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Using information on desired and actual hours of work, we formulate a discrete choice model of constrained labor supply. Using the German Socio-Economic Panel and the microsimulation model STSM, we find that hours and participation elasticities are substantially smaller than those in the conventional model. We evaluate two reforms for Germany. Both redistribute to the working poor. The first reform is financed through an increase in the effective marginal tax rate for welfare recipients, the second through an increase in taxes. The first reform is desirable with equal weights, the second if the social planner has substantial redistributive taste.

Keywords Tax-benefit systems · Household labor supply · Labor market constraints · Involuntary unemployment · Marginal cost of public funds

JEL Classification J22 · H21 · D10

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1 Introduction

Policy reforms aimed at reducing the distortionary effects of the tax and transfer system often focus on improving labor supply incentives for low-income households. Recently, a number of studies have argued that redistribution to the working poor as achieved, e.g., via the Earned Income Tax Credit (EITC) in the US can substantially improve welfare of this group without imposing a large cost on tax payers (e.g. Immervoll et al. 2007; Blundell et al. 2016). However, individuals with low income often face labor market constraints and cannot adjust their hours of work at will. Evidence that workers cannot choose their hours of work freely has been found for several countries including Germany.[1] Restrictions to the set of work hours available to employees may occur due to employers offering specific jobs only in combination with specific work hours. Moreover, a substantial share of the unemployed are involuntarily unemployed and cannot take up work when incentives improve (see Subsection 2.1 and, e.g, Bargain et al. 2010 for evidence for Germany). On the other hand, labor market constraints might even further reduce the costs of redistribution via policy reforms if workers faced with increased marginal tax rates cannot *reduce* their hours of work. Therefore, it is important to model these restrictions for the ex-ante evaluation of policy reforms.

This paper makes three key contributions: First, we extend a standard discrete-choice labor supply model by introducing involuntary unemployment and hours constraints. Second, we incorporate the constrained labor supply model in a microsimulation model and evaluate two hypothetical tax-transfer reforms for Germany aimed at increasing labor supply incentives for low to middle income households. The first simulated reform makes working at very low earning levels unattractive, while increasing income at middle to high income levels. The second—more conventional—reform redistributes from higher income earners to the lower middle class. Third, we summarize the redistributive trade-off of the reforms in a simple policy measure, which measures the cost of redistributing one Euro via a specific reform.

We find that, first, labor supply elasticities under the constrained model are substantially smaller than those estimated using a standard approach that does not allow for constraints. Second, the cost of redistribution is substantially smaller via the first reform than via the second reform. The first reform is desirable for low levels of inequality aversion, while the second dominates if inequality aversion is larger.

[1] For the documentation of constrained hours of work see, e.g., Stewart and Swaffield (1997), Euwals (2001), Bryan (2007), and Chetty et al. (2011) and for Germany Knaus and Otterbach (2019) and papers cited therein.

We add to the literature on labor market constraints in structural labor supply models. (see, e.g., Blundell et al. 1987; Bingley and Walker 1997; Euwals and van Soest 1999; Bryan 2007; Bargain et al. 2010; Beffy et al. 2019). Our approach makes use of a major advantage of the German Socio-Economic Panel (SOEP): It contains information on both *actual* and *desired* hours of work. Using both variables, we first estimate the probability to be constrained for specific numbers of working hours. This includes modeling involuntary unemployment. In a second step, we estimate a discrete choice labor supply model to obtain households' utility functions using information on desired hours of work and the actual budget constraint. The budget constraint is calculated using the microsimulation model STSM. In a third step, we use information on constraints as well as the estimated utility functions to predict labor supply responses.

Our approach differs from previous approaches to model involuntary unemployment and labor market constraints in structural labor supply models. Many papers starting with van Soest (1995) use information on actual hours of work to estimate a discrete choice model of labor supply and include dummy variables for specific hours choices in the deterministic part of the utility function. This can be interpreted as an ad-hoc way to capture labor market frictions. An alternative approach based on information on actual hours of work treats available hours categories as a latent variable, see Aaberge et al. (1995) and Aaberge et al. (1999) for early applications and Dagsvik et al. (2014) for an overview. In contrast, Bingley and Walker (1997), and Bargain et al. (2010) use survey information on whether the unemployed are actively looking for a job. These papers model only involuntary unemployment, but not other constraints in the choice of work hours. Using information on desired hours of work, Euwals and van Soest (1999) model restrictions for several hours categories. However, the study is restricted to singles and for computational tractability it is assumed that, if a given hours category is preferred, but not available, other hours categories are ranked according to their distance to the preferred one. The approach proposed in this paper does not impose this restriction. Another important difference between this study and previous work is that we model involuntary unemployment and other labor market restrictions jointly.[2] For couple households, our approach assumes joint utility maximization and accounts for the complementarity or substitutability of spouses' leisure. In a recent paper, Müller et al. (2018) extend the framework by Euwals and van Soest (1999) to couples and allow for unobservables to impact constraint probabilities. An important distinction between that paper and our approach is that we

[2] Euwals and van Soest (1999) treat involuntary unemployment and constraints for specific positive hours choices separately.

derive an analytical solution for state probabilities.

Our study is related to the recent literature about efficiency increasing reforms of the tax and transfer system. Typically, these studies focus on the working poor. In a recent study, Blundell et al. (2016) find for the UK that increases in tax credit are a relatively cost-effective way to increase welfare. Chan (2013) argues that a further EITC expansion results in substantial efficiency gains, especially among low-wage individuals. Jessen et al. (2017a) show that—under standard assumptions regarding the redistributive taste of the social planner—an optimal tax-transfer schedule for singles in Germany would imply substantially higher net income for the working poor.

Finally, our study is related to papers that quantify the cost of redistribution via specific policy reforms. If individuals work more as a consequence of a reform of the tax and transfer system, the government needs to tax less than one Euro away from one group in order to redistribute one Euro to another group. Therefore, policy reforms of the tax and transfer system often aim at improving labor supply incentives. We use an approach based on Browning and Johnson (1984), which measures the cost of redistribution as the decrease in disposable income for higher income earners necessary to increase disposable income of lower income earners by one Euro.[3] This measure equals one in case of no labor supply reactions. Immervoll et al. (2007) quantify this redistributive trade-off for two types of reforms. While their approach offers the advantage of closed-form solutions, it is limited to particular types of reforms. Moreover, it imposes strict constraints on the modeling of labor supply, which in that study is characterized through two elasticities. Building on this, Eissa et al. (2008) quantify the redistributive trade-off for actual past reforms in the US. Again, labor supply is calibrated through extensive and intensive labor supply elasticities. In contrast, in this paper we build a structural labor supply model, which allows for non-constant, heterogeneous labor supply elasticities. The reforms are carefully calibrated to be budget neutral, taking into account their effects on labor supply. We then directly measure the cost of redistribution of the reforms by comparing the mechanical changes in disposable income for winners and losers. Finally, we apply distributional weights to the gains and losses in order to capture the degree of inequality aversion of the social planner.

The hypothetical reforms analyzed in this study are motivated by features of the tax-transfer systems of other countries that aim at improving labor supply incentives of low income earners. The Earned Income Tax Credit in the US is a prominent example for a policy which aims at *making*

[3]This idea is linked to the concept of the marginal cost of public funds, which measures the decrease in disposable income of tax payers necessary to increase government revenue by one Euro (see, e.g., Ballard and Fullerton 1992). Kleven and Kreiner (2006) provide a recent treatment that considers both extensive and intensive labor supply reactions.

work pay for low-income families. The program served as a role-model for several European countries, which introduced tax credits or subsidies for social security contributions (SSC, see Bargain et al. 2010). However, the specific designs of the programs vary strongly.[4] In Germany, there is a tax and social-security exemption on jobs with a low level of earnings, so-called marginal employment. It has been subject to several empirical evaluations (see, e.g., Steiner and Wrohlich 2005), which show that the labor supply of secondary earners is depressed by the potentially high marginal tax rates imposed by this regulation. The policy reforms analyzed in this study replace the exemption for marginal employment with a basic allowance for SSC on an individual level. In contrast to the status quo, this allowance does not entail high marginal tax rates for individuals earning slightly above the threshold for marginal employment. The two reforms differ in the ways in which budget neutrality is achieved. In case of the first reform (*Withdrawal*), the implicit marginal tax of rate recipients of means-tested transfers is increased to 100%. In case of the second reform (*Taxation*), taxes for higher income earners and the upper social security threshold are increased. These two types of reforms are of particular interest regarding the constrained labor supply model. In case of the first reform financial incentives to work very few hours are reduced—if extended part-time arrangements are rationed, people might stop working altogether instead of opting for full-time. In this case labor market rationing would limit the potential labor supply increases due to the reform. In case of the second reform people with high productivity are likely to want to reduce working hours. This effect could be limited through rationing, which would reduce the potential tax revenue loss at the higher end of the income distribution.

The next section gives a descriptive overview of actual and desired hours of work and describes the model of constrained labor supply. Section 3 explains how we measure the cost of redistribution via policy reforms. Section 4 presents the two hypothetical reforms that we simulate as an illustration of the model. Section 5 presents simulated reform effects and Section 6 concludes.

[4]For instance, the *Working Tax Credit* in the UK entailed a minimum hours condition that varies depending on the household composition.[5] In Belgium, the *Bonus à l'Emploi* (Employment Bonus) focuses exclusively on persons with low earnings capacity by referring to full-time equivalent earnings rather than actual earnings and increases in the working hours of the subsidized employee (see Dagsvik et al. 2011). France recently expanded the size and target group of its in-work program *Prime d'activité*.

