3]. Households maximise the direct utility function $u_j(.)$ in the arguments net income y_j and leisure l_j^m, l_j^w for men and women, denoted by m and w respectively. Leisure time is defined as the difference of total time endowment $TE = 80$ and hours of work h_j^m or h_j^w. Similar to Euwals and van Soest (1999), van Soest et

[3]For the sake of readability, we do not specify a household index in this exposition.

al. (2002), van Soest and Das (2001), or Callan et al. (2007) we take desired working hours h_j^d (as opposed to actual hours h_j^a) as revealed preferences. Consistent with the unitary labor supply model we assume that preferred hours are stated under the condition that both spouses choose freely without facing restrictions. labor supply preferences can then be inferred directly from desired working hours as stated in our data.

Disposable income $y_j = y(h_j^m, h_j^w, w^m, w^f, y^{nl}, X^m, X^w, X)$ depends on both spouses' labor supply, their before tax wage rates (w^m, w^w), non-labor household income y^{nl} and individual or family characteristics (X^m, X^w, X) which determine taxes, contributions and transfers. We use a microsimulation model (Steiner et al., 2012) to compute y_j for all possible labor supply choices of each household. Wage rates are estimated outside of the labor supply model[4].

Following van Soest (1995) we assume that couples choose out of a finite number of mutually exclusive alternatives. A family's unrestricted choice set contains all pairwise combinations of the man's and the woman's hours categories. Alternative j corresponds to the combination of the man's and woman's working hours category h_j^m, h_j^w, and the resulting family income y_j. Hours categories for both spouses include non-employment, marginal employment (10 hours), part-time (20 hours), reduced full-time (30 hours), full-time (40 hours) and overtime (45 hours). The unrestricted choice set thus consists of $J = 36$ alternatives.

We use a linear-quadratic specification of the utility function and allow preferences for leisure and consumption in their linear terms to vary with observed individual or household characteristics. Adding alternative-specific error-terms e_j leads to the following random utility specification:

$$\begin{aligned} u_j \;=\; & l_j^m \beta^{l^m} + (l_j^m \boldsymbol{X}^{l^m})' \boldsymbol{\beta}^{l^m X^{l^m}} + (l_j^m l_j^m)\beta^{l^m l^m} + \\ & l_j^w \beta^{l^w} + (l_j^w \boldsymbol{X}^{l^w})' \boldsymbol{\beta}^{l^w X^{l^w}} + (l_j^w l_j^w)\beta^{l^w l^w} + (l_j^m l_j^w)\beta^{l^m l^w} + \\ & y_j \tilde{\beta}^y + (y_j \boldsymbol{X}^y)' \boldsymbol{\beta}^{yX^y} + (y_j y_j)\beta^{yy} + e_j \end{aligned} \tag{1}$$

where $\boldsymbol{X}^l$ represent observed individual characteristics including age, dummies for

[4]Wage rates are derived from reported gross monthly wage earnings and observed working hours for the employed. Hourly wages of non-employed persons are predicted on the basis of parameters from wage equations and then inserted into the labor supply model. The wage equations control for selectivity as proposed by Heckman (1979) and are estimated separately for men and women as well as East and West Germany. Hourly wages are assumed to be exogenous and constant for different hours categories throughout this analysis (Appendix A).

German nationality and East German residence, disability, and the age of the children in the household. $\boldsymbol{X}^y$ only includes an indicator for young children in the household. β denotes parameters. The coefficient of the linear consumption term can be decomposed into a fixed and a random part: $\tilde{\beta}^y = \beta^y + \kappa$. The random component κ varies between households (section 3.4 below). Bold letters indicate column vectors. Assuming e_j to be i.i.d. type I extreme-value results in the well-known closed form solution for the choice probabilities $P(j)$ (McFadden, 1974).

3.2 Choice restrictions

Instead of modeling restriction mechanisms structurally, we follow Euwals and van Soest (1999) and exploit information in our data to identify restriction probabilities for all choice categories with positive hours and each spouse. We utilize individuals' stated willingness to work and job search activities as well as their stated desired and actual working hours. This survey information loosely reflects the two substantive labor market mechanisms constituting choice restrictions: *participation and hours constraints*.

More concretely, the probability that a certain hours category is available depends, first, on the likelihood that an individual has the general ability to find a job. In order to distinguish employed persons from involuntarily unemployed and (voluntarily) inactive individuals, we exploit information in the data: All people that are observed to work positive hours are considered employed. Individuals that state to actively search for a job and to be available to the labor market, but are observed to work zero hours are regarded as involuntarily unemployed. Observed involuntary unemployment does not necessarily identify a participation constraint, though, but could also result from constraints in preferred hours categories. In the empirical specification we thus do not explicitly differentiate between both mechanisms. We use survey information on whether unemployed individuals seek a part-time and/or full-time position to infer which choices are restricted[5]. Voluntarily inactive persons who do not search and are not available for work do not contribute to the

[5]We assume that involuntarily unemployed individuals seeking a full-time position would accept all jobs. They contribute to the identification of all hours categories as being constrained. Unemployed seeking a part-time position might simply have a large preference for leisure, though. They thus only contribute to the identification of restrictions in part-time categories. As a robustness check we similarly use unemployed individuals seeking a full-time position only to identify restrictions in full-time categories (Appendix D.1).

identification of hours restrictions.

Second, conditional on participation an individual might not have the opportunity and capacity to work the desired number of hours. Whether an individual is able to choose a given number of hours or whether this choice is restricted cannot be observed directly. We infer this information from the individual's stated hours preferences (h^d) and the observed actual working hours (h^a). This approach rests on the assumption that the mapping from h^d to h^a is exclusively determined by individual hours restrictions and is, e.g., not motivated by the partner's deviation from desired hours[6]. For $h^d = h^a$, we know that h^a is available and the individual only contributes to the identification of the restriction probability of h^a. Again, voluntarily inactive people ($h^d = h^a = 0$) do not contribute to identification as we do not have any information on their potential hours restrictions.

When actual and desired hours deviate, it is immediately obvious that h^d is not available but h^a is. Take the example that an individual who desires to work 20 hours, but actually works 40 hours per week. He or she would contribute to the estimation of restriction probabilities for the 20 hours (as being constrained) and the 40 hours category (as being unconstrained). Without making further assumptions it is not known which other choices are potentially available. We do not make any inferences about other choices for those individuals.[7] Restriction probabilities for each positive hours category are estimated by pooling the information from men and women in the sample.

The probability that a given number of working hours k cannot be chosen, is specified as a function of observed and unobserved characteristics and denoted by $\psi(k)$:

$$\psi(k) = D^w \gamma_k^w + \boldsymbol{X}^{emp\prime} \boldsymbol{\gamma}_k^{emp} + \boldsymbol{X}^{h\prime} \boldsymbol{\gamma}_k^h + \mu^m + \mu^w + \epsilon_k \tag{2}$$

Explanatory variables are related to the aforementioned mechanisms of involuntary unemployment and specific hours constraints. The dummy for women D^w picks up

[6] Under the alternative interpretation that individuals answer the question about desired working hours given the constraints of their spouse a deviation between desired and actual hours would be a mixture of restrictions and optimization. As a robustness check we identify hours constraints only based on couples where at least one is working his/her desired hours (Appendix D.2).

[7] Euwals and van Soest (1999) assume, for example, that utility decreases with the absolute distance between actual and desired hours. In our example, the 10 and 30 hours categories would then be treated as not available as they are closer to the desired 20 hours than to the actual 40 hours. However, this assumption is not consistent with the IIA property underlying the preference part of the model which is why we do not follow this approach.

overall differences in restriction probabilities between men and women. All covariates are assumed to have homogenous effects for men and women with the coverage rate for public childcare being the only exception. As women are usually responsible for the bulk of parental care we allow for its impact to vary by gender. Unobserved terms are also specified separately for men and women.

The first set of observables $\boldsymbol{X}^{emp}$ contains variables related to representing an individual's productivity like age, education, health, German nationality or East German residence. Moreover, unemployment rates at the county level are included to reflect the performance of the regional labor market. These variables are primarily thought to affect the overall employment probability. As some of them are also related to specific hours restrictions, we do not constrain parameters $\boldsymbol{\gamma}_k^{emp}$ to be constant across hours categories.

In addition, $\boldsymbol{X}^h$ contains variables that influence constraints for specific hours choices. Related to the demand side of the labor market, we suppose restrictions to vary over different occupations. For certain occupations or types of jobs a full-time contract is the norm, whereas other areas feature more non-standard employment relationships (Eichhorst et al., 2013). To capture this variation, we use the "International Standard Classification of Occupations" (ISCO) of the current (first) employment for (non-)employed individuals[8]. Hours restriction might also rather emerge in smaller firms without the leeway to offer flexible contracts. On the other hand, hours constraints might also arise on the supply side of the market when, e.g., individuals are not capable of working their desired number of hours: Parents of young children who do not have access to public childcare (rationing on the childcare market) face this type of constraints. Thus, $\boldsymbol{X}^h$ includes coverage rates of public care for children collected at the county level and provided by the German Statistical Office as well as of full-time schools collected at the state level.

The terms μ^m, μ^w vary between individuals and represent unobserved heterogeneity for men and women specified as random intercepts in all restriction equations (subsection 3.4). Finally ϵ_k is an error term assumed to follow a logistic distribution. Thus, we get the closed-form representation of the Logit model for the (conditional) hours category-specific restriction probabilities $\Psi(k)$.

[8] As some individuals have never been employed, we orthogonalise the indicator variables of the different occupations.

3.3 Likelihood function

Conditional on unobserved characteristics, the probability for a household to be observed with a given combination of working hours j can be written down in terms of labor supply preferences and restriction probabilities. When both spouses are voluntarily inactive ($j = 0$) it amounts to:

$$P_j\left(h_j^{a,m} = h_j^{d,m} = 0, h_j^{a,w} = h_j^{d,w} = 0|\kappa\right) = \frac{exp\left(u_j|\kappa\right)}{\sum_r exp\left(u_r|\kappa\right)} \tag{3}$$

Since we do not have any information on their restriction probabilities, these households only contribute to the identification of labor supply preferences. Imagine, by contrast, a household where the male spouse desires to work 40 hours and is also observed to have a job in this category with the female spouse preferring 20 hours, but being observed to work 40 hours. This household's probability to be in this particular state conditional on unobservables is:

$$\begin{aligned} & P_j\left(h_j^{a,m} = h_j^{d,m} = 40, h_j^{a,w} = 40, h_j^{d,w} = 20|\kappa, \mu^m, \mu^w\right) \\ = \; & \frac{exp(u_j|\kappa)}{\sum_r exp(u_r|\kappa)}\left(1 - \frac{exp\left(\psi(h_j^m{=}40|\mu^m)\right)}{1{+}exp\left(\psi(h_j^m{=}40|\mu^m)\right)}\right) \times \\ & \frac{exp\left((\psi(h_j^w{=}20|\mu^w)\right)}{1{+}exp\left((\psi(h_j^w{=}20|\mu^w)\right)}\left(1 - \frac{exp\left((\psi(h_j^w{=}40|\mu^w)\right)}{1{+}exp\left((\psi(h_j^w{=}40|\mu^w)\right)}\right) \end{aligned} \tag{4}$$

We thus assume that conditional on observed and unobserved heterogeneity both partner's constraints are independent. They are related through shared household characteristics (e.g. similar labor market conditions and supply side restrictions), correlated individual attributes (e.g. level of schooling and qualification or labor market experience), and unobserved characteristics, though. Note further that restriction probabilities scale down labor supply choice probabilities. To calculated the actual expected state probabilities we numerically re-allocate the 'restricted probability mass' to all other categories according to their relative choice probabilities. This substitution pattern is directly implied by the IIA property underlying the preference part of the model (see Appendix B for more details).

