Why has Income Inequality in Germany Increased from 2002 to 2011?

A Behavioral Microsimulation Decomposition *

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Abstract

To assess the impact of various factors on changes in income inequality in Germany from 2002 to 2011, I simulate counterfactual income distributions and calculate marginal effects. Using data from the Socio-Economic Panel (SOEP), I estimate the marginal contributions of policy reforms (tax reductions and a controversial overhaul of the transfer system) and their behavioral response as well as changes in the wage rates and their behavioral responses. The simulations show that tax and transfer reforms have had an inequality reducing effect. Depending on the order of the decomposition, changes in labor market prices are shown to have led to either an overall decrease in income inequality or to have had a a negligible effect. Graphical representations of the counterfactual distributions are provided.

Keywords Inequality · Decomposition · Labor Supply · Microsimulation

JEL Classification D31 · H23 · I38 · J31

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1 Introduction

Income inequality has increased considerably in Germany from 2002 to 2011. The Gini coefficient of net equivalized household income has increased from 28.5 to 29.4 (own calculation). How have changes in the tax and transfer sytem and in wage rates contributed to this rise? From a policy perspective it is important to learn about the determinants of increasing income inequality, in order to potentially take appropriate countermeasures. The time span from 2002 is particularly interesting as it witnessed a strong increase in inequality as well as major reforms to the tax and transfer system - the controversial Hartz reforms of the transfer system as well as part of the phasing in of major tax reforms that started in 2001. To answer this question I decompose changes in income inequality into contributions from static and behavioral effects due to changes in the tax and transfer system and changes in the wage rate, leaving the remaining change in inequality as a residual. This is done in an entirely disaggregated way that allows for the graphical representation of counterfactual distributions. Building on previous work by, amongst others, Bargain (2012a,b) and Bourguignon et al. (2008), I apply microsimulation, a structural labor supply model and a wage regression to construct counterfactual distributions. In addition to shedding some light on the reasons for the recent increase in income inequality in Germany, this paper suggests an enhancement of the decomposition method in Bargain (2012a) to account for changes in wage rates in a directly interpretable way.

I find that changes of the tax and transfer system have had a negative impact on inequality as measured through the Gini index and the Mean Log Deviation (MLD). The overall effect of changes in the wage rates on inequality is found to be negative or negligible, depending on the order of the decomposition.

The remainder of the paper is organized as follows. Section 2 gives an overview of the related literature, section 3 discusses possible reasons for the observed increase in inequality, section 4 explains the empirical approach, section 5 presents the decomposition results, and section 6 concludes.

2 Related Literature

The related literature can be divided into two broad categories: The first category consists of studies dealing with the decomposition of differences between distributions, be it over periods, as in this paper, or over different groups. This study lends some techniques from this strand of literature. The second category is composed of studies dealing with the determinants of increasing income inequality in Germany to which this study adds.

2.1 Decomposition of Differences between Distributions

Bourguignon et al. (2008) analyze differences between the income distributions of two countries and combine the semi-parametric reweighting technique due to DiNardo et al. (1996) with strictly parametric methods akin to the decomposition method introduced by Blinder (1973) and Oaxaca (1973): Non-labor income is predicted using a Tobit model and wages are predicted using a Mincer-style regression. Intermediate distributions are obtained, e.g., by using the coefficients of the wage regression of one country to predict wages for the other country. As the authors point out, the parametric techniques offer the advantage of a straight-forward economic interpretation (see also Brewer and Wren-Lewis 2015).

In contrast to studies using reweighting techniques, Bargain and Callan (2010), Bargain (2012b), and Bargain et al. (2013) obtain intermediate distributions by simulating counterfactual net incomes by applying the tax and transfer system of a given period to the population of another period using a detailed tax and transfer calculator. In addition, Bargain Bargain (2012b) explicitly models the effect of fiscal drag.

Creedy and Herault (2011), Bargain (2012a), and Bargain et al. (2015) expand the microsimulation approach by simulating counterfactual labor supply decisions in the former two cases and responses of taxable income in the latter case. In the study at hand, I combine the simulation of counterfactual labor supply with a wage regression following Bourguignon et al. (2008).

2.2 Studies on Germany

The analysis conducted in this study complements a small number of papers on the causes of changes of income inequality in Germany in recent periods. A few studies decompose the overall change in income inequality in Germany between two periods into a number of factors. Biewen and Juhasz (2012) apply the reweighing technique by DiNardo et al. (1996) along with parametric

techniques to study the rise income inequality from 1999/2000 to 2005/2006. Six possible reasons for the increase in inequality are considered: Changes in household structures, changes in other socio-demographic characteristics conditional on household structure, changes in employment outcomes conditional on household structure and characteristics such as age and education, changes in labor market returns, changes in the transfer system and changes in the tax system. Finally, transfers are calculated using microsimulation. They calculate the ceteris paribus effect on inequality of each of the analyzed factors by changing only one of the analyzed factors to the 2005/2006 value while keeping everything else at the 1999/2000 level. They find that changes in the household structure and characteristics as well as changes in the transfer system have had a minor effect. Per contra, changes in labor market returns, conditional employment outcomes and changes in the tax system have had a considerable increasing effect on income inequality. It should be noted that their measure of conditional labor market returns is not limited to the effect of wage changes, but, given their broad definition of employment outcomes, includes hours adjustments.

Bargain et al. (2013) focuses on static policy effects for the period 2008 to 2010. They find that policy changes have had no effect on overall inequality and a positive effect on poverty measures.

Peichl et al. (2012) use subgroup decomposition, which is limited to a specific class of inequality measures, and the reweighting technique introduced by DiNardo et al. (1996) to quantify the impact of changes in household size and employment outcomes on the increase of income inequality from 1991 to 2007. They find that the decreasing average household size in Germany is associated with an increase in inequality and that this increase is mitigated by the tax and transfer system.

Arntz et al. (2007) conduct an ex ante study of the distributional effect of the 2005 Hartz IV reforms of the transfer system described in section 3.1. The study is based on SOEP data for 2004, the STSM (Steiner et al. 2012) is used to simulate counterfactual net incomes after the reform and labor supply responses are simulated via predictions from a structural model (see section 4.5 for a description of this method). The paper finds no direct effect of the reform on the Gini coefficient, while it finds that some other inequality measures have decreased. For people directly affected by the reform, i.e. the group composed of individuals who receive Unemployment Benefit II after the reform or who received Social Assistance or Unemployment Assistance before the reform, the changes in the transfer system have led to a substantial decrease in the Gini coefficient (from 0.18 to 0.14). The behavioral reactions to the reforms gave had a very small effect on inequality; for the group affected directly by the reform, they have had a slight equalizing effect.