2 The Constrained Labor Supply Model

2.1 Actual and Desired Working Hours in the SOEP

This study is based on data from the Socio-Economic Panel (SOEP), an annual representative survey of German households with more than 20,000 observations per year, see Wagner et al. (2007). We use survey data from 2015, which contain retrospective information for the year 2014. The sample is restricted to households with at least one person that can in principle adjust hours of work (but might be constrained from doing so). Thus we exclude pensioners, mothers on maternity leave, soldiers, apprentices, and disabled people who work in sheltered workshops. Moreover, the self-employed are excluded because of the difficulty of measuring their hourly wage.[6] Reform effects are calculated for this sample only. The wording of the question in the SOEP that identifies desired hours of work is "If you could choose your own working hours, taking into account that your income would change according to the number of hours: How many hours would you want to work?" Thus the answer can be interpreted as the result of utility maximization under a budget constraint. Tables 1 and 2 display the joint distribution of desired and actual weekly working hours of females and males, respectively. In the spirit of our labor supply model, continuous hours of work are summarized in discrete hours categories. The categories included represent the peaks in the distributions of reported hours. For each individual and working time measure we assign an hours category based on the minimum distance of reported hours from those hours categories.[7] The main diagonal contains individuals that are satisfied with their current hours of work. In general, women are more likely to be dissatisfied with their working time. About 45% of all females would like to increase or decrease working hours, with underemployment and overemployment equally relevant. Men are less likely to be underemployed. For men in couple households, underemployment becomes even less relevant. Contrarily, single men are relatively often found to be involuntarily unemployed (not reported). In general, non-coincidence of desired and actual hours is more relevant at the extremes of the distribution. Three out of four men working 50 hours would prefer to work less.

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[6]For instance, income from self-employment might result from work in the previous year.

[7]The zero hours category is only assigned to individuals reporting less than one hour of weekly working time. Individuals whose desired hours are not observed due to item non-response are assigned their actual hours category. In a robustness test we exclude households with item non-response, see Appendix B. For the unemployed, we only observe whether they are looking for a part-time job, a full-time job, or whether they are indifferent between those two. For unemployed singles, we assign randomly one of the part-time (<30 hours) or full-time ($\geq$ 30 hours) categories, with probability weights given by the observed shares for employed people.

Table 1: Distribution of desired and actual weekly working hours of women (in percent)

	Desired hours						
	0	10	20	30	40	45	*Total*
Actual hours							
0	6.4	2.1	4.7	1.1	1.0	0.0	15.4
10	0.0	6.3	3.0	0.9	0.6	0.0	10.6
20	0.0	1.3	11.0	2.8	1.4	0.1	16.7
30	0.0	0.3	3.5	12.2	2.7	0.2	18.8
40	0.0	0.0	0.8	11.2	18.0	0.9	30.9
45	0.0	0.0	0.2	2.2	4.1	1.1	7.6
Total	6.4	10.1	23.2	30.4	27.7	2.3	100.0

Notes: Numbers weighted by the SOEP weighting factors.
Source: Own calculation based on the SOEP v33.1 (2016).

Table 2: Distribution of desired and actual weekly working hours of men (in percent)

	Desired hours				
	0	20	40	50	*Total*
Actual hours					
0	2.1	0.8	3.6	0.6	7.1
20	0.0	2.8	1.8	0.1	4.6
40	0.0	6.2	64.9	2.6	73.7
50	0.0	0.6	10.5	3.6	14.7
Total	2.1	10.3	80.7	6.9	100.0

Notes: Numbers weighted by the SOEP weighting factors.
Source: Own calculation based on the SOEP v33.1 (2016).

2.2 Discrete-choice labor supply

The conventional labor supply model uses information on *actual* hours of work and households' budget constraints to estimate utility functions. These are used to predict changes in probabilities for different employment outcomes of households, when their budget constraints change.

Households' budget constraints under the *status quo* and hypothetical reform scenarios are calculated using the microsimulation model STSM, see Steiner et al. (2012). In addition to the income tax formula and transfers it accounts for deductions, allowances, social security payments and child benefits as well as the interactions of the different components of the tax and transfer system on the household level. See Jessen et al. (2017b) for budget constraints for a wide range of household types.

For constrained labor supply, labor supply reactions to reforms are obtained in three steps. First, the probability that households are constrained for specific hours categories are estimated. Second, households' utility functions are estimated using information on *desired* hours of work. Third, the probability that a household changes its labor supply is calculated using its utility function and constraint probabilities.

The specification of the structural household labor supply model follows van Soest (1995). Households are assumed to jointly maximize utility, which depends on hours worked and consumption. Given their hourly wage and the tax and transfer system, agents make a discrete choice of weekly working hours. The discretization of working hours into j alternatives allows for the precise calculation of net incomes associated with labor supply decisions using the STSM and does not impose any restrictions on the form of the budget set, such as convexity. This is a major advantage relative to continuous labor supply models. The approach accounts for joint labor supply decisions of couples in a consistent way.

Working hours per week of single women and women with "inflexible" partners that cannot adjust their hours of work are discretized into 0, 10, 20, 30, 40 and 45 and those of single men and men with partners that cannot adjust their hours of work into 0, 20, 40, and 50 hours.[8] As the procedure to calculate employment outcome probabilities in the constrained model becomes computationally very burdensome for a high number of hours choices, see Subsection 2.3, couple households are restricted to combinations of 0, 20 and 40 hours leading to nine alternatives.

Gross labor income is given by the product of working hours and the hourly wage. Potential hourly wages of the unemployed are predicted using a selectivity-corrected Mincer-style wage

[8] To assign working hours categories we again follow the minimum distance approach described above (Subsection 2.1).

regression, where selection is accounted for by the two-step Heckman (1979) approach with binary variables for young children in the household, marital status, non-labor income, and indicators for health as exclusion restriction.[9]

Let Lf denote leisure of the female partner, Lm leisure of the male partner, C consumption, and ε a random disturbance. We suppress individual subscripts in the following. The utility of a household given a choice alternative z is given by

$$V_z = U(Lf_z, Lm_z, C_z) + \varepsilon_z. \tag{1}$$

The deterministic part of the utility function is given by the translog utility function

$$\begin{aligned} U = \beta_1 ln(C_z) + \beta_2 ln(C_z)^2 + \beta_3 ln(Lf_z) + \beta_4 ln(Lf_z)^2 + \beta_5 ln(Lm_z) \\ + \beta_6 ln(Lm_z)^2 + \beta_7 ln(C_z) ln(Lf_z) + \beta_8 ln(C_z) ln(Lm_z) + \beta_9 ln(Lf_z) ln(Lm_z). \end{aligned} \tag{2}$$

Heterogeneity between households is incorporated through observed household characteristics that affect some of the coefficients of the utility function:

$$\begin{aligned} \beta_1 &= \alpha_0^C + X_1^{'} \alpha_1^C, \\ \beta_3 &= \alpha_0^{Lf} + X_2^{'} \alpha_1^{Lf}, \\ \beta_5 &= \alpha_0^{Lm} + X_3^{'} \alpha_1^{Lm}, \\ \beta_9 &= \alpha_0^{LmLf} + X_4^{'} \alpha_1^{LmLF}. \end{aligned} \tag{3}$$

X_1, X_2 and X_3 contain individual and household characteristics like age, disability indicators, a dummy for whether the observed person is a German citizen, and number and age of children (see Table C.1 for the exact specification of the utility function).

The error terms ε_z are assumed to be independently and identically distributed across hour categories and households according to the Extreme-Value type I (EVI) distribution. The probability that alternative z is preferred by a household is then given by a conditional logit model (McFadden 1974):

$$P_d^z = Pr(V_z > V_j, \forall j \neq z) = \frac{exp(U_z)}{\sum_{j=1}^{J} exp(U_j)}, z \in J. \tag{4}$$

[9] An alternative strategy would be to estimate potential wages jointly with the preference parameters. However, we do not follow this approach because the small sample properties of the coefficient estimates might be better without joint estimation and chances of misspecification increase under joint estimation. Additionally, the approach would necessitate an approximation of the budget constraint instead of an exact computation of net income for every household.

Alternative z is chosen if it implies a higher utility than any other alternative. The subscript d denotes desired hours of work. See Table C.1 in the appendix for estimation results.

Changes in net income associated with specific hours points lead to changes in the choice probabilities given by equation (4). For the conventional labor supply model, actual instead of desired hours are used for the estimation. Then the equivalent of equation (4) can be used directly to calculate aggregate labor supply effects of the hypothetical reforms by comparing choice probabilities conditional on the budget set under the status quo and under a reform scenario. For the constrained labor supply model, the estimated utility functions need to be combined with information on the availability of work hours categories.

2.3 State Probabilities under Constraints

In the conventional model, using actual working hours equation (4) gives the probability that a household supplies a specific number of hours. In this sense, observed working hours are treated as revealed preferences. This approach would be valid if there were no constraints in the choice of working hours. In contrast, in the model with hours constraints, the same equation estimated using desired hours of work gives the probability that a household *prefers* a specific number of hours.

Constraint probabilities — For all hours categories z, we separately estimate the probability that an individual is unconstrained, ψ^z, using a logit model on all individuals that prefer category z or prefer another category but choose z due to constraints. Only those who actually work in this category are unconstrained. For instance, if an individual prefers to work 20 hours, but works 40 hours, he is constrained for 20 hours, but not for 40 hours, and thus contributes to the estimation of constraint probabilities for both hours categories. Estimations are carried out separately for women and men using desired and actual hours information pooled over the years 2011–2015. Using these estimates, constraint probabilities are predicted for all individuals for all hours categories. Explanatory variables contain the supply-side factors that also enter the hourly wage equation like education, experience, and disability, as well as a proxy for the state of the regional labor market, and dummies for firm size and occupation. The rationale for the inclusion of the latter two variables is that in some occupations working full-time may be the norm, e.g. due to efficiency gains and fixed cost of work, while in other occupations this is not the case. Additionally the possibility to work full-time or part-time may depend on the size of the employing firm. For example, it might be easier for larger firms to adjust to changes of work hours by a single employee. On the other hand, there might be social norms prevalent in larger firms that prevent employees from working part time. Of course, employees are not bound to specific firms and could be offered a better suited job by another employer. Therefore, it has to be assumed that the search cost exceeds the expected utility gain from changing the workplace due to the limited number of suitable employers.[10]

State probabilities — We derive analytical solutions for the household state probabilities using estimates for the probability that individuals are constrained in given hours categories. In contrast to standard models of involuntary unemployment, constraint probabilities are allowed to differ between positive hours categories and between individuals. The derived state probabilities respect joint utility maximization of couples and are therefore fully consistent with the structural labor supply model.