Having data on $n = 1, 2, \ldots, N$ couple households in potentially $t = 1, 2, 3, 4$ time periods, the individual conditional likelihood contribution of a household n at time

t can be written as:

$$L_{nt}|\kappa,\mu^m,\mu^w = \prod_{j=0}^{J} P_{ntj}\left(h^{a,m}_{ntj}, h^{a,w}_{ntj}, h^{d,m}_{ntj}, h^{d,w}_{ntj}|\kappa,\mu^m,\mu^w\right)^{d_{ntj}} \tag{5}$$

where d_{ntj} is an indicator that is equal to one for the observed combination of actual and desired hours of both spouses in household n and time period t, and zero otherwise. In order to get the unconditional sample likelihood we have to integrate out the unobserved heterogeneity terms:

$$L = \prod_{n=0}^{N} \int f(\kappa,\mu^m,\mu^w) \prod_{t=1}^{T} (L_{nt}|\kappa,\mu^m,\mu^w) \tag{6}$$

The specification of the joint distribution of the unobserved heterogeneity terms ($f(\kappa,\mu^m,\mu^w)$) will be detailed in the following sub-section.

3.4 Unobserved heterogeneity and estimation

The unobserved components in the utility function κ and in the restriction probabilities μ^m, μ^w are assumed to follow discrete distributions (Heckman and Singer, 1984a,b). Mass points in these distributions are interpreted as unobserved household types in terms of preferences for consumption g^u and unobserved individual types with respect to hours restrictions of men g^h_m and women g^h_w. As described in (1) above, unobserved heterogeneity for the preference of consumption is specified as random coefficient in the linear term for consumption which now varies between unobserved types: $\tilde{\beta}^y_{g^u} = \beta^y + \kappa^{g^u}$. In the equations for hours restrictions (2) we include random intercepts which vary between men and women as well as unobserved types: $\mu^{g^h_m}, \mu^{g^h_w}$. We distinguish four unobserved types for consumption preferences and two for the restriction probabilities of men and women, respectively:

$$\begin{aligned}
\kappa^{g^u} &= \mathbb{1}(g^u=1)c^u_1 + \mathbb{1}(g^u=2)c^u_2 + \mathbb{1}(g^u=3)c^u_3 + \mathbb{1}(g^u=4)c^u_4 \\
\mu^{g^h_m} &= \mathbb{1}(g^h_m=1)c^h_{m,1} + \mathbb{1}(g^h_m=2)c^h_{m,2} \\
\mu^{g^h_w} &= \mathbb{1}(g^h_w=1)c^h_{w,1} + \mathbb{1}(g^h_w=2)c^h_{w,2}
\end{aligned} \tag{7}$$

where $\mathbb{1}(.)$ is an indicator function and c are parameters to estimate. Heterogeneity terms for hours constraints are normalised to be zero in expectation. Moreover, we allow the distributions of types g^u and g^h_m, g^h_w to be correlated by specifying a joint distribution (Haan and Uhlendorff, 2013). Let π denote probabilities, then we

assume the following (non-parametric) joint distribution:

$$\begin{aligned} \pi_1 &= P(g^u = 1, g_m^h = 1, g_w^h = 1) \\ \pi_2 &= P(g^u = 2, g_m^h = 1, g_w^h = 2) \\ \pi_3 &= P(g^u = 3, g_m^h = 2, g_w^h = 1) \\ \pi_4 &= P(g^u = 4, g_m^h = 2, g_w^h = 2) \end{aligned} \tag{8}$$

The possible combinations of restriction types within a household add up to four household types which are assumed to differ in their consumption propensity. We thus assume a deterministic relationship between unobserved constraint types for men and women and household preferences for consumption[9]. Whether or not certain restriction types are associated with a higher or lower preference for consumption is a priori not determined, but estimated.

We use an expectation-maximization (EM) algorithm (Train, 2009) for the estimation of the type probabilities π (Appendix B). This is crucial for correcting the described selection due to unobservable characteristics in the estimation of constraints as it allows for computing individual (not merely average) type probabilities. The distribution of unobserved types are thus allowed to vary across the sub-samples contributing to the identification of restriction probabilities in different hours categories. Estimating the parameters conditional on the distribution of unobserved types in the estimation sample prevents an omitted variable bias when explanatory variables are correlated with the probability of being a certain type. Individual type probabilities are further used to compute unconditional expected restriction probabilities for all individuals and for each hours category which do not suffer from selection bias (Appendix B for more details). The unconditional sample likelihood has the following form:

$$L = \prod_{n=0}^{N} \sum_{g=1}^{4} \pi_g \prod_{t=1}^{T} \left(L_{ntg} | \kappa^{g^u}, \mu^{g_m^h}, \mu^{g_w^h} \right) \tag{9}$$

It is a weighted average over the four unobserved type combinations we have specified. Having longitudinal information, i.e. up to four time periods of data, in the sample bolsters identification of unobservables. The latent types are assumed to be time-constant whereas labor market states as well as the restriction status of some

[9] In a robustness check we allow two household types with respect to consumption preferences to be freely correlated with the restriction types (Appendix D.3).

households may change over time. Note that the IIA property underlying the preference part of the model is partly be relaxed by unobserved heterogeneity (Appendix B).

4 Estimation results and policy simulations

In this section we, first, present estimation results related to our labor supply model with constraints. We discuss the theoretical consistency of key parameter estimates, the model's in-sample fit in terms of the distribution of observed actual hours of work, and illustrate the selection correction with respect to hours constraints (sub-section 4.1). Then we discuss labor supply elasticities which are simulated on the basis of the parameter estimates (sub-section 4.2). Second, our model is applied to a specific policy reform. We simulate the behavioral effects of an in-work benefit for parents which is specifically designed to improve incentives for secondary earners within the institutional context of the German tax and transfer system (sub-section 4.3). The model allows the overall employment effect induced by the benefit to be disentangled in the pure incentive effect and the impact of different hours restrictions. Throughout this section results from our labor supply model with hours constraints are compared with those from a standard labor supply model (based on actual working hours without restrictions) as a benchmark. Third, we simulate the effects of removing different kinds of constraints (sub-section 4.4).

4.1 Parameter estimates, selection correction, and model fit

The *parameter estimates* of the *labor supply equation* cannot be interpreted directly because of the non-linearities in the model. Comparing coefficients with estimates based on the standard model reveals that they are qualitatively similar (table A3, Appendix E). Quantitative differences imply some discrepancies in elasticities (sub-section 4.2). There is a pattern in the relationship between unobserved types in terms of hours restrictions and consumption preferences: When the woman is a 'bad' restriction type, i.e. she has c.p. higher restriction probabilities, consumption is valued markedly lower than when she is a 'good' type. For men the opposite is true albeit less pronounced. Households comprising a woman of bad 'type' and a man of good 'type' have negative first derivatives with respect to consumption.

These households constitute only 14% of the sample, though. For the other three unobserved household types, first derivatives are positive for almost all households indicating that model estimates are consistent with the underlying economic theory. Households with both spouses being a 'good' type account for slightly more than half of the sample. The remaining two types represent between 10 % and 20 % of the sample each.

Turning to hours constraints we, first, specified a group of variables rather affecting overall *participation constraints* through individual productivity or labor demand shortages. Living in a tight labor market as approximated by the regional unemployment rate is related to a higher risk of constraints in all hours categories with the effect being significant for all categories but full-time (table A4, Appendix E). Low qualified people have higher restriction probabilities in all hours categories. By contrast, the rationing risk is lower for employees with German nationality as well as for West German employees. As unobserved effects are mean in expectation there is a 'good' and a 'bad' unobserved type for women and men.

Men have markedly lower restriction probabilities for full-time categories and are significantly more likely restricted in the three part-time categories. This points to a second mechanism: differential *hours constraints* conditional on participation. Patterns of occupation-specific heterogeneity in hours constraints confirm that different types of jobs are available depending on people's profiles and qualifications: Managers have lower constraints for overtime hours than the reference group of professionals, but a higher rationing risk when they desire a normal full-time job or want to work 25-35 hours (table A4, Appendix E). A similar pattern is found for service workers. On the other hand, employees with elementary occupations have particularly low restriction probabilities in jobs with low working hours. Clerks and craft workers have markedly lower restriction probabilities for normal full-time work. In terms of supply side constraints we find higher restriction probabilities for mothers in households with children aged below seven. When these mothers live in regions where more places of full-time childcare for children aged three to six exist, the restriction probability for large part-time and normal full-time is reduced. More places in all-day schools have a similar effect. For men supply side variables are much less important.

Looking at average observed and predicted restriction probabilities reveals that the

in-sample fit for the *hours constraints* is very good (Table 2). We find very different patterns of hours restrictions for men and women in observed as well as predicted restriction probabilities: Women have significantly lower probabilities to be constrained in all hours categories below full-time jobs. In contrast, men face significantly lower restriction probabilities in full-time and overtime compared to their rationing risk in all other categories with lower hours and compared to women's rationing risk in the full-time and overtime choices.

Table 2: Observed and predicted restriction probabilities per category

	Men					**Women**				
Hours category	Obs.	Predicted				Obs.	Predicted			
		In-sample	Out-of-sample				In-sample	Out-of-sample		
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-14	0.82	0.82	0.76	0.67	0.66	0.22	0.22	0.19	0.21	0.20
15-24	0.78	0.77	0.63	0.59	0.59	0.26	0.26	0.23	0.26	0.23
25-35	0.65	0.65	0.64	0.57	0.59	0.33	0.34	0.41	0.39	0.37
36-40	0.26	0.26	0.24	0.25	0.26	0.28	0.28	0.30	0.32	0.31
>40	0.12	0.12	0.13	0.12	0.11	0.26	0.27	0.30	0.28	0.25
Unobs. het.		✓	0	✓	✓		✓	0	✓	✓
Weights	0	0	0	0	✓	0	0	0	0	✓

Notes: Obs. – Observed restriction probability, In-sample – predicted restriction probability for estimation samples of respective hours categories, Out-of-sample – predicted restriction probability for entire sample, Unobs. het. – unobserved heterogeneity.
Source: Own calculations based on INKAR, GSOEP and FiD, waves 2010-2013.