3 Reasons for Increase in Inequality

3.1 Changes in the Tax and Transfer System

Several reforms of the German tax and transfer system have taken place between 2002 and 2011. Most prominently, the transfer system has been radically overhauled in the course of the so-called Hartz IV reform. Before the reform, two kinds of means-tested transfers existed for the unemployed: Unemployment Assistance, which amounted to 53% of previous labor income (57% if a child lived in the household) and Social Assistance. In 2005, these transfers were replaced with the so-called Unemployment Benefit II, which amounts only to the social existence minimum, for all individuals deemed able to participate in the labor market. For former recipients of Unemployment Assistance the introduction of Unemployment Benefit II meant a potentially severe reduction of income, in line with the aim of the reform to improve incentives for the unemployed to accept job offers. However, Unemployment Benefit II is slightly higher than Social Assistance, so that former recipients of the latter benefitted directly from the reform. Indeed, the Hartz IV reform has led to an increase in government spending (Biewen and Juhasz 2012) and an ex-post evaluation has shown that average net equivalized income of previous recipients of Unemployment Assistance was higher a year after the reform than before (Bruckmeier and Schnitzlein 2007). [1]

Several changes in the tax system occurred from 2002 to 2011. The initial marginal tax rate was decreased from 19.9 % to 14 %. In 2004, the top marginal tax rate applicable for incomes exceeding 55 000 Euro (year 2002) was decreased from 49 % to 42 % and the top marginal tax rate income threshold was decreased slightly to 52 151 Euro (2004). In 2007 the so-called rich people's tax of 45 % for incomes exceeding 250 000 Euro per year came into force. Additionally, the size of the tax brackets were regularly adjusted slightly to account for inflation.

Finally, the Citizens Relief Act (Bürgerentlastungsgesetz), which is in effect since July 2009, brought about an increase in the possible tax allowances for insurance premia. Overall, tax reforms in the analyzed time-span produced lower marginal taxe rates both at the upper and at the lower end of the income distribution, so the distributional effect is a priori unclear. The same holds for the labor supply effects of these reforms.

[1] Additionally, the period of entitlement to Unemployment Benefit (colloquially referred to as "Unemployment Benefit I"), was reduced from up to 36 months to 12 months and 18 months for individuals over 55 years of age. The entitlement period for the elderly was further increased in 2006 and in 2008. In 2011 the maximum entitlement period for individuals of at least 58 years of age was 24 months. Compared to the year 2002, this still means a reduction in the maximum entitlement period and could potentially have led to an increase in inequality.

Figure 1: Budget constraint of a single household eligible to Social Assitance (2002) or Unemployment Benefit II (2011) in 2011 Euro.

Calculated with the STSM

Figure 1 shows the change in the budget constraint for a single household without children. For the 2002 budget constraint, gross labor incomes have been deflated to 2002 levels and – along with simulated net incomes – inflated back to 2011 levels. For low levels of gross labor income, the transfer of the 2011 regime is substantially more generous. The lower marginal tax rates of 2011 translate into a stepper slope of the budget constraint starting at a monthly gross income of about 2000 Euro.

3.2 Wage Dispersion

The wage distribution in Germany has dispersed considerably since the 1990s, see, e.g., Fuchs-Schuendeln et al. (2010). Several studies attest that this is partly due to polarization, which is consistent with the idea that technological change increased the demand for highly skilled labor,

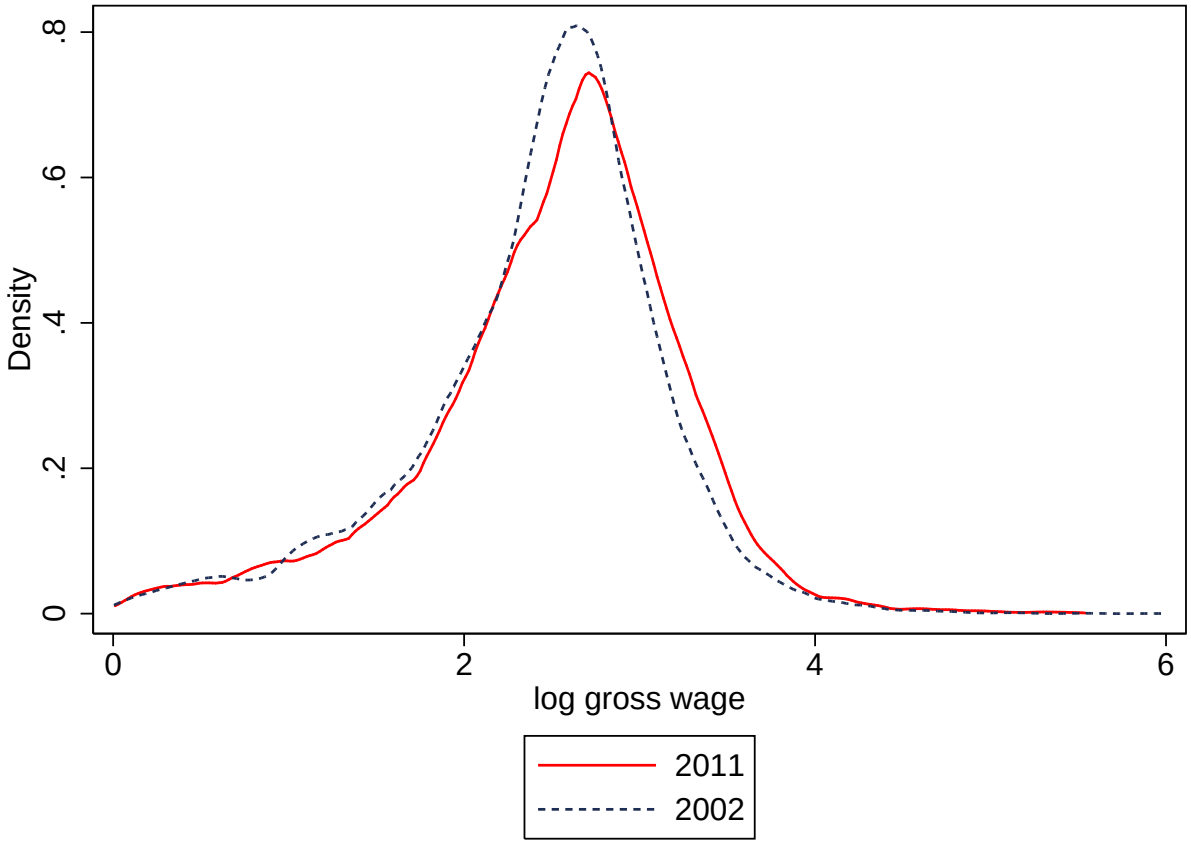

Figure 2: Densities of log hourly wage in 2011 Euro. *Source*: SOEP v.29

see, e.g., Dustmann et al. (2009). However, there is less evidence for skill-biased technological change for the time-span beginning in 2000 and increasing wage dispersion in recent years is likely to be at least partly due to selection as the number of unemployed in Germany has decreased substantially. Hence, the expected effect of changes in labor market prices is unclear.