Denote by ψ^z the probability that a household can choose labor supply category z, i.e. that it is unconstrained for this choice. Let subscripts a and d denote actual and desired hours respectively. We start with the case of two potentially constrained positive hours categories z and j. The hours category 0, unemployment, is always available. The state probability P_a^z for a given hours category $z \neq 0$ is given by

$$P_a^z = \psi^z \left[P_d^z + (1 - \psi^j) P_d^j \frac{P_d^z}{P_d^0 + P_d^z} \right], \tag{5}$$

i.e., by the probability that the household is unconstrained for this alternative times the probability that it prefers category z or chooses it as a fallback option because the preferred alternative j is unavailable. The first term in brackets gives the probability that category z is preferred. The second term gives the probability that category j is preferred, but unavailable, times the probability that the household prefers working in category z instead of not working, category 0. The probability that a specific hours category is preferred is obtained from equation (4).

Now consider the case of three positive hours categories. Denote by CS the three elements set of positive hours choices in the household's choice set.[11] Now the probability of employment outcome $z \in CS$ is

[10]For Germany, Knaus and Otterbach (2019) document that job movers are not much more likely to resolve hours mismatch than non-job movers. This points to a limited importance of job changes as a means to hours adjustments.

[11]In addition, the household can choose not to work, thus it has up to four choices in total.

$$P_a^z = \psi^z \left[P_d^z + \sum_{j \in CS \setminus \{z\}} (1-\psi^j) P_d^j \left(\frac{P_d^z}{1-P_d^j} + (1-\psi^{k \neq j,z}) \frac{P_d^{k \neq j,z}}{1-P_d^j} \frac{P_d^z}{P_d^0 + P_d^z} \right) \right]. \tag{6}$$

Again, the first term in brackets is the probability that the household prefers alternative z. The remaining terms give the probability that a different category j is preferred, but unavailable and z is chosen as fallback. For each alternative $j \in CS \setminus \{z\}$ this is given by the probability that j is preferred, but unavailable $\left((1-\psi^j)P_d^j\right)$ times the probability that z is preferred to all remaining categories $\left(\frac{P_d^z}{1-P_d^j}\right)$ or that category $k \in CS \setminus \{z, j\}$ is preferred from the remaining categories, but unavailable $\left((1-\psi^{k \neq j,z})\frac{P_d^{k \neq j,z}}{1-P_d^j}\right)$, and z is preferred to unemployment $\left(\frac{P_d^z}{P_d^0+P_d^z}\right)$.

The general formula for a finite number of potentially constrained alternatives forming choice set CS is given by

$$\begin{aligned} P_a^z \;=\; & \psi^z \Big[P_d^z + \sum_{j \in CS \setminus \{z\}} (1-\psi^j) P_d^j \Big(\frac{P_d^z}{1-P_d^j} + \sum_{k \in CS \setminus \{z,j\}} (1-\psi^k) \frac{P_d^k}{1-P_d^j} \Big(\frac{P_d^z}{1-P_d^j - P_d^k} \\ & + \sum_{l \in CS \setminus \{z,j,k\}} (1-\psi^l) \frac{P_d^l}{1-P_d^j-P_d^k} \Big(\ldots + (1-\psi^y) \frac{P_d^y}{1-\sum_{m \in CS \setminus \{z,y\}} P_d^m} \frac{P_d^z}{P_d^0+P_d^z} \Big) \Big) \Big) \Big]. \end{aligned} \tag{7}$$

The first line of (7) is equivalent to equation (6), except that it contains a sum over $k \in CS \setminus \{z, j\}$ alternatives. The last term of the second line of equation (7), $(1-\psi^y)\frac{P_d^y}{1-\sum_{m \in CS \setminus \{z,y\}} P_d^m}\frac{P_d^z}{P_d^0+P_d^z}$, denotes the probability that alternative $y \in CS \setminus \{z, j, ..., x\}$ is preferred from the remaining labor supply alternatives unemployment, alternative z, and alternative y $\left(\frac{P_d^y}{1-\sum_{m \in CS \setminus \{z,y\}} P_d^m}\right)$. However, y is unavailable $(1-\psi^y)$, so the household chooses category z. The equation contains $(|CS|-1)!$ summations, in practice limiting the number of possibly constrained alternatives for computational reasons.

The state probability for hours category 0, which is always unconstrained, is given simply by unity minus the sum of state probabilities for positive hours alternatives,

$$P_a^0 = 1 - \sum_{i \in CS} P_a^i. \tag{8}$$

2.4 Labor Supply Elasticities

Table 3 shows uncompensated labor supply elasticities for the different labor supply models. They are estimated by increasing hourly gross wages by one percent and comparing simulated labor supply before and after this wage increase. The elasticities capture adjustments at both intensive and extensive margins. The first two columns show elasticities obtained using the conventional model based on revealed preferences alone as is common in the literature. Females' elasticities are generally larger than males' which is in line with most findings in the literature (see Blundell and Macurdy 1999; Keane 2011). Columns 3 and 4 are based on the same simple model but using desired hours without taking labor market constraints into account. In other words, individuals are treated as if they worked in their desired hours category. The implied elasticities are substantially smaller than those based on actual hours worked.[12] The last two columns show elasticities based on the model of constrained labor supply using information on desired hours as well as constraint probabilities. While smaller than those of the conventional model, the labor supply elasticities of the constrained model for females are—perhaps surprisingly—larger than those based on preferences alone (*Pure Incentive*). The reason is the important role of overemployment. For example, an individual might want to increase hours of work from 20 to 30 hours because of a wage increase. If a job with 30 hours is not available, she might settle for one with 40 hours of work instead. This leads to larger labor supply elasticities than without constraints. In contrast, for single males the labor supply elasticity shrinks further in the constrained model, pointing to the larger role of involuntary unemployment.

Table 4 shows intensive own wage labor supply elasticities. The pattern is very similar to that of total own wage elasticities displayed in Table 3. This indicates that the total elasticities are to a substantial degree driven by intensive elasticities. Table 5 displays own-wage participation semi-elasticities for the same household types. Again, the pattern is similar to the one of total hours elasticities. The largest participation elasticities are estimated using the conventional model, while the pure incentive model tends to yield the smallest elasticities.

[12]This is in line with Bargain et al. (2010) who also find that elasticities based on desired hours are smaller than those based on actual hours. They ascribe this to a "participation bias", which results from unduly allowing the (involuntary) unemployed to switch to participation in the model using actual hours. Participation elasticities shown in Table 5 confirm the importance of the "participation bias".

Table 3: Uncompensated Own-Wage Hours Elasticities

	Conventional		*Pure incentive*		*Constrained*	
Household type	female	male	female	male	female	male
Relative change in total hours worked						
Flexible couples	0.18	0.07	0.04	0.03	0.05	0.03
Couples w. flexible female	0.17		0.07		0.09	
Couples w. flexible male		0.06		0.00		0.00
Female singles	0.17		0.02		0.03	
Male singles		0.20		0.03		0.02

Source: Own calculations based on the SOEP v33.1 (2016) and a modified version of the STSM. $\frac{\Delta H}{H} / \frac{\Delta W}{W}$, simulated with a 1-% wage increase.

Table 4: Uncompensated Own-Wage Intensive Hours Elasticities

	Conventional		*Pure incentive*		*Constrained*	
Household type	female	male	female	male	female	male
Relative change in total hours worked						
Flexible couples	0.08	0.02	0.02	0.02	0.01	0.01
Couples w. flexible female	0.11		0.06		0.06	
Couples w. flexible male		0.05		0.00		0.00
Female singles	0.12		0.02		0.02	
Male singles		0.14		0.03		0.01

Source: Own calculations based on the SOEP v33.1 (2016) and a modified version of the STSM. $\frac{\Delta H}{H} / \frac{\Delta W}{W}|_{H>0}$, simulated with a 1-% wage increase.

Table 5: Own-Wage Participation Semi-Elasticities

	Conventional		*Pure incentive*		*Constrained*	
Household type	female	male	female	male	female	male
Absolute change in the participation rate						
Flexible couples	0.08	0.05	0.02	0.01	0.03	0.02
Couples w. flexible female	0.05		0.02		0.03	
Couples w. flexible male		0.01		0.00		0.00
Female singles	0.04		0.00		0.01	
Male singles		0.06		0.00		0.00

Source: Own calculations based on the SOEP v33.1 (2016) and a modified version of the STSM. Δpart. rate$/\frac{\Delta W}{W}$, simulated with a 1-% wage increase.

3 Measuring the Cost of Redistribution via Policy Reforms

As in Immervoll et al. (2007), we measure the cost of redistribution via each of the revenue neutral reforms as the ratio of mechanical income losses and income gains.[13] This measure indicates by how much disposable income of losers of the reform needs to decrease in order to increase disposable income of reform winners. In contrast to that paper, we allow for a fully flexible labor supply model, which allows for income effects as well as non-constant, heterogeneous extensive and intensive labor supply reactions, and therefore do not obtain closed form expressions. Rather, we first calibrate the reforms to be budgetary neutral after labor supply reactions and in a second step we calculate the cost of redistribution. The measure is given by the ratio of the sum of mechanical increases and decreases in disposable income:

$$\Theta = \frac{L}{G}, \tag{9}$$

where L denotes the overall mechanical decrease in disposable income of losers of the reform prior to labor supply reactions and G denotes the overall mechanical increase for reform winners. For small reforms this term measures the unweighted ratio of money metric utility changes of losers and winners.[14] In our case, G and L can be interpreted as approximations of the money metric utility changes.[15] In the case of Pareto improving reforms without losers the cost of redistribution equals zero. In contrast, the more the government has to tax away from the losers in order to redistribute one Euro to reform winners, the higher is Θ. To fix ideas, consider the simple case where labor supply reactions overall do not impact government revenue, e.g., if labor supply is fixed. In this case the cost of redistribution equals one. In contrast, values higher than one indicate that labor supply reactions lead to a decrease in government revenue.