More importantly, we can also illustrate the degree of selectivity prevalent in the different sub-samples of each hours category on which the estimation of hours constraints is based. To that end in-sample and out-of sample predictions are compared. We can thereby disentangle the contribution of observed and unobserved characteristics to the sample selection by comparing model predictions without and with unobserved heterogeneity. For men the strong discrepancies in restriction probabilities between full-time and overtime hours on the one hand and all part-time categories on the other hand are mitigated when selectivity in category-specific sub-samples is corrected - the difference stays substantial, though (Table 2). The selection due to unobservables is slightly higher than the contribution of observed variables. The restriction probability for men in normal part-time, e.g., goes down from 0.82 to 0.67 implying that over-proportionally many bad types contribute to its identification. Correcting for selection also decreases the restriction probability for the other part-time categories but hardly affects full-time categories. The overall re-

striction probability is thus over-estimated due to selection. The reason is rooted in involuntarily unemployed men being over-proportionally bad types. While employed individuals contribute to the identification of at most two hours categories, involuntarily unemployed may even contribute to all. Weighting has a very limited impact.

For women the restriction probabilities increase for large part-time and full-time when selection due to observed and unobserved heterogeneity is taken into account. The most prevalent changes are for large part-time where the restriction probability increases by six percentage points. For women, selection thus results in underestimating the overall restriction probability. The reason is that women out of work who do not contribute to the estimation have on average higher restriction probabilities than those who either work or desire positive hours.

Finally, we check the *in-sample fit of the model* for the men's and women's *distributions of actual working hours.* Expected choice probabilities from a standard labor supply model without constraints are taken as a benchmark. Our model fits the data reasonably well (Table 3). It performs slightly better than the standard model for both sexes.

Table 3: In-sample fit: observed and predicted hours distributions

	Men			**Women**		
Hours	Observed	Full	Standard	Observed	Full	Standard
0	0.077	0.008	0.032	0.342	0.306	0.274
1-14	0.008	0.012	0.041	0.128	0.230	0.246
15-24	0.011	0.046	0.056	0.198	0.190	0.185
25-35	0.065	0.121	0.102	0.180	0.132	0.136
36-40	0.440	0.374	0.265	0.109	0.086	0.090
>40	0.399	0.439	0.504	0.044	0.056	0.069

Notes: Observed – Observed actual hours, Standard – Discrete choice model based on actual hours, Full – Discrete choice model based on desired hours of work augmented by constraints (section 3).
Source: Own calculations based on INKAR, GSOEP and FiD, waves 2010-2013.

For men, non-employment and full-time are clearly underestimated whereas part-time and over-time are over-predicted. For women, marginal employment is clearly over-estimated while large part-time and full-time are under-predicted. That part-time categories tend to be over-predicted could be explained by (unobserved) fixed costs of working (Euwals and van Soest, 1999) that are not explicitly dealt with in

the current specification. In our full model the high restriction probabilities for men in part-time categories work in that direction, though, which is why the fit is better than in the standard model.

4.2 Elasticities

Wage elasticities with respect to hours worked and participation are calculated numerically. Probabilities for choosing the different hours categories are calculated based on the parameter estimates and status quo incomes. Then, gross wage rates are increased by one percent for one spouse at a time, disposable incomes are re-simulated and choice probabilities re-estimated. Elasticities are inferred from the difference between probabilities in the counterfactual and the status quo. We consider changes in expected participation rates in percentage points (pp.) and in expected working hours in percent separately for women and men (table 4). Hours elasticities include the extensive and intensive margin.

Table 4: Own-wage elasticities of labor supply

	Men		**Women**	
Change working hours (%)				
Incentive	0.05	(0.04 ; 0.05)	0.21	(0.20; 0.22)
Standard model	0.15	(0.14 ; 0.15)	0.31	(0.29 ; 0.32)
Change participation rate (pp.)				
Incentive	-0.00	(-0.00 ; -0.00)	0.05	(0.05 ; 0.06)
Standard model	0.04	(0.04 ; 0.05)	0.11	(0.10 ; 0.11)

Notes: Incentive =Undistorted labor supply effects based on the preference part of our model (section 3.1), Standard=Discrete choice model based on actual hours, bootstrapped 95%-confidence bands in parentheses.
Source: Own calculations based on GSOEP and FiD, waves 2010-2013.

The first row in each panel refers to the pure labor supply elasticities based on the preference part of our model with choice restrictions (sub-section 3.1). They are based on desired instead of actual working hours; restrictions are not relevant for the calculation of elasticities. Elasticities from the standard labor supply model based on actual working hours serve as a benchmark for comparison (second row in each panel, table 4).

Expectedly, elasticities of women are higher than those of men. This is true for both models. The level of elasticities is in the range of previous findings for Germany (Dearing et al., 2007; Steiner and Wrohlich, 2008; Müller and Wrohlich, 2015) given

the focus of our sample on couple households with young children. The substantial difference between men and women is a well-established finding (Bargain et al., 2014; Bargain and Peichl, 2013). The difference can be explained by men's substantially higher employment rates and is mirrored in the changes in participation rates (which are virtually zero for men).

Elasticities from the labor supply model with hours constraints based on desired hours of work are smaller for both sexes compared to the standard model. This points to a moderate upward bias in the labor supply model that is estimated with actual working hours and confirms previous findings for Germany (Bargain et al., 2010; Haan and Uhlendorff, 2013).

4.3 Policy simulation: in-work benefit for parents

In this section we simulate the effects of introducing an in-work benefit for parents which aims at increasing incentives for full-time or large part-time work. We first present the design of the policy in detail and then discuss the simulation results.

4.3.1 Design of the in-work benefit

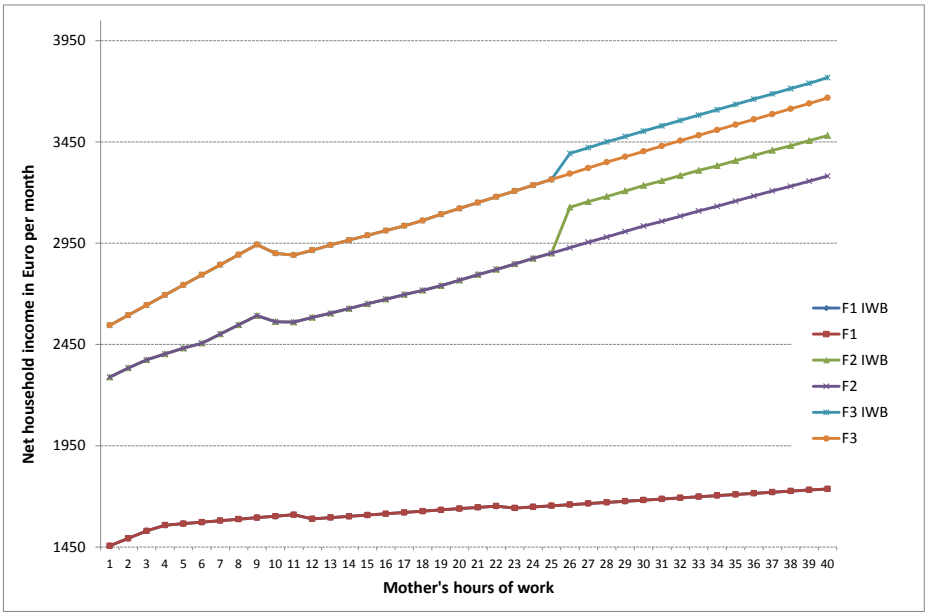
The German tax and transfer system provides strong incentives for an uneven share of market work between mothers and fathers, in particular through joint taxation of married spouses, subsidies to social security contributions for 'minijobs' (i.e. jobs with earnings up to 450 Euro per month) and free health insurance for non-working married spouses. Therefore, mothers' employment rates and average working hours for those employed are still significantly lower compared to fathers (section 2). This has far-reaching consequences for future career perspectives and old-age pensions of women. Furthermore, work incentives for parents with low wages and many children are generally low due to the social assistance scheme that is means-tested at the household level and withdrawn with increasing earnings, as well as child care costs.

In this sub-section we present an in-work benefit (IWB) for parents that is designed to tackle these two issues. It is conditional on the parents' hourly wage rate and on the number of children under 18 years. Each parent has an individual claim to this benefit, and it is not means tested at the household level. Eligibility requires at least 25 hours of work per week. The amount of the benefit is determined by the

number of children and the individual's gross hourly wage rate. The basic amount is 1200 € per year and parent. This amount is increased by 600 € for every child. The benefit is withdrawn at a rate of 50% for each Euro the gross hourly wage rate exceeds a certain threshold that is 8.50 € for parents of one child and increases by 2 € for any further child. For a parent of one child this implies that the benefit is completely phased out for an hourly wage rate of 10.50 €[10].

Conditioning the in-work benefit on the individual hourly wage rate instead of the household income prevents adverse incentives, in particular for secondary earners with low wages. An increase in hours of work does not result in a decrease of the benefit and the partner's income does not impact eligibility or the amount of the benefit. Although this has the disadvantage that some families might be subsidised who actually have a high income due to first earner's high income, it explicitly incentivises an increase of working hours for secondary earners with low wages[11]. The benefit is paid out tax-free but is deducted from the means-tested unemployment assistance (*Arbeitslosengeld II*).

Figure 1: Budget lines of different household types



Notes: F1 IWB: mother's hourly wage rate: 8.5 €, father not employed, IWB scenario; F1: mother's hourly wage rate: 8.5 €, father not employed, status quo scenario; F2 IWB: mother's hourly wage rate: 10.5 €, father full-time with hourly wage of 14 €, IWB scenario; F2: mother's hourly wage rate: 10.5 €, father full-time with hourly wage of 14 €, status quo scenario; F3 IWB: mother's hourly wage rate: 11.5 €, father full-time and hourly wage of 17 €, IWB scenario; F3: mother's hourly wage rate: 11.5 €, father full-time with hourly wage rate of 17 €, status quo.
Source: Own calculations.

[10]Mean hourly wage rate for men in our sample is 19.82 €, for women 13.37 €.

[11]For a discussion on the effects of individualised in-work credits versus family based in-work schemes, see Bargain and Orsini (2006).

Figure 1 plots budget lines for different exemplary households. Budget line F2 shows the example of a family with two children where the father (gross hourly wage 14 €) works full-time. The mother has an hourly wage of 10.50 € and is thus eligible for the program (whereas the father is not). The curve shows how family net income changes with working hours of the mother. Due to joint taxation, 40 hours of full-time work increase the family's income by only about 1,000 €. The in-work benefit for parents would make employment more attractive when the mother works at least 25 hours per week, as is shown by the curve F2_IWB. If the mother earns 11.50 € per hour, half of the benefit is withdrawn and the incentive to work 25 hours per week or more is considerably lower (see lines F3 and F3_IWB).

Finally, F1 and F1_IWB show the case of a family (two adults and one child) with only one earner (mother or father). If the single earner has an hourly wage of 8.5 € per hour, the program has no effect on net earnings, since the in-work benefit for parents leads to a reduction of the means-tested unemployment assistance. Thus, for families where both parents have low hourly wages, this in-work benefit clearly provides incentives for both parents to work more than 25 hours instead of incentivizing the one-earner model.