Figure 2 depicts the log hourly wage densities in the two years. It shows a marked increase in mass at the right of the distribution from 2002 to 2011.

4 Empirical Strategy: Decomposition

4.1 Counterfactual Distributions and Decomposition

The decomposition is restricted to parametric techniques that have a straightforward economic interpretation. I decompose changes in inequality into five different factors. Let $y_a(x_{bd}^{ce})$ be a matrix that describes socio-demographic characteristics and market income of the population of

period b with conditional wage rates of period d with labor supply outcomes given the incentives of the tax and transfer regulations of period c and wages of period e. Let y_a be the tax and transfer function that translates market income and socio-demographic characteristics into net income of each household and denote I an inequality index. Specifically, let $I\left(y_{2011}\left(x^{2011,2011}_{2011,2011}\right)\right)$ be an inequality index of the actually observed outcomes of 2011 and $I\left(y_{2002}\left(x^{2002,2002}_{2002,2002}\right)\right)$ inequality of observed outcomes in 2002. Then the overall change in inequality can be decomposed as follows:

$$
\begin{aligned}
\Delta I &= I\left(y_{2011}\left(x^{2011,2011}_{2011,2011}\right)\right) - I\left(y_{2002}\left(x^{2002,2002}_{2002,2002}\right)\right) \\
&= \left\{I\left(y_{2011}\left(x^{2011,2011}_{2011,2011}\right)\right) - I\left(y_{2011}\left(x^{2011,2002}_{2011,2011}\right)\right)\right\} \text{behavioral wage effect} \\
&+ \left\{I\left(y_{2011}\left(x^{2011,2002}_{2011,2011}\right)\right) - I\left(y_{2011}\left(x^{2011,2002}_{2011,2002}\right)\right)\right\} \text{static wage effect} \\
&+ \left\{I\left(y_{2011}\left(x^{2011,2002}_{2011,2002}\right)\right) - I\left(y_{2011}\left(x^{2002,2002}_{2011,2002}\right)\right)\right\} \text{behavioral policy effect} \\
&+ \left\{I\left(y_{2011}\left(x^{2002,2002}_{2011,2002}\right)\right) - I\left(y_{2002}\left(x^{2002,2002}_{2011,2002}\right)\right)\right\} \text{static policy effect} \\
&+ \left\{I\left(y_{2002}\left(x^{2002,2002}_{2011,2002}\right)\right) - I\left(y_{2002}\left(x^{2002,2002}_{2002,2002}\right)\right)\right\} \text{other effects}
\end{aligned}
\tag{1}
$$

Each of these marginal effects is given by the change in income inequality obtained by changing one factor while keeping everything else equal. Different orders of the intermediate distributions are possible. For instance, in this example static policy effects are calculated conditional on other effects, but it is equally possible to calculate other effects conditional on static policy effects. In section 5 I show the marginal effects of wage rate and policy changes both conditional and unconditional on other effects. [2]

I construct intermediate distributions by simulating counterfactual taxes and transfers using a microsimulation model and by predicting counterfactual wages using a wage regression. Counterfactual labor supply behavior is simulated using a structural microeconometric model.

4.2 Data

This study is based on wave 29 of the Socio-Economic Panel (SOEP), a yearly representative survey of German households. See Wagner et al. (2007) for further information. It contains about 27,000 observations in the examined years 2002 and 2011. Like most surveys the SOEP does not capture the very top of the income distribution. Bach et al. (2009) combine the SOEP with income

[2] Another possibility would be to calculate all possible orders of the decomposition and calculate the average contribution of e.g., wage rate changes over all decomposition orders. Instead I focus on marginal effects, which have a straight-forward economic interpretation.

tax return data to cover the entire distribution of market incomes until the year 2003. They find that the SOEP serves reasonably well to describe the evolution of income inequality as measured with the inequality indices used in this study, while it fails to describe the change of the top-heavy entropy index GE(2).

4.3 Changes in Wage Rates

Table 1: Wage regression 2002

	(1)	(2)	(3)	(4)
	men east	women east	men west	women west
ln(hourly wage)				
Years of schooling	0.0658***	0.0643***	0.0639***	0.0701***
	(0.00524)	(0.00711)	(0.00238)	(0.00358)
Years not worked	-0.161***	-0.117***	-0.102***	-0.0402***
	(0.0195)	(0.0149)	(0.00889)	(0.00497)
Experience	0.0516***	0.0737***	0.0647***	0.0596***
	(0.00657)	(0.00838)	(0.00319)	(0.00441)
Experience squared	-0.101***	-0.158***	-0.119***	-0.119***
	(0.0164)	(0.0223)	(0.00786)	(0.0120)
Constant	1.078***	0.834***	1.361***	1.059***
	(0.101)	(0.147)	(0.0449)	(0.0772)
Mills				
lambda	0.117	0.0565	0.0507	0.0888*
	(0.0706)	(0.0855)	(0.0311)	(0.0445)
N	2616	2899	7586	8253

Standard errors in parentheses

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

Biewen and Juhasz (2012) find that broadly defined changes in labor market returns have led to an increase in inequality until 2006. To shed some additional light on this factor, I analyze the

effect of conditional wages by running a regression of log hourly wages on years of education, work experience and experience squared as well as years not worked in the last ten years (to capture loss of human capital). The Heckman (1979) method is used to account for selection bias with variables for the number of children, family status, and the income of other household members as exclusion restriction. Seperate regressions are run for women and men and East and West Germany.