Now we link the cost of redistribution to equity concerns. A reform is desirable if the following condition holds:

[13] Immervoll et al. (2007) use a model without income effects and therefore the cost of redistribution can directly be linked to efficiency losses as labor supply reactions to a tax increase fully account for the deadweight loss of taxation. This interpretation is not possible with more general utility functions that allow for income effects—as is the case for the translog utility function used in this study. See Dahlby (1998) for a discussion of income effects in the context of the marginal cost of public funds.

[14] In this case the envelope theorem can be applied and welfare effects due to behavioral adjustments are negligible. Note that the envelope theorem can be applied as long as reforms do not change the hours restrictions, which we assume to be the case.

[15] An alternative approach would be to calculate the equivalent variation or compensating variation by simulation as in McFadden (1999), Herriges and Kling (1999), and Creedy et al. (2011) or analytically as in Dagsvik and Karlström (2005) and Dagsvik et al. (2009).

$$\sum_{i \in W} w_i s_i \times G > \sum_{i \notin W} w_i s_i \times L, \tag{10}$$

where W indicates the set of winners, s_i indicates the share of individual i of the total gain or loss, respectively, and w_i are marginal social welfare weights, which indicate the value for the social planner of redistributing one Euro to a specific household (Saez 2002).[16] Rearranging yields

$$\frac{\sum_{i \in W} w_i s_i}{\sum_{i \notin W} w_i s_i} > \frac{L}{G} = \Theta. \tag{11}$$

The left hand side denotes the ratio of the sum of marginal welfare weights of winners and losers weighted by the share of each individual's gain or loss in total gains or losses. It is an indicator of the change in equity achieved by the reform. Usually, individuals with lower income are assumed to have higher social welfare weights. Thus, the more gains are concentrated on low income individuals, the larger is this term. The right hand side simply denotes the ratio of total losses to gains and is a measure of how the reform affects the "size of the cake", the cost of redistribution introduced above. For instance, if there are no labor supply adjustments ($\Theta = 1$), a reform is desirable as long as the social planner values an additional Euro of consumption for the winners more than an additional Euro of consumption for the losers. If Θ equals the ratio of the weighted sums of marginal social welfare weights of the groups of winners and losers, the respective policy reform does not impose a change to social welfare and the social planner is indifferent whether to implement the reform.

4 Two Policy Reforms for Germany

We analyze two hypothetical reform scenarios for Germany. Both reforms redistribute to the (full-time) working poor by introducing a basic allowance to social security contributions. To provide insights into the impact of both upward and downward constraints on labor supply adjustment, the reforms differ in the way budget neutrality is achieved. The first reform (*Withdrawal*) makes working low hours unattractive by increasing the effective marginal tax rate for transfer recipients to 100%, which allows to analyze constraints to positive responses at the intensive margin. The second reform (*Taxation*) increases marginal income tax rates, which might induce individuals to

[16] The right hand side divided through the left hand side of equation (10) equals the "distributionally weighted cost of redistribution", which is closely related to the social marginal cost of public funds in Dahlby (1998) and Kleven and Kreiner (2006).

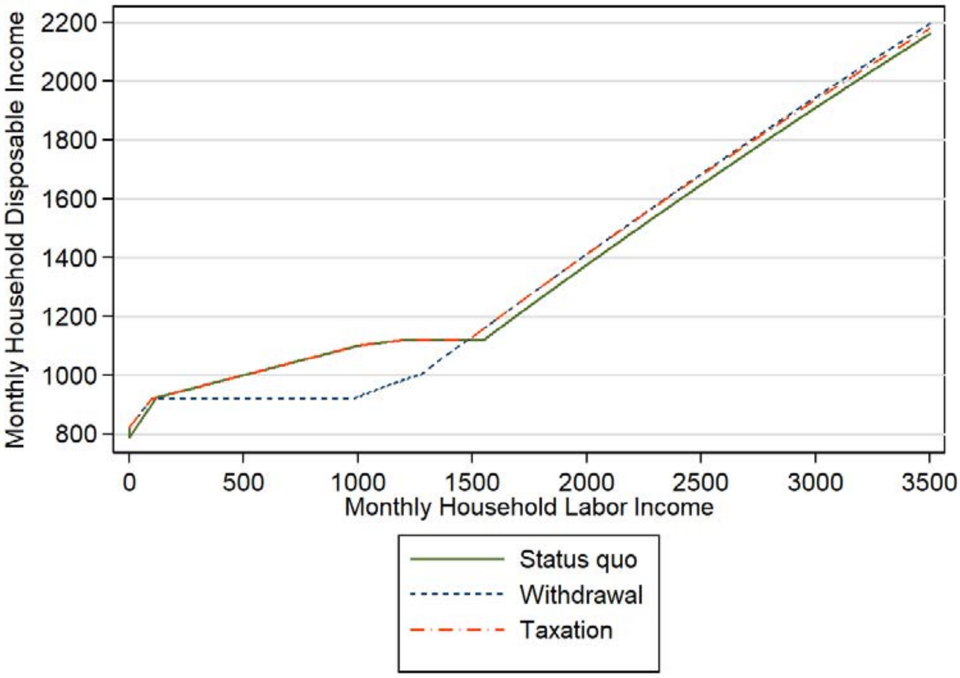
work less, and therefore sheds light on potential downward constraints. The current legislation and the two reforms are described in detail in Appendix A.

Figure 1 shows the budget constraint under the *status quo* and the two reform scenarios of a stylized single without children who is eligible for welfare benefits at low levels of labor income. The figure depicts how monthly disposable income varies with monthly gross labor income for earnings up to 3,500 Euro (Subfigure (a)) and higher earnings between 3,500 and 7,000 Euro (Subfigure (b)). Under the *status quo*, the household is eligible for welfare benefits up to a monthly labor income of about 1600 Euro. Under the *Withdrawal* scenario the effective marginal tax rate is 100% due to means testing for low labor incomes above 100 Euro. Thus most working individuals who receive transfer payments under the *status quo* are worse off. However, for the depicted individual the effective marginal tax rate decreases relative to the *status quo* for labor incomes above 950 Euro. Under the *Taxation* scenario, disposable income does not deviate from the *status quo* for transfer recipients.

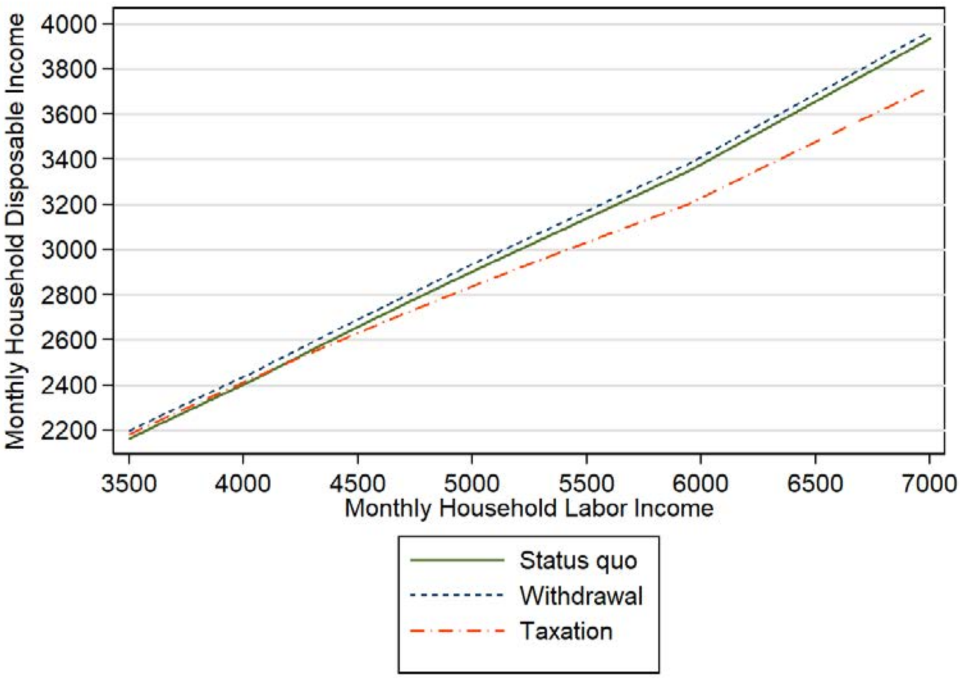
If the individual earns more than about 1,500 Euro per month, he or she is better off under both reform scenarios relative to the *status quo*. The maximum financial gain produced by the two reforms is about 40 Euro per month. Under the *Taxation* scenario, this gain decreases and turns negative at earnings of about 4200 Euro due to the increase in marginal tax rates. In contrast, under the *Withdrawal* scenario the household is better off even for very high earnings.

Since the effective marginal tax rate under the *Withdrawal* scenario changes notably only for low earnings, labor supply reactions can also be expected to be concentrated at low income levels. The full withdrawal of transfers disincentivizes positive working hours at low earnings and therefore imposes a negative impetus on labor supply at the extensive margin. On the other hand, working more hours becomes more attractive relative to part-time work.