4.3.2 Employment effects of introducing the in-work benefit

Table 5 shows the results of a policy simulation introducing the in-work benefit for parents with children aged between one and three. Women's hours would increase by almost 2% and the participation rate would increase by 0.3 percentage points (Table 5, first column). The share of couples in which both spouses work more than 24 hours would increase by 1.3 percentage points. Starting from a base level of 29% in the status quo, this is an increase of almost 5%. For men, effects are negligible. This is not surprising as over 90% of men already work in one of the subsidised hours categories. More importantly thus is that no negative effects are observed. This can be ascribed to the program eligibility being based on the individual hourly wage rate impeding incentives to reduce hours of work.

The second column of Table 5 displays the pure labor supply effect based on the preference part of our model. In this case, the point estimate of the increase of the share of couples in which both spouses work more than 24 hours is significantly higher (1.6 pp.) than in the full model. This suggests that the pure labor supply

Table 5: Employment effects: in-work benefit for parents

	Full	**Incentive**
Men		
Hours - change (%)	0.04	0.07
	(0.03 ; 0.04)	(0.06 ; 0.08)
Part. - base (%/100)	0.99	0.99
	(0.99 ; 0.99)	(0.99 ; 0.99)
Part. - change (pp.)	0.01	0.00
	(0.01 ; 0.01)	(0.00 ; 0.00)
Women		
Hours - change (%)	1.87	1.64
	(1.81 ; 1.99)	(1.58 ; 1.78)
Part. - base (%/100)	0.74	0.83
	(0.73 ; 0.74)	(0.83 ; 0.84)
Part. - change (pp.)	0.29	0.25
	(0.28 ; 0.31)	(0.24 ; 0.27)
Both spouses' hours > 24		
base (%/100)	0.29	0.34
	(0.29 ; 0.30)	(0.34 ; 0.35)
change (pp.)	1.34	1.60
	(1.29 ; 1.40)	(1.54 ; 1.72)

Notes: Full=Discrete choice model based on desired hours of work augmented by constraints (section 3), Incentive =Undistorted labor supply effects based on the preference part of our model, bootstrapped 95%-confidence bands in parentheses.
Source: Own calculations based on INKAR, GSOEP and FiD, waves 2010-2013.

response to the introduced financial incentives is reduced by almost 20% due to restrictions hampering individuals from drawing on the benefit. Interestingly, hours responses of women are smaller when restrictions are not considered. This is rooted in a lower restriction probability for full-time work vis-à-vis large part-time. When complying women can choose freely, they rather prefer extending their labor supply to at most large part-time. When restrictions are taken into account this category is often not feasible, though. Our results suggest that in those cases many women accept taking up a less restricted full-time position in order to draw on the benefit. The estimated cost of the program is moderate. When behavioral responses are taken into account the total amount of the IWB received by households is almost 800 million Euro (Table 6). However, as individuals on average increase their hours of work as a response to the IWB, additional taxes and social security contributions reduce the costs of the program to roughly 550 million Euro.

Table 6: Expected costs of in-work benefit for parents

	After behavioral responses	**Before behavioral responses**
In-work benefit for parents		
Total	793.67	669.83
Women	134.88	116.19
Men	658.79	553.64
Taxes and transfers		
Income tax	153.37	0.01
Solidarity tax	6.13	0.00
Social security contributions	134.76	0.00
Unemployment benefits	-58.11	-32.34
Housing subsidy	-1.17	-1.87
Total net costs	558.69	704.04

Source: Own calculations based on INKAR, GSOEP and FiD, waves 2010-2013.

Table 7 presents behavioral effects of the in-work benefit (based on the full model) for different subgroups. While west German women increase their hours of work more than women in east Germany, the increase of the share of couples in which both spouses work more than 24 hours is significantly higher in the latter region. This is the case although the base level is much higher in east Germany (55 %) than in west Germany (24%). One reason for this result is that wages are still lower in east than in west Germany, and thus the share of individuals eligible for the in-work benefit is higher.

Differences in the wage distribution obviously also explain varying effects across education groups. As expected, we find the highest behavioral effects for parents with low education. We also find considerable labor supply effects in the medium education group (Table 7).

4.4 The role of hours constraints

The full model that we estimate allows to distinguish the effects of financial incentives and constraints on labor supply behavior. In the sub-section above, we showed how financial incentives introduced by the IWB affect labor supply behavior of parents and how restrictions impact the policy effects. In this sub-section, we simulate a removal of all constraints in order to show how labor supply would change in

Table 7: Effect heterogeneity: in-work benefit for parents

	Region		Education		
	West	**East**	**Low**	**Medium**	**High**
Men					
Hours - change (%)	0.02	0.14	0.06	0.05	0.01
	(0.01 ; 0.02)	(0.11 ; 0.17)	(0.05 ; 0.07)	(0.04 ; 0.06)	(0.00 ; 0.01)
Part. - base (%/100)	0.99	0.99	0.99	0.99	0.99
	(0.99 ; 0.99)	(0.99 ; 0.99)	(0.99 ; 0.99)	(0.99 ; 0.99)	(0.99 ; 0.99)
Part. - change (pp.)	0.01	0.01	0.01	0.01	0.00
	(0.00 ; 0.01)	(0.01 ; 0.02)	(0.01 ; 0.01)	(0.01 ; 0.01)	(0.00 ; 0.00)
Women					
Hours - change (%)	1.95	1.45	3.26	2.00	0.74
	(1.89 ; 2.05)	(1.33 ; 1.65)	(3.14 ; 3.47)	(1.93 ; 2.12)	(0.71 ; 0.78)
Part. - base (%/100)	0.72	0.85	0.66	0.75	0.76
	(0.71 ; 0.72)	(0.85 ; 0.86)	(0.65 ; 0.67)	(0.75 ; 0.75)	(0.75 ; 0.76)
Part. - change (pp.)	0.30	0.28	0.51	0.31	0.12
	(0.29 ; 0.31)	(0.26 ; 0.31)	(0.47 ; 0.55)	(0.30 ; 0.33)	(0.12 ; 0.13)
Both spouses' hours > 24					
base (%/100)	0.24	0.55	0.22	0.29	0.33
	(0.24 ; 0.25)	(0.54 ; 0.56)	(0.21 ; 0.23)	(0.29 ; 0.30)	(0.33 ; 0.34)
change (pp.)	1.29	1.59	1.82	1.52	0.61
	(1.24 ; 1.34)	(1.52 ; 1.75)	(1.74 ; 1.93)	(1.46 ; 1.58)	(0.58 ; 0.63)

Notes: All effects based on the full model, a discrete choice model based on desired hours of work augmented by constraints (section 3), Low education: ISCED level 0-2 (at most *Mittlere Reife*, no vocational training), Medium education: ISCED level 3-4 (A-levels or vocational training), High education: ISCED level 5-6 ((Applied) University degree and higher), bootstrapped 95%-confidence bands in parentheses.
Source: Own calculations based on INKAR, GSOEP and FiD, waves 2010-2013.

this case. Note, however, that this simulation cannot be interpreted as a policy reform since the reasons for the restrictions are numerous (for example, demand side restrictions such as unemployment, social norms regarding part-time employment of men, or insufficient child care). For the scenario in which all restrictions are removed, i.e. all individuals can actualize their desired working hours on the labor market, we find strong employment effects for women: The participation rate of women would increase by almost 10 percentage points and their average hours worked would increase by 24% (see Table 8, first column).

The results thus reveal the strong labor market restrictions leading to substantial under-employment for mothers with children aged below 18. The effect on working hours for men in our sample goes in the opposite direction than for women: In case that all restrictions were removed, men would decrease their working hours by about 5%. This reflects the fact that men are more likely to be restricted with respect to part-time jobs than full-time jobs resulting in over-employment. The participation rate would increase by about 0.3 percentage points implying a low predicted rate of involuntary unemployment for fathers.[12]

[12]Our model considerably underestimates non-employment for men (section 4.1). The predicted participation rate is almost 99 % (vs. 92 % in the observed data) leaving not much scope for participation effects.

Table 8: Employment effects: (partly) removing constraints

	All	**Childcare**
Men		
Hours - change (%)	-4.85	-1.67
	(-5.01 ; -4.63)	(-2.34 ; -0.81)
Part. - base (%/100)	0.99	0.99
	(0.99 ; 0.99)	(0.99 ; 0.99)
Part. - change (pp.)	0.30	0.12
	(0.28 ; 0.32)	(0.06 ; 0.14)
Women		
Hours - change (%)	23.85	14.73
	(22.76 ; 24.90)	(10.98 ; 17.95)
Part. - base (%/100)	0.74	0.74
	(0.73 ; 0.74)	(0.73 ; 0.74)
Part. - change (pp.)	9.48	0.87
	(9.14 ; 9.95)	(-1.02 ; 2.99)
Both spouses' hours > 24		
base (%/100)	0.29	0.29
	(0.29 ; 0.30)	(0.29 ; 0.30)
change (pp.)	5.16	3.21
	(4.67 ; 5.62)	(1.00 ; 6.00)

Notes: All: All restrictions are removed, *Unemployment*: Unemployment is reduced to the lowest observed value of all counties (2.1 %), *Childcare*: The various childcare coverage rates are increased to the highest observed values of all counties. All effects based on the full model, a discrete choice model based on desired hours of work augmented by constraints (section 3), bootstrapped 95%-confidence bands in parentheses.
Source: Own calculations based on INKAR, GSOEP and FiD, waves 2010-2013.

Differentiating the behavioral effects between east and west Germany, we find that mother are much more likely to be under-employed in west than in east Germany. If all restrictions were removed, average working hours of women in our sample would increase by 26 % in west, but only by 12 % in east Germany (Table 9). The difference in the participation effect points in the same direction but is much smaller. Both translates into a much higher increase of the share of couples in which both spouses work more than 24 hours in west Germany. For men, we find only small differences in hours and participation effects.

However, differentiating by education level, we find very strong differences: Mothers with low education seem to be particularly effected by under-employment. If all constraints were removed, mothers with low education would increase their working hours by 40%. Mothers with medium and high levels of education face considerably lower effects (22% and 19%, respectively). These effects are among others driven by

changes in participation which shows a similar pattern. Effects for fathers hardly vary with education.