Table 2: Wage regression 2011

	(1)	(2)	(3)	(4)
	men east	women east	men west	women west
ln(hourly wage)				
Years of schooling	0.0550***	0.0677***	0.0546***	0.0565***
	(0.00522)	(0.00643)	(0.00255)	(0.00330)
Years not worked	-0.137***	-0.113***	-0.146***	-0.0484***
	(0.0159)	(0.0129)	(0.00990)	(0.00548)
Experience	0.0711***	0.0544***	0.0682***	0.0520***
	(0.00721)	(0.00743)	(0.00387)	(0.00429)
Experience squared	-0.156***	-0.106***	-0.131***	-0.0948***
	(0.0187)	(0.0188)	(0.00968)	(0.0111)
Constant	1.235***	1.035***	1.486***	1.330***
	(0.0902)	(0.125)	(0.0465)	(0.0740)
Mills				
lambda	0.0818	-0.00145	0.0970**	0.0274
	(0.0718)	(0.0717)	(0.0370)	(0.0458)
N	2419	2695	6898	7825

Standard errors in parentheses

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

The coefficients and the constant for the years 2002 and 2011 are used to predict counterfactual wages for the respective other years' populations. Following Bourguignon et al. (2008) and Bourguignon and Ferreira (2004), individual's residuals are multiplied by the ratio of standard deviations of residuals of the counterfactual and the observed period and added to the deterministic

part of the counterfactual wage. The ratio of the standard deviations of the residuals of 2011 and 2002, is 1.01, implying essentially no change in within-group wage inequality. Counterfactual wages are inflated or deflated to the data year (as for instance predicting wages for 2002 with 2011 coefficients would lead to higher wages due to inflation if this was not accounted for).

The results of the wage regressions are reported in tables 1 and 2. The signs of the coefficients are as expected implying positive returns to schooling, positive and decreasing returns to experience, a wage penalty to human capital loss and a positive selection term. They offer no evidence for skill-biased technological change in the observed period, instead, the returns to schooling have decreased for all groups except East German women. However, it should be kept in mind that changes in conditional wage rates reflect changes in both labor demand, e.g., because of skill-biased technological change, and labor supply.

4.4 Tax- and Transfer System: Simulated Net Incomes

Counterfactual net incomes and budget constraints are calculated using the STSM, see Steiner et al. (2012) for additional information and Jessen et al. (2015) for a detailed depiction of budget constraints and marginal tax rates simulated with the STSM. The STSM covers the German tax and transfer system and accounts for deductions, allowances, social security payments and child benefits as well as interactions of the components of the tax and transfer system. When simulating counterfactual net incomes, all monetary variables in the data set are inflated or deflated respectively to the policy year. The simulated net incomes are than deflated or inflated back to the data year.

4.5 Behavioral Effects

Labor supply reactions to policy and wage changes are simulated via a random utility discrete choice model following van Soest (1995) implemented in the STSM. For the estimation of the labor supply model, the sample is restricted to household heads and partners with flexible labor supply, i.e., working age individuals excluding self-employed, civil servants, the severely disabled and people in parental leave. The number of observations can be found in the appendix in tables 5 and 6. Households are assumed to jointly maximize utility, which depends on disposable household income and the leisure of the male and female partner.

The coefficients of the utility function in turn depend on household characteristics such as the household members' age and the number of children. Weekly labor supply is discretized into sex

categories for women and six categories for men mimicking the observed distribution of labor supply. The net income for each labor supply category (five for men, six for women, and 30 for couples) is calculated using the STSM. Gross labor income is given by the product of work hours and the (actual or counterfactual) hourly wage, potential hourly wages of the unemployed as well as hourly wages of employed with item non-response are predicted using the selectivity corrected wage regressions described above. Let L_f denote leisure of the female partner, L_m leisure of the male partner, C consumption and ε a random disturbance. Then the utility of household i of choice alternative j is given by

$$V_{ij} = U(Lf_{ij}, Lm_{ij}, C_{ij}) + \varepsilon_{ij}. \tag{2}$$

I use the translog specification of the deterministic part of individual utility and allow for interactions of the components of the utility fuction, i.e.:

$$\begin{aligned} U_{ij} = \beta_1 ln(C_{ij}) + \beta_2 ln(C_{ij})^2 + \beta_3 ln(Lf_{ij}) + \beta_4 ln(Lf_{ij})^2 + \beta_5 ln(Lm_{ij}) \\ + \beta_6 ln(Lm_{ij})^2 + \beta_7 ln(C_{ij}) ln(Lf_{ij}) + \beta_8 ln(C_{ij}) ln(Lm_{ij}) + \beta_9 ln(Lf_{ij}) ln(Lm_{ij}). \end{aligned} \tag{3}$$

Heterogeneity between households' utility functions is incorporated through taste shifters – observed household characteristics that affect some of the coefficients of the utility function:

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

X_1, X_2, X_3, and X_4 contain individual and household characteristics like age, disability indicators, whether the observed person is German citizen, and number and age of children.

The error terms ε_{ij} are assumed to be independently and identically distributed across hour categories and households according to the extreme value type I distribution. As shown in (McFadden 1974), the probability that alternative k is chosen by household i is then given by :

$$P_{ik} = Pr(V_{ik} > V_{ij}, \forall j = 1 \ldots J) = \frac{exp(U_{ik})}{\sum_{j=1}^{J} exp(U_{ik})}, k \in J. \tag{4}$$

Alternative k is chosen if it implies a higher utility than any other alternative.

Changes in net income associated with specific hours points lead to changes in the choice probabilities given by equation 4. These allow for the calculation of aggregate labor supply effects of the hypothetical tax and transfer systems or gross wages.

I use the calibration method (see Duncan and Weeks 1998; Creedy and Kalb 2005; Creedy et al. 2006) to predict behavioral responses, i.e., I add random errors from the extreme value type 1 distribution to the measured utility levels of each alternative until the predicted choice coincides with the one actually observed. The alternative and individual specific error terms are thereupon added to the predicted utilities for counterfactual policy and wage regimes and the behavioral responses are calculated from this.

Estimation results and resulting elasticities are reported in the appendix in tables 5 and 6. The uncompensated labor elasticity for women in couples is particularly large and cross-wage elasticities are negligible, in line with common previous findings in the literature summarized in Blundell and Macurdy (1999).

5 Decomposition Results

I show two kinds of marginal effects of wage rate and tax and transfer changes. First, I present ceteris paribus effects of changes in labor market returns and the tax and transfer system, i.e., I keep everything at the 2002 level and change only one factor. Following Biewen and Juhasz (2012), this comes closest to the "effect" of a particular factor. Second, I keep everything at the 2011 level and change only one factor to the 2002 level. This exercise provides the answer to the question, what would have happened if wage rates or the tax and transfer system had not changed since 2002 apart from adjustment to inflation. I analyze the distribution of equivalized net income according to the OECD modified equivalence scale, i.e., net household incomes are divided by 1 plus 0.5 for each additional adult and 0.3 for each child under 14 years.