Under the *Taxation* scenario, jobs with low to moderate earnings become more attractive compared to very low or medium-to-high earnings. Employees with relatively high earnings are made worse off compared to the *status quo*. They face a higher marginal tax rate and a decrease in net income. The sign of their labor supply reaction thus depends on the importance of income and substitution effects. Importantly, for both reform scenarios, labor supply reactions depend on the availability of hours alternatives. In the following, we account for potential labor supply constraints.



(a) Labor Income up to 3500 Euro



(b) Labor Income between 3501 and 7000 Euro

Figure 1: Budget Constraint of a Single Household Without Children

Source: Own calculations based on a modified version of the STSM..

5 Results

5.1 Reform effects

Labor supply effects — Table 6 shows simulated labor supply effects of the two reforms obtained using the constrained labor supply model. Results are displayed by deciles of potential net equivalent income under the *status quo* regime, i.e., net income if all adults in the household worked full time adjusted by the modified OECD equivalence scale.[17] Using the potential instead of the actual income decile offers the advantage that the government might be more interested in effects on the ”deserving poor”, i.e., those who would still be poor if they worked full time, instead of effects on those who have a low income only because they enjoy high amounts of leisure (see Decoster and Haan 2015). Additionally, results are displayed by household composition.

The *Withdrawal* reform leads to a small increase in labor supply of women and a small decrease in labor supply of men in the first decile. Thus for the latter group the effect of the increased effective marginal tax rate outweighs the positive labor supply incentives brought about by the SSC basic allowance. In the second to eighth decile, labor supply effects are positive, while they are virtually zero in the two highest deciles. The effect is strongest for the 3rd to 5th decile with generally substantially larger effects for females than for males. The effects by household composition are all positive on average and strongest for single females. The total labor supply effect is positive, 0.2 percent.

The *Taxation* reform leads to small increases in labor supply for the lower six deciles, while it leads to decreases in labor supply for the upper four deciles with the strongest effect for the top ten percent (-0.2 percent). For households with relatively low income, SSC are more important, while for higher income households, the tax increases worsen labor supply incentives. Again, female labor supply reacts stronger to the reform. The analysis by household type shows slight increases in labor supply for couples with at least two children and decreases for singles. The total labor supply effect of this reform is very small, but negative.

Table 7 shows participation effects for both reforms. For the *Withdrawal* reform these effects are negative in the first two deciles. However, as shown in Table 6, the positive intensive labor supply response dominates the negative participation effect, leading to a positive overall hours effect. For some individuals, increased effective marginal tax rates make working unattractive. However, both the SSC basic allowance as well as the decreased disposable income for working

[17] Net income divided through one plus 0.5 for every additional adult and 0.3 for every child under 14.

Table 6: Simulated Labor Supply Effects of the Reform Scenarios Under Constraints

	Withdrawal			*Taxation*		
	Women	Men	Total	Women	Men	Total
Changes in Hours Worked (in Percent)						
By Deciles of Potential Net Equivalent Income						
1st	0.2	−0.1	0.1	0.0	0.0	0.0
2nd	0.5	0.1	0.3	0.1	0.0	0.1
3rd	0.8	0.2	0.5	0.1	0.0	0.1
4th	0.8	0.3	0.5	0.1	0.0	0.1
5th	0.6	0.2	0.4	0.0	0.0	0.0
6th	0.4	0.2	0.3	0.0	0.0	0.0
7th	0.2	0.1	0.2	−0.1	−0.0	−0.0
8th	0.1	0.1	0.1	−0.1	−0.0	−0.1
9th	0.0	0.0	0.0	−0.1	−0.1	−0.1
10th	−0.0	0.0	−0.0	−0.3	−0.1	−0.2
By Household Type						
Couples, 0 Children	0.2	0.1	0.2	−0.0	−0.0	−0.0
Couples, 1 Child	0.3	0.2	0.2	−0.0	−0.0	−0.0
Couples, 2+ Children	0.4	0.2	0.2	0.0	−0.0	0.0
Singles, 0 Children	0.5	0.1	0.3	−0.1	−0.0	−0.0
Singles, 1 Child	0.5	0.1	0.5	−0.1	−0.0	−0.0
Singles, 2+ Children	0.4	0.1	0.4	0.0	−0.0	−0.0
All Households	0.4	0.1	0.2	−0.0	−0.0	−0.0

Source: Own calculations based on the SOEP v33.1 (2016) and a modified version of the STSM.

welfare recipients rates make working *more* hours conditional on working attractive too. The latter effect dominates. For all other deciles, participation rates increase overall; Participation rates decrease both for single men and women, with and without children. In contrast, participation effects are positive for couples. The reason is that secondary earners are not affected by the increase in the effective marginal tax rate if primary earners have a relatively high labor income.

Across the deciles, the participation rate effects of the *Taxation* reform are qualitatively similar to the effects on total labor supply with very small increases in the participation rate for lower income households and slight decreases for higher-income households.

Overall, the labor supply effects of the two reform proposals are relatively limited—more so than under the conventional model (not reported). In case of the *Withdrawal* reform, this is true especially for participation effects in the two lowest deciles, for which the conventional model predicts decreases of about one percentage point. At the same time, the conventional model predicts positive participation effects of 0.2 - 0.4 percentage points for the 4th to 8th decile. The overall

Table 7: Simulated Participation Effects of the Reform Scenarios Under Constraints

	Withdrawal			*Taxation*		
	Women	Men	Total	Women	Men	Total
Changes in Participation Rates (in Percentage Points)						
By Deciles of Potential Net Equivalent Income						
1st	−0.2	−0.0	−0.1	0.0	0.0	0.0
2nd	−0.1	−0.0	−0.1	0.0	0.0	0.0
3rd	0.0	−0.0	0.0	0.0	0.0	0.0
4th	0.1	0.1	0.1	0.0	0.0	0.0
5th	0.1	0.1	0.1	0.0	0.0	0.0
6th	0.1	0.1	0.1	0.0	0.0	0.0
7th	0.1	0.1	0.1	0.0	0.0	0.0
8th	0.0	0.1	0.1	0.0	0.0	0.0
9th	0.0	0.1	0.0	0.0	−0.0	0.0
10th	0.0	0.0	0.0	−0.0	−0.0	−0.0
By Household Type						
Couples, 0 Children	0.0	0.1	0.1	0.0	0.0	0.0
Couples, 1 Child	0.0	0.1	0.1	0.0	0.0	0.0
Couples, 2+ Children	0.1	0.1	0.1	0.1	0.0	0.0
Singles, 0 Children	−0.0	−0.0	−0.0	0.0	0.0	0.0
Singles, 1 Child	−0.1	−0.0	−0.1	0.0	0.0	0.0
Singles, 2+ Children	−0.1	−0.0	−0.1	0.0	−0.0	0.0
All Households	0.0	0.1	0.0	0.0	0.0	0.0

Source: Own calculations based on the SOEP v33.1 (2016) and a modified version of the STSM.

hours effect is substantially larger when applying the conventional model (0.6 percent compared to 0.2 percent). For the *Taxation* reform, the negative hours effects for high income earners are also much more pronounced under the conventional model (e.g. -0.7 percent compared to -0.2 percent for the highest decile). This is also true regarding the positive response found for low to middle income households. For this reform, this results in an overall effect on labor supply that is quantitatively similar to that obtained under the constrained model as the larger positive and larger negative effects cancel each other out.

Distributional effects — Table 8 shows changes in disposable net equivalent income caused by the two reforms with and without behavioral adjustments. The mechanical and total effect of the *Withdrawal* reform in the lower three deciles is a decrease in income. Positive labor supply effects lead to a smaller decrease after labor supply effects (total effects). The upper sixty percent of the income distribution gain both before and after labor supply adjustments with the largest postlabor supply reaction effect, an increase of 1.4 percent occurring at the 7th decile. The analysis by household type shows positive mechanical effects for couples with zero or one child and slight negative mechanical effects for couples with at least two children. Incomes of childless singles decrease slightly, while lone parents are hit hard and suffer income losses of more than one percent, even after increasing labor supply.

Table 8: Simulated Distributional Effects of the Reform Scenarios under Constraints

	Withdrawal		*Taxation*	
	Mechanical	Total	Mechanical	Total
Changes in Net Equivalized Income (in Percent)				
By Deciles of Potential Net Equivalent Income				
1st	−4.7	−4.6	0.7	0.7
2nd	−4.1	−4.0	0.7	0.8
3rd	−2.5	−2.3	1.0	1.1
4th	−0.2	0.1	1.2	1.3
5th	0.8	1.0	1.3	1.3
6th	1.0	1.2	0.8	0.7
7th	1.3	1.4	0.7	0.7
8th	1.2	1.2	0.3	0.2
9th	1.0	1.0	−0.5	−0.6
10th	0.7	0.7	−2.4	−2.6
By Household Type				
Couples, 0 Children	0.6	0.7	0.1	0.0
Couples, 1 Child	0.2	0.3	−0.0	−0.1
Couples, 2+ Children	−0.1	−0.0	−0.2	−0.3
Singles, 0 Children	−0.2	−0.0	−0.1	−0.1
Singles, 1 Child	−1.8	−1.6	0.3	0.2
Singles, 2+ Children	−2.0	−1.8	0.3	0.2
All Households	0.1	0.2	−0.0	−0.1

Source: Own calculations based on the SOEP v33.1 (2016) and a modified version of the STSM.

Under the *Taxation* reform scenario, the lower 80 percent of the income distribution enjoy an increase in income. The effects of labor supply reactions on income are much more limited in this scenario. The highest increases in income are enjoyed in the 4th and 5th decile, 1.3 percent. The ten percent with the highest income suffer substantial net income losses of 2.6 percent after labor supply adjustments. On average couples with zero or one child and childless singles are nearly unaffected by the reform, while couples with at least two children lose, and lone parents enjoy income increases. Individuals on average lose 0.1 percent income under this reform scenario. Again, the reform effects are moderate compared to those obtained under the conventional model, which predicts an overall average income increase of 0.5 percent for the *Withdrawal* reform and a 0.2 percent decrease for the *Taxation* reform. However, qualitatively the results remain similar.