Table 9: Effect heterogeneity: Remove all constraints

	Region		Education		
	West	**East**	**Low**	**Medium**	**High**
Men					
Hours - change (%)	-4.77	-5.28	-5.10	-4.84	-4.80
	(-4.92 ; -4.54)	(-5.63 ; -4.79)	(-5.39 ; -4.71)	(-5.00 ; -4.59)	(-4.92 ; -4.62)
Part. - base (%/100)	0.99	0.99	0.99	0.99	0.99
	(0.99 ; 0.99)	(0.99 ; 0.99)	(0.99 ; 0.99)	(0.99 ; 0.99)	(0.99 ; 0.99)
Part. - change (pp.)	0.29	0.34	0.36	0.28	0.30
	(0.27 ; 0.32)	(0.30 ; 0.38)	(0.33 ; 0.41)	(0.26 ; 0.31)	(0.27 ; 0.32)
Women					
Hours - change (%)	26.09	11.82	40.64	22.11	18.50
	(25.05 ; 27.19)	(10.22 ; 13.83)	(38.03 ; 43.84)	(21.15 ; 23.08)	(17.68 ; 19.51)
Part. - base (%/100)	0.72	0.85	0.66	0.75	0.76
	(0.71 ; 0.72)	(0.84 ; 0.86)	(0.65 ; 0.67)	(0.75 ; 0.75)	(0.75 ; 0.76)
Part. - change (pp.)	9.76	8.00	14.41	8.98	7.89
	(9.41 ; 10.26)	(7.58 ; 8.50)	(13.51 ; 15.41)	(8.62 ; 9.39)	(7.53 ; 8.28)
Both spouses' hours > 24					
base (%/100)	0.24	0.55	0.22	0.29	0.33
	(0.24 ; 0.25)	(0.53 ; 0.56)	(0.21 ; 0.23)	(0.29 ; 0.30)	(0.33 ; 0.34)
change (pp.)	5.89	1.20	5.75	5.44	4.06
	(5.43 ; 6.32)	(-0.09 ; 2.47)	(4.91 ; 6.64)	(5.00 ; 6.00)	(3.54 ; 4.50)

Notes: All effects based on the full model, a discrete choice model based on desired hours of work augmented by constraints (section 3), Low education: ISCED level 0-2 (at most *Mittlere Reife*, no vocational training), Medium education: ISCED level 3-4 (A-levels or vocational training), High education: ISCED level 5-6 ((Applied) University degree and higher), bootstrapped 95%-confidence bands in parentheses.
Source: Own calculations based on INKAR, GSOEP and FiD, waves 2010-2013.

Since the removal of all possible restrictions on the labor market is hard to interpret, we conduct an additional simulation that have a more straight-forward economic interpretation. We simulate a scenario in which we dramatically decrease employment restrictions due to lack of child care. In this scenario we set the local availability of formal child care slots to the respective highest levels observed in our sample which amount to 93.7% for children aged below three, 100% for full-time slots of children aged three to six and 78% for full-time school slots). Since the average rate amounts to 23.8%, 33.6 % and 30.4 %, respectively, the treatment simulated in this scenario is very large and – as in the scenario above – very unequally distributed throughout Germany. For example, in west Germany the average increase of child care coverage for children aged below three is much larger (+75.6 percentage points) than in east Germany (+45.9 percentage points).

As expected, while employment effects of men are almost negligible women considerably increase their hours of work if child care was dramatically extended (15%, Table 8). women's participation rate would increase by 2.3 percentage points and total hours would increase by almost 28% (Table 8). The latter is more than half

the size of the hours response for removing all constraints; child care restrictions thus seem to play a crucial role for under-employment of employed women. For participation constraints child care rationing is less relevant. As can be seen from Table 10, we find a stronger increase of hours of work for mothers in west Germany (16 %) than for women in east German (6.35%). The participation rate would increase slightly stronger in east Germany. Mothers with low education show the strongest reaction in this scenario: their average working hours would increase by 22% and their participation rate would increase by 1.8 percentage points. Mothers with medium or high education would increase average working hours by about 14% and 11%, respectively.

Table 10: Effect heterogeneity: Expand formal childcare

	Region		**Education**		
	West	**East**	**Low**	**Medium**	**High**
Men					
Hours - change (%)	-1.81	-0.92	-1.84	-1.67	-1.61
	(-2.49 ; -0.95)	(-1.66 ; -0.09)	(-3.11 ; -0.68)	(-2.34 ; -0.77)	(-2.20 ; -0.84)
Part. - base (%/100)	0.99	0.99	0.99	0.99	0.99
	(0.99 ; 0.99)	(0.99 ; 0.99)	(0.99 ; 0.99)	(0.99 ; 0.99)	(0.99 ; 0.99)
Part. - change (pp.)	0.13	0.06	0.15	0.11	0.12
	(0.07 ; 0.16)	(0.01 ; 0.09)	(0.09 ; 0.19)	(0.06 ; 0.13)	(0.05 ; 0.15)
Women					
Hours - change (%)	16.29	6.35	21.56	14.48	11.31
	(11.91 ; 20.03)	(4.47 ; 8.04)	(15.86 ; 26.22)	(10.70 ; 17.78)	(8.21 ; 13.73)
Part. - base (%/100)	0.72	0.85	0.66	0.75	0.76
	(0.71 ; 0.72)	(0.84 ; 0.86)	(0.65 ; 0.67)	(0.75 ; 0.75)	(0.75 ; 0.76)
Part. - change (pp.)	0.70	1.78	1.76	0.82	0.46
	(-1.52 ; 3.17)	(0.86 ; 2.66)	(-0.81 ; 4.63)	(-1.12 ; 2.92)	(-1.33 ; 2.38)
Both spouses' hours > 24					
base (%/100)	0.24	0.55	0.22	0.29	0.33
	(0.24 ; 0.25)	(0.53 ; 0.56)	(0.21 ; 0.23)	(0.29 ; 0.30)	(0.33 ; 0.34)
change (pp.)	3.72	0.46	3.60	3.33	2.67
	(1.42 ; 6.82)	(-1.54 ; 2.89)	(1.29 ; 6.65)	(1.09 ; 6.35)	(0.72 ; 4.81)

Notes: All effects based on the full model, a discrete choice model based on desired hours of work augmented by constraints (section 3), Treatment is increase of the various childcare coverage rates to the highest observed values of all counties, Low education: ISCED level 0-2 (at most *Mittlere Reife*, no vocational training), Medium education: ISCED level 3-4 (A-levels or vocational training), High education: ISCED level 5-6 ((Applied) University degree and higher), bootstrapped 95%-confidence bands in parentheses.
Source: Own calculations based on INKAR, GSOEP and FiD, waves 2010-2013.

From these simulations we conclude that restrictions on the labor markets such as lack of childcare seem to play an important role, in particular for mothers with low education. This is also true for the the share of couples in which both spouses work more than 24 hours. Our simulations show that removing constraints could evoke a stronger increase of this share than improving financial work incentives for secondary earners by the in-work benefit analyzed above.

5 Discussion and conclusions

In this paper we have specified a static labor supply model based on desired hours of work. The model also includes participation and working hours constraints. We exploit sample information on search activities and actual as well as desired hours of work for the estimation. The framework is designed for the evaluation of policies where not only economic incentives but also constraints on the labor market determine employment outcomes. We illustrate this by applying the model to an in-work benefit for low-paid parents that targets work incentives for secondary earners. Eligibility is conditional on hours of work exceeding a certain threshold. Restrictions might thus hamper individuals drawing on the benefit.

The in-work benefit increases with the number of children in the household and is based on an individual's hourly wage and conditioned on a minimum number of 25 hours of work per week. Simulation results based on our labor supply model with restrictions show that while behavioral effects of fathers are negligible, such a policy would affect labor supply of mothers: their participation rate would increase by 0.3 percentage points and their average working hours would increase by two percent. Mothers with low education would react most strongly, their average hours of work would increase by over three percent.

Based on our full model we are able to directly simulate the effects restrictions have on actual employment of individuals. In a first exercise all restrictions are removed completely to illustrate their impact on actual employment. Working hours of mothers would increase by 24% and their participation rate by ten percent. Mothers with low education face the strongest restrictions on the labor market: their participation rate would increase by 14 percentage points and their working hours almost 41% when constraints could be removed completely. This exercise also reveals the heterogenous impact of restrictions along other dimensions: men and women are confronted with very different constraints on the labor market. Besides being overall restricted to a lesser degree fathers face the largest constraints in part-time employment whereas mothers are restricted in jobs of all hours categories, but in particular in full-time jobs.

A complete removal of all types of restrictions at the same time is hard to interpret economically. We therefore conducted a simulation that reduces constraints on the

childcare market (increasing childcare coverage). It shows that for mothers the lack of formal childcare accounts for more than half of the restrictions which prevent them from realizing their desired employment levels.

The application of our empirical framework to the evaluation of an in-work benefit underlines the importance of understanding different mechanisms on the labor market to gauge the potential and improve the design of labor market or family policies. In this paper we took another step towards identifying preferences and constraints in the household context based on rich survey information. We introduced observed and unobserved heterogeneity in preferences and constraints. This brought us closer to determine the impact of various types of constraints that affect different groups on the labor market in various ways. In terms of policy conclusions we showed that the incentive effect of an in-work benefit is reduced by restrictions employees face when making employment decisions. At the same time this result highlights other areas for intervention, e.g. alleviating constraints through regulatory or family policies.

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Appendix

A Wage estimation

Hourly wage rates in our model are treated as exogenous and constant for different hours categories. They are derived from reported gross monthly wage earnings and observed working hours including paid and unpaid overtime for the employed. Hourly wages of non-employed persons are predicted on the basis of parameters from wage equations. The estimation is conducted outside of the labor supply model and is based on GSOEP and FiD data pooled over the years 1999 to 2013. Individuals below 18 and above 65 are excluded. We estimate separately for men and women as well as East and West Germany. We control for selection into employment as proposed by Heckman (1979). Estimation results for the wage and the selection equations are presented in table A5 in Appendix E.

B Unobserved heterogeneity: EM algorithm & IIA

B.1 EM algorithm

Information on the availability of a given hours category is only available, if an individual desires to or actually works in this state and thus crucially depends on preferences. If preferences and restrictions are not independent - i.e. if, for instance, households with a high propensity for consumption are more or less likely comprised of members with high restriction probabilities - the identification of hours constraints is based on groups of individuals that are not representative for the whole population. This is similar to the standard selection problem in labor economics (Heckman, 1979). In our model preferences and choice restrictions are therefore related through observed and unobserved factors and estimated jointly.

In order to correct the described selection due to unobservable characteristics in the estimation of constraints, we need to account for the distribution of unobserved types in the sub-samples underlying the identification of constraints in different hours categories. We therefore use an expectation-maximization (EM) algorithm (Train, 2009) for the estimation of the type probabilities π. It is appropriate for our case as the conditional likelihood contributions are weighted by the individual

(not merely average) type probabilities in the estimation of the parameters. The parameters are thus estimated conditional on the distributions of unobserved types in the respective sub-samples preventing an omitted variable bias when explanatory variables are correlated with the probability of being a certain type. Individual type probabilities further allow for calculating individual restriction probabilities which are essential to correctly predict policy effects, in particular when effect heterogeneity is analyzed.

Methodologically, the EM algorithm we use comprises the following steps (Kabatek, 2013):

1. choose starting values for model parameters (θ^0) and sample group probabilities (π_g^0) for each type $g = 1, ..., 4$
2. calculate individual conditional likelihood contributions L_{ng} for each household n and type g based on current (iteration i) parameters θ^i
3. derive corresponding individual probabilities of types by $p_{ng} = \frac{\pi_g L_{ng}}{\sum_{g'=1}^{G} \pi_{g'} L_{ng'}}$
4. derive new sample group probabilities by $\pi_g^{i+1} = \frac{\sum_n p_{ng}(\theta^i)}{\sum_n \sum_{g'} p_{ng'}(\theta^i)}$
5. re-estimate parameters based on likelihood contributions weighted by $p_{ng} \rightarrow \theta^{i+1}$
6. repeat steps two to five until change in sample likelihood is sufficiently small

B.2 IIA property

The error term in the utility function is assumed to be i.i.d. type I extreme-value. This results in the IIA (independence of irrelevant alternatives) property of the choice probabilities $P(j)$ (McFadden, 1974). The IIA property indicates that the odds ratio of two alternatives is not affected by modifying a third alternative. We make use of this property to reallocate the probability mass of restricted alternatives (section C). When an hours category is excluded from the choice set due to constraints, probabilities of all other categories increase such that their odds ratios are not affected (Appendix C). This is an undesirable property when it is the case that (conditional on the shared characteristics) similar hours category are closer substitutes than categories with a very different amount of hours.