Figure 3 shows the kernel density of log equivalized net income for the population of 2002 (solid line) as well as counterfactual distributions where the tax and transfer system is as in 2011 but labor supply remains as in 2002 (short-dashed line) and where the tax and transfer system is as in 2011 and labor supply reactions to the tax and transfer changes are simulated (long-dashed line).

The static effect of policy reforms is a decrease in density at the bottom of the distribution which is in line with the findings by Biewen and Juhasz (2012) and can be explained with former recipients of Social Assistance receiving the more generous Unemployment Benefit II. Moreover,

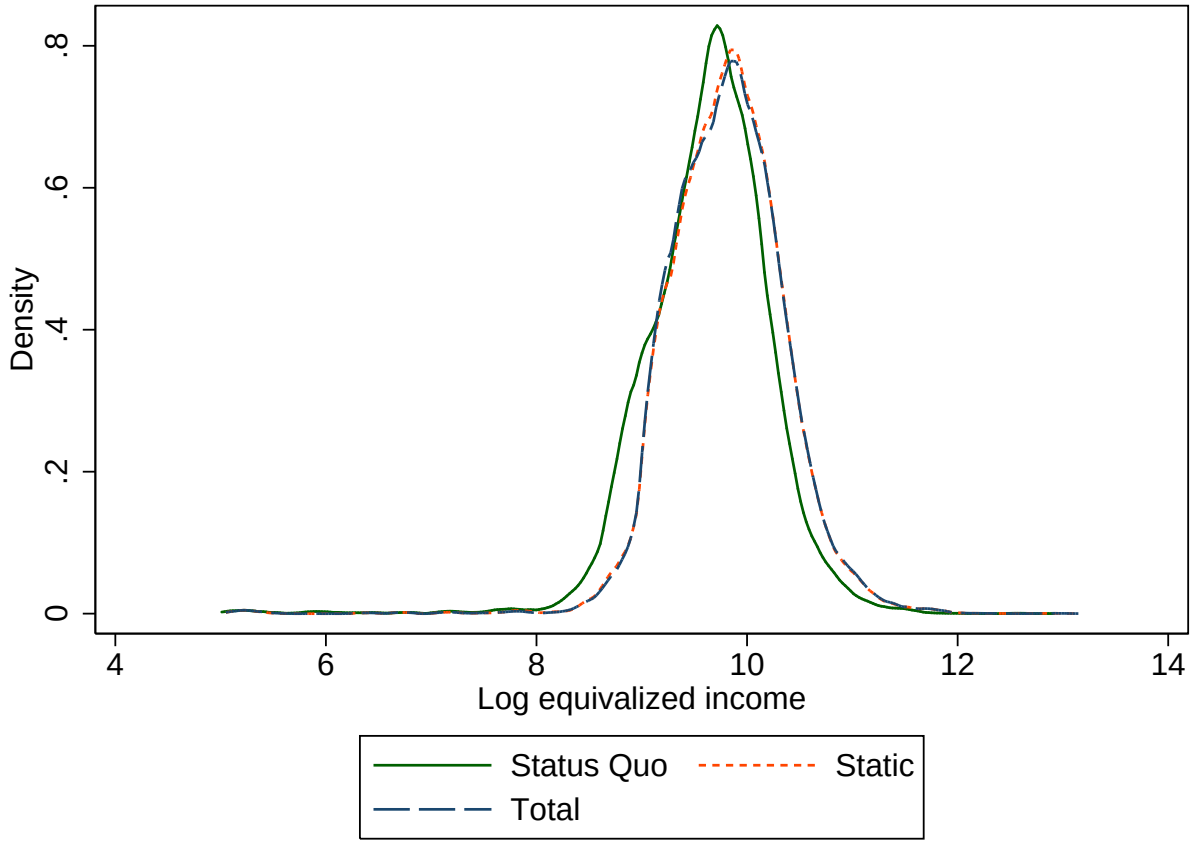

Figure 3: Tax and transfer effect – base 2002. *Source:* Own calculations based on the SOEP v29l and the STSM.

density at the right of the distribution is increased due to policy reforms – this is the effect of tax reductions for high income earners. Compared to the static counterfactual, labor supply reactions to tax and transfer reforms seem to have led to an increase in inequality: The density at the left of the distribution has increased and density in the middle of the distribution has decreased relatively to the static tax and transfer effect implying reductions in labor supply at the middle of the distribution.

Figure 4 shows static and behavioral counterfactual distributions using the year 2011 as base and applying the tax- and transfer system of 2002. It is the "inverse" of Figure 3 and confirms the results: Applying the tax and transfer system of 2002 to the population of 2011 leads to an increase in density at the bottom of the distribution due to more generous transfers in 2011. The higher 2002 top marginal tax rate leads to a decrease in density at the top of the distribution and the labor supply effects are similar to those depicted in Figure 3. Behavioral adjustments partly offset the higher inequality if no policy reforms had taken place between 2002 and 2011.