5.2 The cost of redistribution

Table 9 shows the cost of redistribution Θ via the two reforms under both the conventional and the constrained labor supply model. Recall that with no labor supply reaction the cost of redistribution equals one. Under the constrained model, 91 cents need to be taxed away from the losers of the reform in order to redistribute one Euro to the winners. The reason is that increases in labor supply lead to increases in government revenue in this scenario. The cost of redistribution is even smaller under the conventional model, where only 81 cents have to be taxed away for each Euro redistributed to the winners. In contrast, the cost of redistribution via the *Taxation* reform exceeds one under both labor supply models. Even though the average labor supply effect is close to zero, as reported above, the fiscal effect of labor supply reactions is negative because higher income earners reduce labor supply, which leads to a higher loss in tax income than an equivalent adjustment at the lower end of the distribution. Nonetheless the revenue losses are modest in size. Correspondingly, the cost of redistribution is close to one. Under the constrained model, only six cents are lost due to behavioral adjustments for every redistributed Euro. Under the conventional model the cost of redistribution is predicted to be substantially larger, 15 cents are lost for every redistributed Euro. The comparison between the two models shows that in our example the cost of redistribution is closer to one, when taking labor market constraints into account than when they are ignored.

Table 9: The Cost of Redistribution under Constraints and Using the Conventional Model

Reform	*Constrained*	*Conventional*
Withdrawal	0.91	0.81
Taxation	1.06	1.15

Source: Own calculations based on the SOEP v33.1 (2016) and a modified version of the STSM.

Table 10 shows how mechanical gains and losses of the reforms are distributed over income deciles. For each decile, it displays the share of winners and losers as well as average gains and losses. Net incomes of the remaining share are unchanged. Losses of the *Withdrawal* reform are concentrated at the lower four deciles, while gains are concentrated on the upper half of the

Table 10: Gains and Losses under Constraints, by Net Equivalent Income

	Withdrawal				*Taxation*			
	winners		losers		winners		losers	
Income decile	share	∅ gain	share	∅ loss	share	∅ gain	share	∅ loss
1st	0.23	412	0.65	-1098	0.59	225	0.24	-37
2nd	0.23	423	0.76	-1503	0.61	219	0.31	-27
3rd	0.43	462	0.57	-1714	0.72	315	0.23	-77
4th	0.72	525	0.28	-1853	0.86	462	0.12	-210
5th	0.88	564	0.12	-1453	0.89	538	0.11	-441
6th	0.93	585	0.07	-1233	0.88	539	0.12	-462
7th	0.96	575	0.04	-913	0.80	501	0.20	-622
8th	0.96	595	0.04	-813	0.72	469	0.28	-645
9th	0.98	557	0.02	-777	0.41	387	0.59	-642
10th	0.98	497	0.02	-741	0.06	224	0.94	-1983
all	0.73	543	0.25	-1435	0.65	420	0.32	-890

Source: Own calculations based on the SOEP v33.1 (2016) and a modified version of the STSM.
share is the share of households who gain/loose without taking labor supply responses into account. ∅ *gain/loss* is the conditional average gain/loss in disposable incomes per year by group (winners/losers), income decile, and reform scenario.

distribution. Thus, a social planner, who puts a higher weight on low income individuals would find this reform desirable only if the cost of redistribution was quite small. In contrast, gains of the taxation reform are more evenly distributed, while the largest losses due to tax increases occur at the top of the income distribution.[18] An inequality averse social planner might thus find the reform desirable even if it entailed a substantial cost of distribution.

Finally, we calibrate marginal welfare weights for different degrees of inequality aversion and calculate the left hand side of inequality (11) in order to determine whether the two reforms are desirable relative to the status quo. We calibrate households' marginal welfare weights as

$$w_i = \frac{hh_i}{sc_i}\frac{1}{(x_i/sc_i)^{\gamma}} / \overline{\frac{hh}{sc}\frac{1}{(x/sc)^{\gamma}}}, \tag{12}$$

where hh_i indicates the number of household members and sc_i is the modified OECD equivalence scale. x_i denotes the disposable income of the household and γ is a parameter of redistributive taste. Dividing through the mean normalizes the weights. When $\gamma = 0$ there is no inequality aversion, but social welfare is increased by redistributing to larger households due to the scale effects implied

[18]In the three lowest deciles, about one fourth of all households loose from the *Taxation* reform (due to the abolition of tax exemptions for marginal employment, see Appendix A), however, the average loss is quite small.

by the equivalence scale.

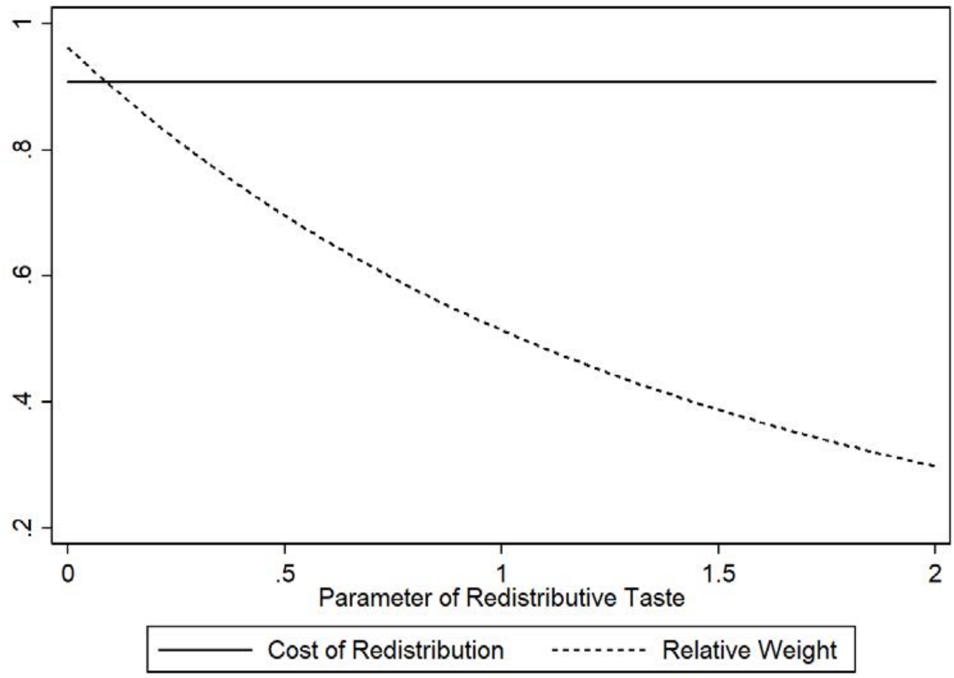
Figure 2 illustrates the redistributive trade-off of the two reforms. The solid lines indicate the cost of redistribution via the respective reforms. The dashed lines show the left-hand side of inequality (11), the weighted change in equity. The figure thus demonstrates the trade-off between increasing the size of the cake and distributing it evenly. When the dashed line is above the straight line for the respective reform, inequality (11) holds and the reform is desirable relative to the status quo. As expected, for relatively low values of inequality aversion the *Withdrawal* reform is desirable. The *Taxation* reform is desirable as soon as the social planner is somewhat inequality averse.

For values of inequality aversion where both reforms are desirable, the figures cannot be used to measure which of the two reforms is superior. Therefore, in Figure 3, we calculate the distributionally weighted average mechanical income change induced by the reforms,

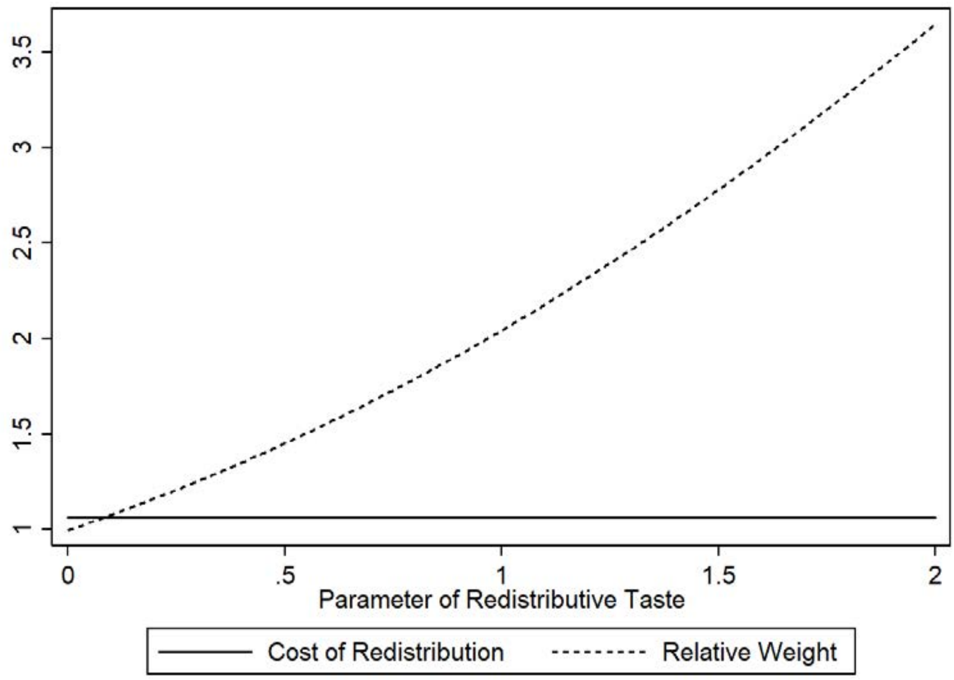
$$\text{Weighted average income change} = \frac{1}{N}\sum_i w_i \times \Delta x_i, \tag{13}$$

where N indicates the number of households and Δx_i is the income change in Euro of household i.[19] Figure 3 measures the total weighted average gain or loss per person. In contrast, the representation in Figure 2 is normalized and measures the impact of the reforms per redistributed Euro. Figure 3 thus takes the "size" of the reforms into account, i.e., how much is redistributed. For small values of redistributive taste the *Withdrawal* reform is superior to the *Taxation* reform. For larger values of inequality aversion, the *Taxation* reform becomes more desirable, but the weighted average gain decreases starting from a value of γ of about one. The reason is that households with very low income benefit from the social security exemption only to a very limited degree. Similarly, with rising inequality aversion, the absolute value of the weighted average loss due to the *Withdrawal* reform decreases. This is because households without market income do not lose from higher effective marginal tax rates. Table 10 shows that a higher share of households in the second decile lose than in the first decile and these losses are larger on average.