Modeling unobserved heterogeneity relaxes the IIA property. For our setting unobserved heterogeneity implies that if an hours category is excluded from the choice set due to constraints, probabilities of categories with a similar unobserved effect increases over-proportionally. As we specify unobserved heterogeneity as heterogeneous consumption propensity, hours categories with more similar net earnings are closer substitutes. The reason is that the IIA property sill holds conditional on being of a certain unobserved type. Imagine there are two unobserved types with one having a high and one a low propensity for consumption. In the case of the former all hours categories with high hours have a higher likelihood to be chosen. When one of these categories is constraint, the other high hours categories benefit particularly much due to their high choice probabilities.

C Computation of expected state probabilities and approximation of substitution pattern

In the standard model the probability for the actual state k ($P^a(k)$) is equal to the probability for the desired choice according to the household members' labor supply preferences ($P^d(k)$), i.e. $P^a(k) = P^d(k)$. Expected state probabilities $\hat{P}^a(k)$ are thus solely based on the parameters of the labor supply model.

In the model with labor demand and hours constraints the probability for the actual state ($P^a(k)$) depends on $P^d(k)$ as well as the rationing probability in state k, $\Psi(k)$ (and actually on $\Psi(.)$ and $P^d(.)$ of all other states). In order to calculate expected state probabilities $\hat{P}^a_j$, $\hat{P}^d_j$ needs to be adjusted by the expected probability of being able to work in the desired state $(1 - \hat{\Psi}(k))$. The probability mass of being constrained in category k, i.e. $\hat{P}^d(k)\hat{\Psi}(k)$, is re-allocated to all other states $l \neq k$ according to their relative choice probabilities. This procedure respects the IIA property of the underlying discrete choice labor supply model as odds ratio of states $l \neq k$ are not affected. At the same time alternative k receives probability mass from hours restrictions in all other states $l \neq k$ with $h^a_l > 0$ (there is by definition no hours restriction on non-employment). This probability mass is again subject to the rationing probability $\Psi(k)$. A fraction is thus again re-allocated to the other categories and so on. As analytical solutions for the expected choice probabilities get complex very quickly for increasing choice sets we implement the substitution

pattern by a numerical algorithm which iterates until the probability mass which has to be re-allocated is sufficiently small (we use a threshold of 0.1% as convergence criterion).

As hours constraints are defined on the individual level, we perform the algorithm successively for men and women. One spouse's restricted probability mass for hours category k is re-allocated to all household categories in which this spouse does not work k hours. Note that the algorithm is run conditional on unobserved types. This ensures that the IIA property holds which provides us with the above described substitution pattern. The unconditional state probabilities are then calculated as the weighted average of the conditional state probabilities.

D Robustness checks

In this section we examine whether the estimated effects of an introduction of the in-work benefit for parents are robust with respect to the most crucial specification decisions. Detailed estimation results, results for the other simulations as well as elasticities estimated are available on request. Overall the qualitative picture of the policy effects is fairly stable.

D.1 The role of involuntary unemployed in identifying hours constraints

Individuals that state to actively search for a job and to be available to the labor market, but are observed to work zero hours are regarded as involuntarily unemployed. This information contributes to the identification of hours constraints depending on what kind of position an individual states to seek. In the main text involuntarily unemployed individuals seeking a part-time position only contribute to the identification of restrictions in part-time categories. The reasoning is that these individuals might have a strong preference for leisure. Being involuntarily unemployed thus might not necessarily imply being restricted in full-time categories. Involuntarily unemployed individuals seeking a full-time position, by contrast, contribute to the identification of all hours categories. We assume that these individuals - although they prefer a full-time position - would also accept jobs with fewer hours. Inferring information about all hours categories additionally implies that these individuals are at least potentially confronted with all kind of job offers. It might

be the case, though, that either unemployed individuals seeking a full-time position might decline job offers with fewer hours or that part-time job offers do not reach them as they only look for full-time job advertisements. In this robustness check unemployed individuals seeking a full-time position therefore only contribute to the identification of restrictions in full-time categories.

The estimated policy effects turn out to be very robust in that respect (column (1) in table A1, Appendix E). The slightly larger effects might be rooted in the smaller average restriction probabilities.

D.2 Couple with one spouse working her desired hours

Desired hours of work is a crucial variable in our framework. The exact wording of the survey question underlying the information is: "If you could choose your own number of working hours, taking into account that your income would change according to the number of hours: Would you prefer to decrease, increase or maintain your number of working hours?". If they prefer a change, they will be asked for their desired working hours. There are two possible interpretations to this question (Callan et al., 2007): Respondents might choose their desired hours of work conditional on their partners' actual working hours (constrained optimization). In the main text we deviate from this view and assume that both spouses can freely choose their desired labor supply (unconstrained optimization of family utility). A deviation between an individual's desired and actual hours then implies that she is not able to work her desired hours of work. Under the alternative interpretation this conclusion cannot be deducted. In this robustness check we therefore restrict the estimation sample to couples where at least one is working his/her desired hours. This ensures that a deviation between desired and actual hours of work is rooted in individual constraints. Simulation results are again based on the whole sample.

An in-work benefit for parents would increase the fraction of households where both spouses work more than 24 hours by 1 percentage point (column (2) in table A1, Appendix E). This is significantly smaller than based on the main specification (≈ 1.4). The overall picture is preserved, though.

D.3 Free correlation of unobserved types

In the main text we impose a deterministic relationship between unobserved constraint types for men and women and household preferences for consumption. We choose a joint distribution such that the possible combinations of restriction types within a household add up to four household types which are assumed to differ in their consumption propensity. In this section we do not restrict the correlation between unobserved types in the two model parts. We assume two household types with respect to preferences and two individual types with respect to restrictions for men and women, respectively. Their joint distribution is estimated nonparametrically.

The estimated policy effects increase slightly (column (3) in table A1, Appendix E). The difference is not statistically significant, though.

D.3.1 Unobserved heterogeneity of linear effect of leisure

In the main text we assume the coefficient of the linear consumption term to vary across households in an unobserved way. Alternatively, unobserved heterogeneity may be specified as a heterogeneous effect of leisure which is done in this robustness check. The policy effects almost halve relative to the basic specification (column (4) in table A1, Appendix E). This is rooted in a significantly smaller estimate of female labor supply elasticities.

E Additional tables

Table A1: Employment effects: in-work benefit for parents, robustness

	Basic	**(1)**	**(2)**	**(3)**	**(4)**
Men					
Hours - change (%)	0.04	0.06	0.22	0.05	0.08
	(0.03 ; 0.04)	(0.05 ; 0.06)	(0.05 ; 0.38)	(0.04 ; 0.06)	(0.07 ; 0.09)
Part. - base (%/100)	0.99	0.99	0.98	0.99	0.99
	(0.99 ; 0.99)	(0.99 ; 0.99)	(0.97 ; 0.98)	(0.99 ; 0.99)	(0.99 ; 0.99)
Part. - change (pp.)	0.01	0.01	0.14	0.01	0.01
	(0.01 ; 0.01)	(0.00 ; 0.01)	(0.11 ; 0.16)	(0.01 ; 0.01)	(0.01 ; 0.01)
Women					
Hours - change (%)	1.87	1.89	3.80	2.08	1.00
	(1.81 ; 1.99)	(1.80 ; 1.98)	(3.17 ; 4.46)	(1.96 ; 2.17)	(0.96 ; 1.06)
Part. - base (%/100)	0.74	0.75	0.58	0.75	0.75
	(0.73 ; 0.74)	(0.74 ; 0.75)	(0.57 ; 0.58)	(0.74 ; 0.75)	(0.75 ; 0.76)
Part. - change (pp.)	0.29	0.28	0.45	0.34	0.17
	(0.28 ; 0.31)	(0.26 ; 0.30)	(0.41 ; 0.50)	(0.32 ; 0.35)	(0.16 ; 0.18)
Both spouses' hours > 24					
base (%/100)	0.29	0.28	0.14	0.29	0.35
	(0.29 ; 0.30)	(0.28 ; 0.29)	(0.14 ; 0.15)	(0.28 ; 0.30)	(0.34 ; 0.35)
change (pp.)	1.34	1.42	1.04	1.46	0.88
	(1.29 ; 1.40)	(1.36 ; 1.48)	(0.97 ; 1.12)	(1.39 ; 1.51)	(0.84 ; 0.93)

Notes: Basic: Specification as in the main text, (1): Involuntarily unemployed seeking a full-time position only contribute to the identification of full-time hours restrictions (section D.1), (2): Estimation sample is restricted to couples where at least one spouse is working in the desired hours category (section D.2), (3): Joint distribution of unobserved consumption and restriction types does not restrict correlation (section D.3), (4): Unobserved heterogeneity specified as heterogeneous propensity for leisure (section D.3.1), All effects based on the full model, a discrete choice model based on desired hours of work augmented by constraints (section 3), bootstrapped 95%-confidence bands in parentheses.
Source: Own calculations based on INKAR, GSOEP and FiD, waves 2010-2013.

Table A2: Summary statistics

Variable	Mean	Std. Dev.	N
Household characteristics			
Net income	3732.57	1941.54	11327.00
East	0.19	0.39	11327.00
Child aged $0-2$	0.31	0.46	11327.00
Child aged $3-6$	0.37	0.48	11327.00
Child aged $7-12$	0.31	0.46	11327.00
Child aged >12	0.42	0.49	11327.00
Individual characteristics woman			
Hours of work	16.54	15.09	11327.00
Hourly wage	13.37	11.79	11327.00
Age	39.77	8.45	11327.00
German	0.87	0.34	11327.00
Handicapped	0.06	0.23	11327.00
Occ.: Managers	0.02	0.15	8289.00
Occ.: Professionals	0.16	0.36	8289.00
Occ.: Technicians	0.30	0.46	8289.00
Occ.: Clerical support workers	0.16	0.37	8289.00
Occ.: Service & sales workers	0.21	0.41	8289.00
Occ.: Craft & related trades	0.01	0.07	8289.00
Occ.: Agricultural workers	0.04	0.19	8289.00
Occ.: Plant & machine operators	0.02	0.14	8289.00
Occ.: Elementary	0.09	0.28	8289.00
Occ.: Armed Forces	0.00	0.03	8289.00
Edu.: Isced 0-2	0.13	0.34	11282.00
Edu.: Isced 3-4	0.59	0.49	11282.00
Edu.: Isced 5-6	0.27	0.45	11282.00
Small firm	0.10	0.30	7141.00
Mid-size firm	0.48	0.50	7141.00
Large firm	0.42	0.49	7141.00
Individual characteristics man			
Hours of work	38.27	13.10	11327.00
Hourly wage	19.82	11.32	11327.00
Age	42.60	8.57	11327.00
German	0.88	0.33	11327.00
Handicapped	0.04	0.20	11327.00
Occ.: Managers	0.08	0.27	10543.00
Occ.: Professionals	0.20	0.40	10543.00
Occ.: Technicians	0.17	0.38	10543.00
Occ.: Clerical support workers	0.07	0.25	10543.00
Occ.: Service & sales workers	0.05	0.21	10543.00
Occ.: Craft & related trades	0.01	0.11	10543.00
Occ.: Agricultural workers	0.23	0.42	10543.00
Occ.: Plant & machine operators	0.11	0.32	10543.00
Occ.: Elementary	0.07	0.25	10543.00
Occ.: Armed Forces	0.01	0.09	10543.00
Edu.: Isced 0-2	0.12	0.32	11255.00
Edu.: Isced 3-4	0.54	0.50	11255.00
Edu.: Isced 5-6	0.35	0.48	11255.00
Small firm	0.04	0.20	10254.00
Mid-size firm	0.42	0.49	10254.00
Large firm	0.54	0.50	10254.00
Regional characteristics			
Rate of unempl.	7.25	3.31	11327.00
CC quota 0-2	23.77	13.68	11327.00
CC quota 3-6 FT	33.64	21.81	11327.00
FT school quota	30.36	16.83	11327.00