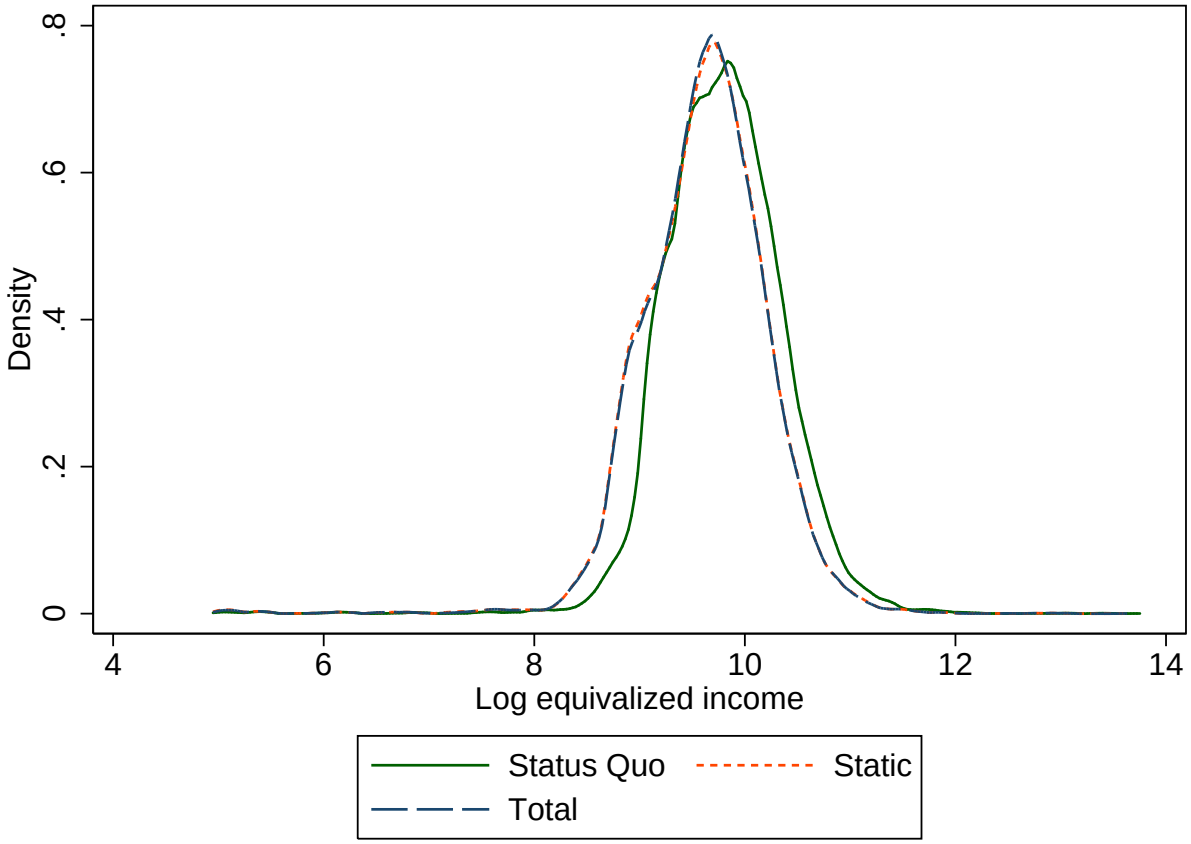

Figure 4: Tax and transfer effect – base 2011. *Source:* Own calculations based on the SOEP v29l and the STSM.

Figure 5 shows the actual log income distribution of 2002 (solid line) along with counterfactual distributions applying 2011 wage rates with (long-dashed line) and without (short-dashed line) labor supply reactions to wage changes. Applying the coefficients of the 2011 wage regression to the 2002 population leads to a higher spread of the distribution, the labor supply effect is negligible.

Applying 2002 wage rates to the 2011 population (Figure 6) leads to an increase in density at the right and a shift of the lower middle to the higher middle, which might be attributable to the higher education premium of 2002. Labor supply effects are small, but the dynamic counterfactual distribution (long-dashed line) has a slightly higher density in the middle and lower density at left indicating that some former low income households have slightly higher labor supply than in the static counterfactual distribution (short-dashed line).

Table 3 shows the Gini along with two entropy measures, the Theil index (GE(1)) and the Mean Log Deviation (MLD, GE(0)), of the distributions depicted in Figure 3 and Figure 5. The Gini index, which is sensitive to changes in the middle of the distribution, was 28.5 in 2002 and

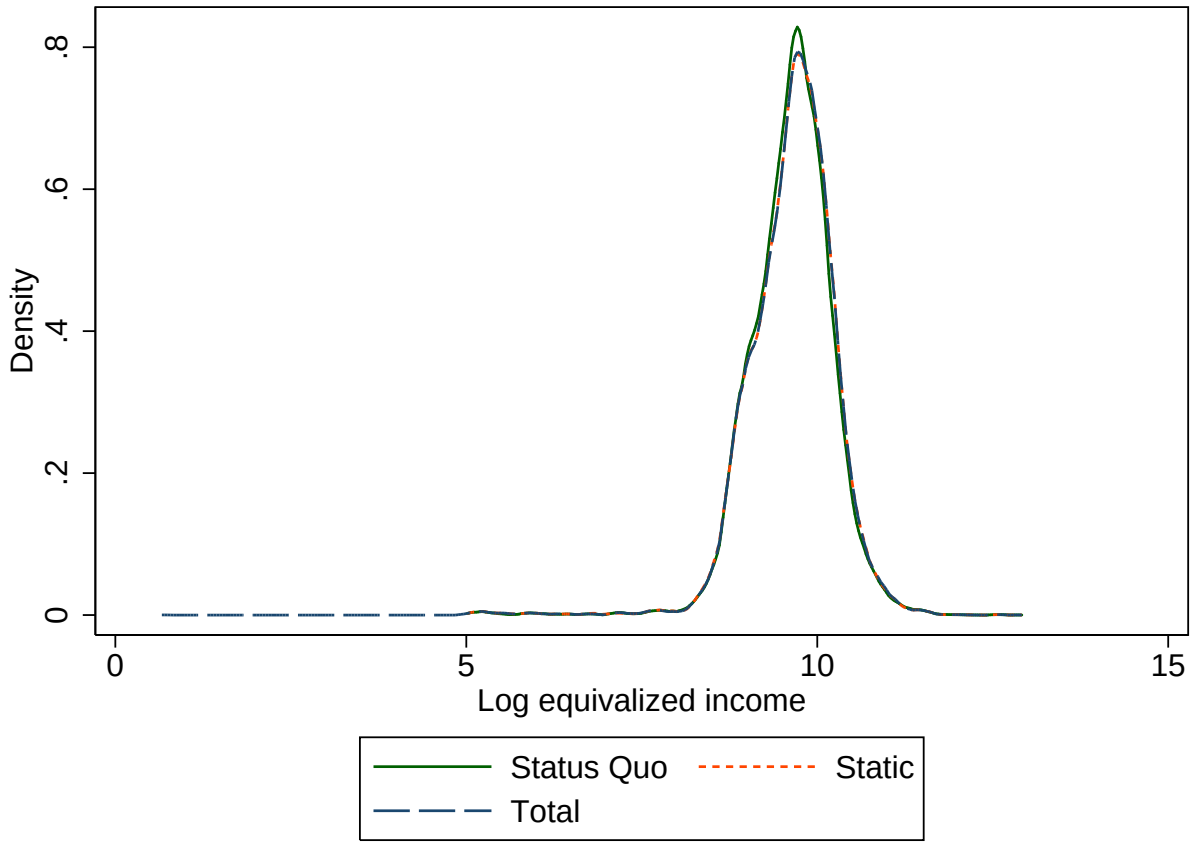

Figure 5: Wage effect – base 2002. *Source:* Own calculations based on the SOEP v29l and the STSM.