[19] Recall that the weight w_i contains the number of individuals living in the household and thus translates the income change from the household to the person level.



(a) *Withdrawal* reform



(b) *Taxation* reform

Figure 2: The Redistributive Trade-off of the Reforms

Source: Own calculations based on the SOEP and the STSM. Dashed lines: left-hand side of inequation (10); straight lines: right hand side.

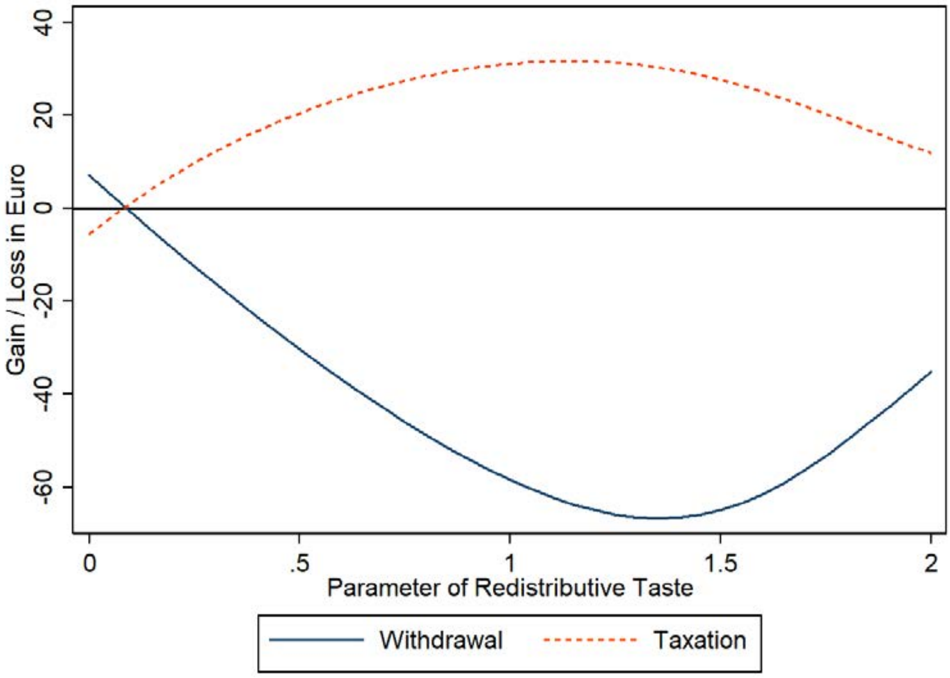


Figure 3: Weighted Average Income Changes

Source: Own calculations based on the SOEP and the STSM. Weighted average income changes calculated using equation (13).

6 Conclusion

This paper makes three key contributions. First, it proposes a theoretically consistent model of constrained labor supply. Incorporating hours restrictions in a standard discrete-choice household labor supply model for Germany shows that labor supply elasticities are smaller than the conventional model would suggest. Second, two hypothetical budget neutral reforms aimed at improving labor supply incentives for the working poor are simulated and evaluated. Third, it proposes a way to capture the cost of redistribution via reforms of the tax and transfer system in an intuitive measure. Allowing for detailed microsimulation and a flexible labor supply model, this measure is not limited to particular types of reforms.

Both reform proposals analyzed in this study include basic allowances for social security contributions. In contrast to tax reductions, reforms of SSC have a substantial impact on the budget constraints of lower income workers. The first reform is financed by increasing the withdrawal rates of means tested transfer to 100 percent and the second reform is financed through tax increases for higher income workers. We find that the cost of redistributing one Euro via the first reform is less than one. This is due to increases in labor supply. This effect is stronger under the conventional labor supply model. Using the constrained model, the costs of redistributing one Euro are still less than one, but larger. The reason is that—in contrast to the conventional model—the constrained model recognizes involuntary unemployment as such. Therefore efficiency gains of this reform are smaller. The second reform leads to substantial revenue reductions due to labor supply reactions under the conventional model, while the losses are more limited, but still relevant, when imposing labor market constraints. Thus, constraints can also reduce the costs of redistribution if high income earners cannot reduce their hours of work at will. This shows that using the constrained model based on desired hours instead of the conventional model makes a difference.

A major drawback of the first type of reform, *Withdrawal*, is that it decreases disposable income of lone parents, a particularly vulnerable group. In future research, a similar reform could be simulated that includes elements to explicitly counter this negative side-effect. A second line of future research would be to explore the causes of labor market constraints and how these constraints can be overcome. This extension would be worthwhile in order to achieve a lower cost of redistribution via reforms of the tax-transfer system.

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Appendix

A The German Tax and Transfer System in the Status Quo and Reform Scenarios

Table A.1 summarizes the changes to the tax-transfer system brought about by the two hypothetical reforms. The current German income tax schedule is characterized by a basic allowance, two "progressive zones" with increasing marginal tax rates, starting with marginal tax rates (MTRs) of 14% and 24% respectively, and two linear zones with marginal tax rates of 42% and 45% respectively.[20] The *Taxation* reform scenario stipulates increases in marginal tax rates by transforming the tax schedule from currently two progressive and two linear zones into three progressive and one linear zone. The starting rate of the third zone increases from 42% to 45%. Marginal tax rates thus begin to increase relative to the *status quo* already from the lower threshold of the second progressive zone at 13,469 Euro of yearly taxable income for a single. The top marginal tax rate rises from 45% due from about 251,000 Euro annual taxable income to 48% due from 70,000 Euro annual income. Finally, the threshold up to which SSC for health and long-term care are due is lifted to the same upper threshold as for old age insurance in West Germany (5,950 Euro).

The long-term unemployed receive the means-tested transfer *Unemployment Benefit II*, about 400 Euro per person and month, plus transfers for rent and heating. The first 100 Euro of monthly labor income are exempted from transfer withdrawal. For earnings above this threshold, in the *status quo* the effective marginal tax rate is 80% up to gross monthly incomes of 1,000 Euro, 90% between 1,001 and 1,200 Euro (1,500 Euro for households with children), and 100% for incomes above the upper thresholds until transfers are fully withdrawn. For the *Withdrawal* reform, budget neutrality is achieved by increasing the marginal transfer withdrawal rate to 100% starting from earnings of 100 Euro.

Currently, individual earnings up to 450 Euro—so-called Mini jobs—are exempted from income tax and employee's SSC. In the reform scenarios, the newly introduced SSC allowance replaces the existing exemption. This change increases the number of individuals that benefit from SSC exemptions to all employees.[21] Due to the non-progressive nature of SSC in Germany, the

[20] The effective marginal tax rate is slightly higher because of the so-called solidarity surcharge of additional 5.5% of the tax liability for tax liabilities of at least 972 Euro per year for singles.

[21] In Germany, SSC are due up to a specified earnings threshold. The SSC reforms are designed such that employees always benefit from the SSC allowance even if their income lies above this threshold.

Table A.1: Current System and Changes under Alternative Reform Scenarios

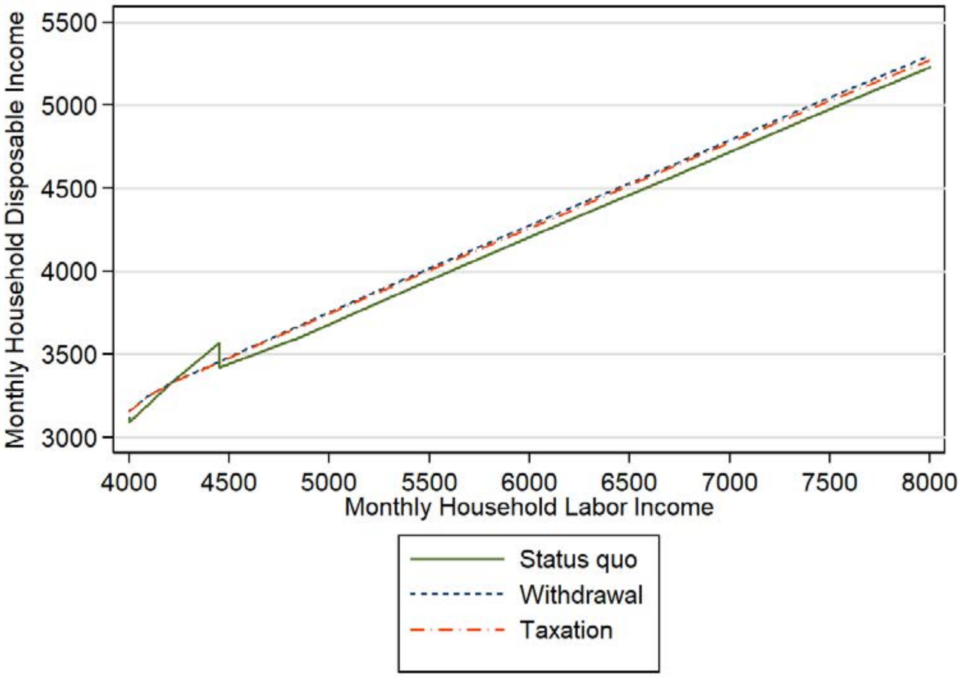
Status Quo (2014)	Withdrawal	Taxation
Marginal Income Tax Rates (MTRs)		
Tax exemption of Mini jobs	–	–
1st progressive zone: from 8,354 Euro	No change	No change
2nd progressive zone: from 13,469 Euro	No change	No change
3rd progressive zone: –	–	increasing MTR starting with 0.45 from 52,882 Euro
1st linear zone: MTR of 0.42 from 52,882 Euro	No Change	MTR of 0.49 from 70,000 Euro
2nd linear zone: MTR of 0.45 from 250,731 Euro	No Change	–
Social Security Contributions (SSC)		
Exemption up to 450 Euro/month (Mini jobs)	–	–
Phase-in of SSC up to 850 Euro/month (Midi jobs)	–	–
Marginal SSC of 0.20175 from 851 Euro/month	from 228 Euro	from 228 Euro
up to earnings threshold of 4050 Euro/month		
for health and long term care insurance	No change	5950 Euro
Allowance: –	227 Euro	227 Euro
Marginal Transfer Withdrawal Rates (MWRs)		
Allowance of 100 Euro/month	No Change	No Change
MWR of 0.8 up to labor income of 1,000 Euro/month	MWR of 1	No Change
MWR of 0.9 between 1,001 and 1,200 Euro/month (1,500 Euro with children in household)	MWR of 1	No Change
MWR of 1 afterwards	No Change	No Change