Notes: Std. Dev.=Standard deviation, N=Amount of non-missing observations, East=Household lives in Eastern Germany, Occ.=occupation, edu.=Education aggregated by ISCED code, Small firm:$<$ 5 employees, Mid-size firm:$5-199$ employees, , Large firm:$>$ 199 employees, Rate of unempl.=Rate of unemployment on the county level, CC quota=Formal child care slots for children aged 0-2 (full-time and part-time) or 3-6 (full-time only) relative to households with respective children (on the county level), Comp school quota=Available full-time school slots (on the state level).
Source: Own calculations based on INKAR, GSOEP and FiD, waves 2010-2013.

Table A3: Estimation results: preferences

	Full		**Standard**	
	coeff.	s.e.	coeff.	s.e.
Consumption				
c_1^u: bad-bad (18%)	0.98	0.12	1.69	0.05
c_2^u: bad-good (15%)	5.93	0.20	1.00	.
c_3^u: good-bad (14%)	-1.03	0.09	1.00	.
c_4^u: good-good (54%)	2.31	0.10	1.00	.
x Age child $0-2$	-1.24	0.13	-0.52	0.06
x Age child $3-6$	0.44	0.13	0.37	0.09
x Age child $7-12$	0.26	0.14	0.38	0.10
Quadratic term	-0.05	0.02	0.14	0.00
Leisure woman				
Linear term	0.91	0.05	1.06	0.04
x Age	0.12	0.02	0.04	0.02
x East	-0.89	0.03	-0.74	0.03
x German	-0.29	0.04	-0.30	0.03
x Handicapped	0.09	0.05	0.08	0.04
x Age child $0-2$	1.14	0.05	0.95	0.04
x Age child $3-6$	0.63	0.05	0.53	0.04
x Age child $7-12$	0.30	0.05	0.32	0.04
Squared term	-0.55	0.01	-0.11	0.01
Leisure man				
Linear term	-1.00	0.05	-0.10	0.04
x Age	0.20	0.02	0.06	0.02
x East	0.11	0.04	0.11	0.03
x German	-0.13	0.04	-0.30	0.04
x Handicapped	0.68	0.05	0.43	0.04
x Age child $0-2$	-0.26	0.06	-0.09	0.04
x Age child $3-6$	0.10	0.05	0.15	0.04
x Age child $7-12$	0.07	0.05	0.00	0.04
Squared term	-0.92	0.01	0.19	0.02
Interactions				
Leisure woman x man	-0.20	0.02	0.05	0.01
Observations	11327	.	11327	.
Positive 1st Derivates (in %)				
U_{c1} (consumption)	0.93	.	1.00	.
U_{c2} (consumption)	1.00	.	.	.
U_{c3} (consumption)	0.00	.	.	.
U_{c4} (consumption)	1.00	.	.	.
U_{lm} (leisure woman)	0.99	.	0.94	.
U_{lf} (leisure man)	0.83	.	0.01	.

Notes: Full=Discrete choice model based on desired hours of work augmented by constraints (section 3), Standard=Discrete choice model based on actual hours of work, East=Household lives in Eastern Germany, *bad* (*good*) refers to the unobserved restriction types with c.p. a higher (lower) restriction probability, coeff.=regression coefficient, s.e.=standard errors.
Source: Own calculations based on FiD, waves 2010-2013.

Table A4: Estimation results: hours constraints

	Hours categories				
	1-14	**15-24**	**25-35**	**36-40**	**>40**
Constant	-1.08	-0.59	-0.05	-0.63	-0.64
	0.20	0.15	0.11	0.10	0.19
Fid	-0.44	-0.16	-0.64	-0.81	-0.17
	0.15	0.11	0.08	0.07	0.11
Individual Characteristics					
Male	2.12	1.76	1.29	-0.20	-1.17
	0.25	0.20	0.08	0.08	0.19
Edu.: Isced 0-2	0.44	0.40	0.21	0.30	1.03
	0.14	0.10	0.08	0.07	0.10
Edu.: Isced 3-4	-0.15	-0.03	-0.00	-0.08	0.28
	0.04	0.03	0.02	0.02	0.04
Age	0.01	-0.10	0.11	-0.01	-0.24
	0.10	0.06	0.04	0.04	0.06
German	-0.37	-0.31	0.03	0.07	-0.78
	0.17	0.13	0.09	0.08	0.11
East	0.74	1.09	0.16	0.63	0.15
	0.37	0.25	0.15	0.14	0.23
Handicapped	0.31	0.46	-0.14	-0.06	0.73
	0.19	0.12	0.10	0.10	0.15
Occupation (reference: professionals)					
Managers	0.11	-0.04	0.27	0.69	-0.21
	0.21	0.15	0.10	0.09	0.17
Technicians	0.17	-0.02	-0.10	-0.10	-0.13
	0.15	0.07	0.04	0.05	0.11
Clerks	0.35	0.02	0.11	-0.23	0.63
	0.15	0.08	0.07	0.09	0.13
Service workers	0.09	0.10	-0.10	0.48	-0.34
	0.12	0.08	0.06	0.08	0.14
Agriculture	0.74	0.26	0.45	0.63	0.79
	0.55	0.40	0.33	0.20	0.29
Craft workers	0.45	0.45	-0.13	-0.22	-0.01
	0.21	0.15	0.06	0.05	0.10
Plant	-0.90	-1.07	-0.25	-0.26	-0.25
& machine operators	0.32	0.30	0.10	0.08	0.14
Elementary	-0.43	-0.36	0.14	-0.12	-0.39
	0.16	0.12	0.10	0.09	0.19
Firm size (reference: 5-199 employees)					
>5 employees	-0.50	0.23	0.08	0.56	-0.17
	0.16	0.12	0.11	0.11	0.27
>199 employees	0.26	-0.11	-0.01	-0.20	0.11
	0.12	0.05	0.03	0.03	0.05
Regional level					
Reg. rate of unempl.	0.20	0.19	0.07	0.05	0.34
	0.08	0.06	0.03	0.03	0.05

Notes: East=Household lives in Eastern Germany, Occ.=occupation, Edu.=Education aggregated by ISCED code (reference Isced 5-6), standard errors is parantheses.
Source: Own calculations based on INKAR, GSOEP and FiD, waves 2010-2013.

Table A4: Estimation results: hours constraints (cont.)

	Hours categories				
	1-14	**15-24**	**25-35**	**36-40**	**>40**
Children					
0-2 m	0.11	-0.18	-0.03	-0.16	-0.15
	0.36	0.28	0.11	0.08	0.12
0-2 f	0.18	0.18	0.34	0.06	0.40
	0.20	0.14	0.12	0.18	0.37
3-6 m	-0.02	-0.24	-0.08	-0.08	-0.16
	0.35	0.27	0.10	0.07	0.10
3-6 f	0.45	0.18	0.27	0.28	0.11
	0.16	0.11	0.09	0.13	0.28
7-12 m	0.32	-0.43	0.04	-0.01	-0.10
	0.38	0.26	0.10	0.07	0.10
7-12 f	-0.30	-0.12	0.04	0.04	-0.22
	0.14	0.09	0.08	0.11	0.26
Childcare coverage 0-2					
m	-0.21	-0.31	-0.02	-0.21	-0.06
	0.26	0.20	0.08	0.06	0.10
f	0.35	-0.21	-0.04	-0.17	-0.03
	0.16	0.10	0.06	0.07	0.17
m x child	-0.01	-0.05	0.07	-0.14	-0.06
	0.35	0.25	0.12	0.07	0.11
f x child	-0.10	-0.11	-0.05	0.03	0.01
	0.20	0.15	0.10	0.13	0.29
Childcare coverage 3-6					
ft m	-0.04	-0.14	-0.10	0.00	0.12
	0.30	0.25	0.08	0.05	0.08
ft f	-0.03	-0.15	-0.07	-0.02	-0.25
	0.12	0.08	0.06	0.09	0.20
ft m x child	-0.05	0.08	0.07	-0.01	-0.09
	0.43	0.29	0.09	0.06	0.10
ft f x child	0.05	-0.01	-0.14	-0.19	0.13
	0.14	0.10	0.07	0.11	0.27
all-day school					
m	0.15	-0.29	0.13	-0.01	-0.13
	0.24	0.23	0.06	0.04	0.07
f	0.05	-0.01	-0.04	0.00	0.03
	0.11	0.07	0.04	0.06	0.14
m x child	-0.11	0.63	-0.05	0.02	-0.03
	0.42	0.25	0.10	0.06	0.10
f x child	0.07	-0.28	-0.08	-0.16	0.03
	0.15	0.09	0.07	0.10	0.25
Observations	1678.00	3178.00	5299.00	8748.00	5375.00
u_m^1	1.25	1.25	1.25	1.25	1.25
	0.04	0.04	0.04	0.04	0.04
u_m^2	-0.64	-0.64	-0.64	-0.64	-0.64
u_f^1	1.48	1.48	1.48	1.48	1.48
	0.04	0.04	0.04	0.04	0.04
u_f^2	-0.55	-0.55	-0.55	-0.55	-0.55

Notes: East=Household lives in Eastern Germany, Occ.=occupation, Edu.=Education aggregated by ISCED code (reference Isced 5-6), standard errors is parantheses.
Source: Own calculations based on INKAR, GSOEP and FiD, waves 2010-2013.