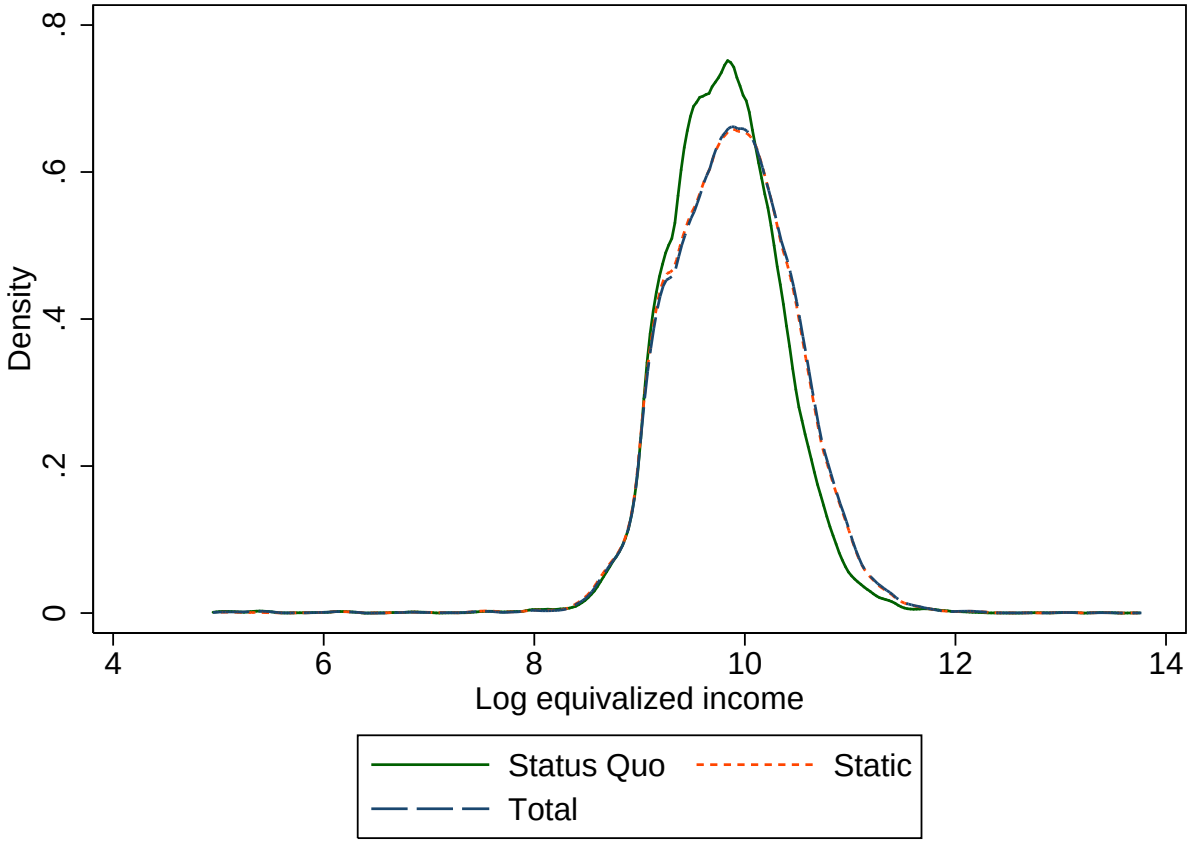

Figure 6: Wage effect – base 2011. *Source:* Own calculations based on the SOEP v29l and the STSM.

a change to the tax and transfer system of 2011 would have led to a reduction of inequality 0.4. The effect on the MLD, which is more sensitive to changes at the lower end of the distribution, is negative as well (-0.009). The Theil index, which puts the same weight on inequality at all parts of the distribution, remains unchanged. The increased generosity of the transfer system has reduced inequality as measured by the MLD and the Gini, but when an equal weight is put on all parts of the distribution (Theil index), this is offset by the inequality increasing effect of tax reductions for high income earners. Labor supply reactions lead to an increase in all three reported inequality measures compared to the static effect of tax and transfer changes. The total effect of policy changes is small and negative for the MLD and Gini and small and positive for the Theil index.

A change in wage rates to 2011 levels with and without behavioral adjustments would have led to slight increases in the Gini and the MLD and no change in the Theil index. The last two line show how changes in wage rates and policy changes interact. The static effect of these two changes on inequality is negative as measured by all three inequality measures, while the total effect including labor supply reactions is positive for the Gini and Theil and negative for the MLD.

Table 3: Decomposition with base 2002.

Net Incomes	Interpretation	Gini	Theil	Mean Log Deviation
$y_{2002}(x^{2002,2002}_{2002,2002})$	Status quo	28.5	0.144	0.143
$y_{2011}(x^{2002,2002}_{2002,2002})$	Static tax and transfer effect	28.1	0.144	0.134
$y_{2011}(x^{2011,2002}_{2002,2002})$	Overall tax and transfer effect	28.4	0.146	0.136
$y_{2002}(x^{2002,2002}_{2002,2011})$	Static wage effect	28.6	0.144	0.146
$y_{2002}(x^{2002,2011}_{2002,2011})$	Overall wage effect	28.6	0.144	0.147
$y_{2011}(x^{2002,2002}_{2002,2011})$	Static wage and tax-transfer effect	28.3	0.143	0.136
$y_{2002}(x^{2011,2011}_{2002,2011})$	Overall wage and tax-transfer effect	28.6	0.146	0.138

$y_a(x^{ce}_{bd})$: household net incomes according to the tax and transfer regulations of period a of gross incomes of the population of period b with wages according to labor market prices of period d with labor supply outcomes given the incentives of the tax and transfer regulations of period c and wages of period e.

A comparison of the first line of Table 4, which displays counterfactual inequality measures with the year 2011 as base, with the last line of Table 3, shows that policy and wage rate changes explain only a small part of the overall change in inequality. For instance, only 0.1 of the increase in the Gini by 0.9 is explained by these two factors.

Table 4: Decomposition with base 2011.