level of the SSC reduction is constant for earnings above the SSC allowance. In contrast to income tax reforms, SSC allowances relieve working individuals over almost the entire range of the income distribution, particularly low to moderate earners who pay little or no income tax. Additionally, the allowance does not have a regressive effect due to uniform SSC rates. Nonetheless, the allowance interacts with the income tax and means tested transfers[22] such that the net effect on disposable income varies across individuals.

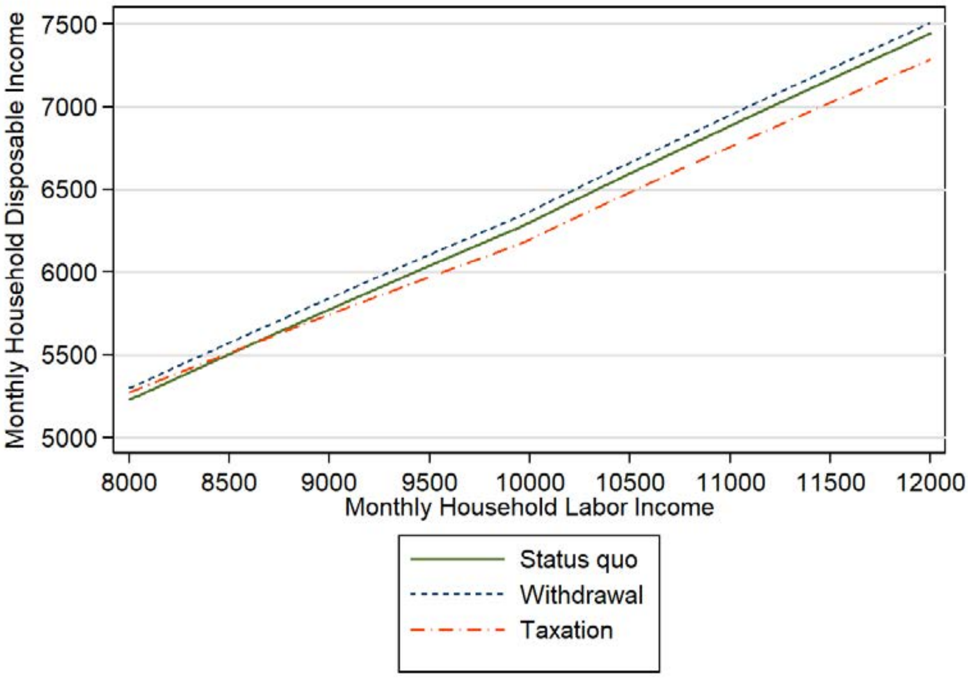
While the replacement of Mini jobs with an SSC allowance does not impose financial gains or losses on households receiving means-tested transfers like Unemployment Benefit II, two-earner couples can suffer considerable income losses in some cases. The current regulation benefits couple households with secondary earners employed in a Mini job through the tax exemption. Married couples can opt for joint taxation with income splitting such that, due to progressive taxation, tax benefits of the Mini job increase in the income level of the primary earner. When the secondary earner earns slightly more than the Mini job threshold of 450 Euro per month, earnings are fully taxed. Thus, working slightly more leads to a *decrease* in disposable household income.

Figure A.1 illustrates how the reforms impact on the budget constraint of an exemplary couple household—a married couple with two children, with the primary earner's income held fixed at 4000 Euro per month. The decrease in disposable income at a monthly labor income of 4450 Euro in Subfigure (a) is due to the Mini job rule.

[22] SSC are largely deducted from taxable income and deducted from gross income when calculating claims to means-tested transfers.



(a) First Earner: 4000 Euro Labor Income, Second Earner: up to 4000 Euro Labor Income



(b) First Earner: 4000 Euro Labor Income, Second Earner: 4001–8000 Euro Labor Income

Figure A.1: Budget Constraint of a Married Couple Household With Two Children

Source: Own calculations based on a modified version of the STSM..

B Robustness Test

In the main specification we assume that individuals with unit non-response for desired hours are satisfied with their actual hours of work. As a robustness test we exclude households with at least one person with unit non-response for desired hours of work and recalculate the estimated elasticities under constraints. Table B.1 shows that elasticities are almost unchanged.

Table B.1: Uncompensated Own-Wage Hours Elasticities under the Constrained Model

	Drop hh with non-response	
Household type	female	male
Relative change in total hours worked		
Flexible couples	0.05	0.03
Couples w. flexible female	0.08	.
Couples w. flexible male	.	0.00
Female singles	.	0.02
Male singles	0.03	.

Source: Own calculations based on the SOEP v33.1 (2016) and a modified version of the STSM.
$\frac{\Delta H}{H} / \frac{\Delta W}{W}$, simulated with a 1-% wage increase.

C Additional Tables

Table C.1: Estimation Results for Labor Supply Model, Dependent Variable: Desired Hours Category

Variables	Flexible Couples	Women with Inflexible Spouse	Men with Inflexible Spouse	Single Men	Single Women
Log Net Income	−23.69**	−20.26***	0.494	−4.136	−15.12***
	(8.978)	(4.098)	(9.700)	(5.046)	(3.691)
(Log Net Income)^2	0.782*	0.796***	−0.0618	0.253	0.464***
	(0.313)	(0.166)	(0.382)	(0.165)	(0.119)
Log Net Income × German Female	−0.340	1.424*	−0.272		1.480**
	(0.546)	(0.702)	(0.476)		(0.561)
Log Leisure Female	90.12***	68.61***			91.24***
	(6.183)	(5.288)			(7.675)

Table continued on next page.

Variables	Flexible Couples	Women with Inflexible Spouse	Men with Inflexible Spouse	Single Men	Single Women
Log Leisure Female × Log Net Income	1.720*** (0.328)	1.012*** (0.286)			1.460** (0.449)
(Log Leisure Female)^2	−14.15*** (0.410)	−9.942*** (0.451)			−13.50*** (0.578)
Log Leisure Female × German Female	−0.663* (0.318)	−0.211 (0.383)			−0.593 (0.457)
Log Leisure Female × Age Female	−0.252** (0.0816)	−0.221* (0.0882)			−0.192 (0.0997)
Log Leisure Female × (Age Female)^2	0.00435*** (0.000970)	0.00432*** (0.00101)			0.00375** (0.00117)
Log Leisure Female × Disability I	1.270** (0.477)	0.257 (0.555)			1.407** (0.486)
Log Leisure Female × Disability II	3.340** (1.042)	2.962** (1.033)			2.958** (0.911)
Log Leisure Female × Children under 3 Years	2.758*** (0.254)	2.909*** (0.356)			3.274*** (0.613)
Log Leisure Female × Children 4 to 6 Years	2.088*** (0.211)	1.694*** (0.307)			2.501*** (0.441)
Log Leisure Female × Children 7 to 16 Years	2.196*** (0.194)	1.738*** (0.272)			1.568*** (0.303)
Log Leisure Female × Children over 17 Years	0.552* (0.222)	0.257 (0.304)			−0.756* (0.353)
Log Net Income × German Male	0.317 (0.724)	−0.203 (0.373)	0.807 (0.931)	0.115 (0.981)	
Log Net Income × Log Leisure Male	0.609 (0.500)		0.114 (0.598)	−0.0561 (0.552)	
Log Leisure Male	5.603 (10.35)		123.0*** (9.093)	124.2*** (10.28)	
(Log Leisure Male)^2	−2.791** (0.918)		−16.41*** (0.625)	−16.43*** (0.816)	
Log Leisure Male × German Male	0.0219 (0.444)		0.00224 (0.560)	−0.163 (0.790)	

Table continued on next page.

Variables	Flexible Couples	Women with Inflexible Spouse	Men with Inflexible Spouse	Single Men	Single Women
Log Leisure Male	-0.0712		-0.0623	-0.0298	
× Age Male	(0.110)		(0.113)	(0.116)	
Log Leisure Male	0.00137		0.00104	0.00115	
× (Age Male)^2	(0.00122)		(0.00130)	(0.00136)	
Log Leisure Male	2.472***		1.385	1.957**	
× Disability I	(0.384)		(0.727)	(0.635)	
Log Leisure Male	2.095**		4.786***	1.446	
× Disability II	(0.648)		(1.053)	(0.951)	
Log Leisure Male × Log Leisure Female × German Male	0.0642 (0.0982)				
Log Leisure Male	1.332*				
× Log Leisure Female	(0.599)				
N	35,460	12,234	5,764	3,836	11,754

Standard errors in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Own calculations based on the SOEP v33.1 (2016) and a modified version of the STSM.

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