Table A5: Estimation results: hourly wage

	Men, East		Women, East		Men, West		Women, West	
	coeff.	s.e.	coeff.	s.e.	coeff.	s.e.	coeff.	s.e.
Age	0.014	0.004	0.039	0.003	0.013	0.002	0.027	0.001
squared	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Education, reference: primary								
Secondary 1st step	0.204	0.049	0.156	0.064	0.002	0.014	0.071	0.017
Secondary 2nd step	0.216	0.049	0.182	0.064	0.013	0.013	0.094	0.017
Post-secondary	0.226	0.052	0.265	0.066	0.045	0.015	0.140	0.018
Tertiary 1st step	0.230	0.051	0.243	0.066	0.055	0.015	0.147	0.019
Tertiary 2st step	0.287	0.052	0.359	0.066	0.155	0.015	0.272	0.019
Years education x German					0.007	0.001	0.010	0.001
Experience (in years)								
Full-time			0.001	0.002			0.010	0.002
squared			0.004	0.003			-0.011	0.006
x German							0.002	0.002
x German squared							-0.010	0.006
Part-time			0.003	0.002			0.002	0.003
squared			-0.006	0.007			-0.010	0.011
x German							-0.004	0.003
x German squared							0.019	0.012
Both	0.008	0.002			0.009	0.001		
squared	-0.035	0.004			-0.038	0.003		
x German					0.003	0.001		
x German squared					-0.001	0.003		
Tenure	0.011	0.001	0.019	0.001	0.026	0.002	0.029	0.002
squared	-0.017	0.003	-0.028	0.003	-0.045	0.005	-0.058	0.007
x German					-0.014	0.002	-0.014	0.002
x German squared					0.031	0.006	0.037	0.008
Loss human capital	-0.170	0.006	-0.080	0.005	-0.075	0.007	-0.014	0.005
x German					-0.063	0.008	-0.017	0.005
Firm size, reference: <5 employees								
$5-19$	-0.186	0.011	-0.198	0.009	-0.155	0.007	-0.157	0.005
$20-199$	-0.014	0.002	-0.002	0.003	-0.020	0.001	-0.004	0.002
>200	0.109	0.006	0.102	0.006	0.060	0.002	0.089	0.004
Sector, reference: (Electrical) Machinery								
Energy	0.138	0.017	0.155	0.034	0.048	0.011	0.211	0.022
Wood/paper/chemicals	0.057	0.013	0.062	0.021	0.077	0.005	0.051	0.008
Construction	0.041	0.008	-0.016	0.020	-0.011	0.005	-0.029	0.014
Heavy industry	0.038	0.011	0.019	0.027	0.070	0.005	0.088	0.013
Textile/food	-0.062	0.048	-0.114	0.034	-0.067	0.019	-0.088	0.019
Whole sale/retail	-0.089	0.010	-0.070	0.008	-0.090	0.005	-0.071	0.004
Transport/communication	-0.006	0.010	0.035	0.016	-0.037	0.005	0.049	0.010
Public services	0.024	0.006	0.057	0.004	-0.039	0.004	0.020	0.002
Private services	-0.031	0.009	-0.046	0.008	0.001	0.005	-0.006	0.004
Other	-0.055	0.012	-0.091	0.011	-0.043	0.006	-0.061	0.007
Agriculture	-0.249	0.016	-0.262	0.026	-0.148	0.014	-0.164	0.024
Task, reference: Worker								
Skilled worker	-0.112	0.005	-0.147	0.011	-0.097	0.003	-0.105	0.011
Foreman	0.008	0.011	-0.012	0.038	-0.011	0.006	-0.060	0.025
Employee: no training	-0.237	0.018	-0.222	0.012	-0.311	0.010	-0.220	0.006
Employee: training	-0.108	0.012	-0.078	0.008	-0.160	0.008	-0.073	0.005
Employee: qualified tasks	0.044	0.008	0.057	0.004	0.030	0.003	0.095	0.002
Employee: management	0.329	0.008	0.323	0.009	0.287	0.003	0.300	0.006
Civil servant: middle grade	0.008	0.021	0.153	0.024	-0.098	0.009	0.129	0.014
Civil servant: upper grade	0.326	0.016	0.302	0.018	0.109	0.007	0.299	0.009
Hamburg					0.028	0.013	0.046	0.015
Lower Saxony					-0.007	0.009	-0.014	0.010
Bremen					-0.052	0.018	-0.030	0.019
Northrhine-Westphalia					0.017	0.008	0.006	0.009
Hesse					0.045	0.009	0.039	0.010
Rhineland-Palatinate					0.001	0.010	0.006	0.011
Baden-Württemberg					0.064	0.008	0.058	0.010
Bavaria					0.021	0.008	0.028	0.010
Saarland					0.012	0.014	-0.026	0.017
Brandenburg	-0.094	0.011	-0.113	0.011				
Mecklenburg WP	-0.096	0.013	-0.115	0.013				
Saxony	-0.156	0.010	-0.167	0.010				
Saxony-Anhalt	-0.146	0.011	-0.180	0.011				
Thuringia	-0.153	0.011	-0.164	0.011				

Table A5: Estimation results: hourly wage (cont.)

	Men, East		Women, East		Men, West		Women, West	
	coeff.	s.e.	coeff.	s.e.	coeff.	s.e.	coeff.	s.e.
2000	0.024	0.015	0.039	0.016	0.007	0.008	0.015	0.010
2001	0.069	0.015	0.065	0.016	0.065	0.007	0.068	0.009
2002	0.096	0.015	0.081	0.016	0.100	0.008	0.087	0.010
2003	0.112	0.015	0.099	0.016	0.097	0.008	0.098	0.010
2004	0.107	0.016	0.080	0.017	0.091	0.008	0.088	0.010
2005	0.107	0.016	0.076	0.017	0.066	0.008	0.068	0.010
2006	0.091	0.015	0.064	0.016	0.072	0.008	0.078	0.010
2007	0.111	0.016	0.084	0.017	0.082	0.008	0.076	0.010
2008	0.112	0.015	0.109	0.016	0.082	0.008	0.103	0.010
2009	0.114	0.015	0.097	0.016	0.096	0.007	0.077	0.009
2010	0.129	0.015	0.108	0.015	0.110	0.007	0.089	0.009
2011	0.142	0.015	0.135	0.015	0.115	0.007	0.102	0.009
2012	0.144	0.016	0.182	0.017	0.091	0.007	0.110	0.009
Handicapped, degree	0.000	0.001	-0.001	0.001	0.001	0.000	0.002	0.000
squared	-0.001	0.001	0.001	0.001	-0.002	0.000	-0.003	0.001
Constant	1.806	0.083	1.259	0.086	1.991	0.036	1.447	0.036
Selection step								
Age	0.111	0.011	0.071	0.009	0.139	0.007	0.064	0.004
squared	-0.003	0.000	-0.002	0.000	-0.002	0.000	-0.002	0.000
Education, reference: primary								
Secondary 1st step	0.804	0.103	0.551	0.108	0.367	0.042	0.148	0.039
Secondary 2nd step	1.184	0.097	0.953	0.104	0.676	0.040	0.424	0.037
Post-secondary	1.732	0.113	1.405	0.112	0.948	0.050	0.684	0.041
Tertiary 1st step	1.815	0.108	1.515	0.111	1.063	0.050	0.606	0.043
Tertiary 2st step	2.354	0.102	1.737	0.106	1.436	0.045	0.937	0.039
Experience (in years)								
Full-time			0.095	0.004		0.003	0.074	0.002
squared			0.030	0.011			0.007	0.006
Part-time			0.182	0.005			0.214	0.003
squared			-0.243	0.024			-0.459	0.010
Both	0.068	0.006			0.041			
squared	0.102	0.014			0.065	0.008		
Handicap degree	0.498	0.028	-0.004	0.003	0.302	0.020	0.001	0.001
Squared	-0.148	0.052	0.008	0.004	-0.105	0.035	-0.006	0.002
Current health, reference: very good								
Good	0.033	0.058	0.030	0.037	-0.059	0.037	0.005	0.018
Satisfactory	-0.058	0.033	-0.099	0.039	-0.087	0.021	-0.060	0.020
Bad	-0.068	0.044	-0.329	0.045	-0.069	0.028	-0.205	0.024
Very bad	-0.015	0.003	-0.705	0.073	-0.006	0.001	-0.711	0.041
Married	0.021	0.004	0.148	0.024	0.003	0.002	-0.232	0.015
Number of children aged								
< 3	0.097	0.042	-1.215	0.040	0.029	0.026	-1.608	0.023
$3 - 6$	-0.025	0.045	-0.686	0.043	-0.163	0.028	-1.100	0.023
$7 - 16$	-0.448	0.053	-0.299	0.029	-0.563	0.032	-0.656	0.016
> 16	-0.929	0.080	-0.142	0.039	-1.138	0.046	-0.262	0.021
Non-labor income	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hamburg					0.076	0.065	0.017	0.049
Lower Saxony					0.148	0.042	0.007	0.031
Bremen					-0.076	0.079	0.028	0.062
Northrhine-Westphalia					0.082	0.038	-0.056	0.029
Hesse					0.161	0.044	0.033	0.032
Rhineland-Palatinate					0.141	0.047	-0.107	0.035
Baden-Württemberg					0.370	0.041	0.008	0.030
Bavaria					0.236	0.040	0.044	0.030
Saarland					0.136	0.068	-0.044	0.050
Brandenburg	-0.352	0.042	-0.075	0.037				
Mecklenburg WP	-0.276	0.049	-0.101	0.042				
Saxony	-0.202	0.039	-0.078	0.033				
Saxony-Anhalt	-0.202	0.042	-0.172	0.036				
Thuringia	-0.104	0.043	-0.102	0.036				

Table A5: Estimation results: hourly wage (cont.)

	Men, East		Women, East		Men, West		Women, West	
	coeff.	s.e.	coeff.	s.e.	coeff.	s.e.	coeff.	s.e.
2000	-0.089	0.055	-0.060	0.051	-0.140	0.041	-0.097	0.029
2001	0.008	0.055	0.096	0.051	-0.029	0.040	0.065	0.028
2002	-0.136	0.056	-0.043	0.051	-0.214	0.040	-0.065	0.029
2003	-0.033	0.056	0.073	0.051	-0.192	0.040	-0.042	0.029
2004	-0.068	0.057	-0.014	0.052	-0.229	0.041	-0.045	0.030
2005	-0.046	0.057	0.047	0.053	-0.230	0.040	-0.092	0.029
2006	0.146	0.059	0.187	0.054	-0.034	0.043	0.005	0.030
2007	0.233	0.062	0.221	0.055	-0.014	0.044	0.014	0.031
2008	0.388	0.061	0.399	0.055	0.011	0.042	0.130	0.031
2009	0.358	0.058	0.250	0.048	-0.159	0.038	-0.025	0.026
2010	0.398	0.057	0.351	0.048	-0.061	0.039	0.032	0.026
2011	0.450	0.060	0.382	0.051	-0.005	0.041	-0.103	0.029
2012	0.415	0.064	0.357	0.057	-0.197	0.041	-0.197	0.031
German					0.448	0.022	0.279	0.017
Constant	-1.600	0.224	-1.060	0.190	-2.028	0.133	-0.356	0.096
Mills λ	-0.092	0.020	0.030	0.019	-0.112	0.011	0.039	0.009
Observations								
Employed	17251		17802		58830		54442	
Non-employed	4120		6687		6644		24848	

Notes: Education is classified by ISCED. Reference categories for state: Schleswig-Holstein and West Berlin for West Germany, East Berlin for East Germany, coeff.=regression coefficient, s.e.=standard errors, x refers to an interaction effect.
Source: Own calculations based on GSOEP and FiD, waves 1999-2013.