Net Incomes	Interpretation	Gini	Theil	Mean Log Deviation
$y_{2011}(x^{2011,2011}_{2011,2011})$	Status quo	29.4	0.167	0.147
$y_{2002}(x^{2011,2011}_{2011,2011})$	Static tax and transfer effect	29.8	0.166	0.155
$y_{2002}(x^{2002,2011}_{2011,2011})$	Overall tax and transfer effect	29.6	0.164	0.153
$y_{2011}(x^{2011,2011}_{2011,2002})$	Static wage effect	31.6	0.184	0.168
$y_{2011}(x^{2002,2011}_{2011,2002})$	Overall wage effect	31.6	0.184	0.169
$y_{2002}(x^{2011,2011}_{2011,2002})$	Static wage and tax-transfer effect	31.5	0.180	0.173
$y_{2002}(x^{2002,2002}_{2011,2002})$	Overall wage and tax-transfer effect	31.2	0.177	0.170

$y_a(x^{ce}_{bd})$: household net incomes according to the tax and transfer regulations of period a of gross incomes of the population of period b with wages according to labor market prices of period d with labor supply outcomes given the incentives of the tax and transfer regulations of period c and wages of period e.

While the base year changes the magnitude of the results, the results for the tax and transfer system are qualitatively similar:[3] Changes in the tax and transfer system have led to an increase in inequality as measured by the Gini index and the MLD, the effect on the Theil is very small. However, when using 2011 as base year, changes in wage rates from 2002 to 2011 have had a relatively strong decreasing impact on income inequality in Germany. The last two lines of Table 4 show the interaction of policy and wage effects. This combined effect is dominated by the strong wage effect.

Overall, both decompositions, with base 2002 and 2011, show that policy changes from 2002 to 2011 have reduced inequality (Gini index and MLD) and this reduction was partly offset by labor supply reactions. In contrast, the effect of wage rate changes depends on the order of the decomposition. Using 2011 as base year, changes in wage rates from 2002 to 2011 have had an inequality decreasing effect.

6 Conclusion

This paper suggests a decomposition of changes in inequality into contributions from changes in the tax and transfer system and changes in labor market prices, while considering both static and

[3]It is common that the order of the decomposition has a strong influence on the estimated effect of a particular factor on the change in inequality. For instance, Bargain and Callan (2010) decompose the change in inequality in Ireland from 1994 to 2000. When using 1994 as base year, the effect of policy changes on the Gini coefficient is 1.4. When using 2000 as base year, the effect is only 0.7.

behavioral effects. In the application of the decomposition method to changes in income inequality in Germany from 2002 to 2011 I find that

1) Changes in the tax and transfer system have had a small inequality reducing effect on inequality as measured by the Gini and MLD and a negligible effect as measured by the Theil index.

2) This inequality decreasing effect was partly offset by labor supply reactions to the policy reforms.

3) Contrary to the often stipulated skill-biased technological change, the education premium has decreased from 2002 to 2011 for all groups except for East German women.

4) Changes in labor market prices have led to a decrease in income inequality when using the year 2011 as base for the decomposition.

This study confirms findings in Arntz et al. (2007) and Biewen and Juhasz (2012) regarding the distributional effects of the most important reforms of the German tax and transfer system in recent years, which, contrary to common believe, seem to have had an inequality reducing effect. As the policy reforms undertaken in the analyzed time span, an increase in the generosity of the transfer system and a tax reduction, have had a negative impact on the government budget, future research should look at the distributional effects of the funding of these policy measures.

In addition, the decomposition exercise shows that most of the change in inequality cannot be explained with policy and wage rate changes. Other factors that warrant further research include changes in household structure and the distribution of non-labor income (Biewen and Juhasz 2012; Peichl et al. 2012) as well as changes in employment patterns unrelated to changes in wage rates and the tax- and transfer system.

7 Appendix (next page)

Table 5: Estimation Results for Labor Supply Model 2002.

Variables	Flexible Couples	Women with Inflexible Spouse	Men with Inflexible Spouse	Single Men	Single Women
Log Net Income	-6.174**	-4.813	6.383	-0.570	-2.716
	(2.073)	(4.133)	(6.234)	(2.551)	(2.372)
Log Net Income^2	0.628***	0.602***	-0.0275	0.322***	0.283***
	(0.0583)	(0.178)	(0.249)	(0.0801)	(0.0663)
Log Net Income × East	-3.166	-1.550	-5.020	2.018	-1.838
	(1.926)	(7.450)	(7.168)	(1.414)	(2.552)
Log Net Income^2 × East	0.182	0.00286	0.291	-0.118	0.143
	(0.109)	(0.390)	(0.370)	(0.0952)	(0.159)
Log Net Income × German Female	0.658*	1.736	-0.316		0.545
	(0.278)	(0.939)	(0.342)		(0.405)
Log Leisure Female	127.4***	118.5***			123.9***
	(6.918)	(9.574)			(10.49)
Log Net Income	-0.449*	-1.028***			-0.391
× Log Leisure Female	(0.192)	(0.250)			(0.384)
Log Leisure Female ^{2}	-14.61***	-12.36***			-14.43***
	(0.753)	(1.111)			(1.096)
Log Leisure Female × German Female	-0.318	0.0331			1.127
	(0.346)	(0.642)			(0.622)
Age Female *x* Log Leisure Female	-0.369***	-0.525***			-0.399***
	(0.0623)	(0.0813)			(0.0770)
Age ^{2} × Log Leisure Female	0.00586***	0.00821***			0.00624***
	(0.000749)	(0.000937)			(0.000892)
Log Leisure Female × Disability I	-0.132	-0.273			0.263
	(0.324)	(0.470)			(0.542)
Log Leisure Female × Disability II	1.014	1.082			1.187
	(0.575)	(0.781)			(0.885)
Log Leisure Female × East	-7.595***	-2.526***			0.824
	(1.699)	(0.491)			(0.563)
Log Leisure Female	4.903***	3.907***			5.976***
× Children Under 3 Years	(0.268)	(0.439)			(0.738)
Log Leisure Female	2.407***	2.008***			1.374***
× Children 7 to 16 Years	(0.159)	(0.275)			(0.315)
Log Leisure Female	2.139***	2.236***			2.837***
× Children 4 to 6 Years	(0.226)	(0.409)			(0.493)
Log Leisure Female	0.447**	0.466			0.245
× Children over 17 Years	(0.161)	(0.259)			(0.349)
Female Part Time I	-2.116***	-2.499***			-3.053***
	(0.0793)	(0.130)			(0.183)
Female Part Time II	-2.124***	-2.133***			-2.572***
	(0.0971)	(0.149)			(0.146)

Table continued on next page.

Variables	Flexible Couples	Women with Inflexible Spouse	Men with Inflexible Spouse	Single Men	Single Women
Log Net Income × German Male	-1.687***	-1.142*	-0.366	-0.179	
	(0.496)	(0.487)	(0.899)	(0.420)	
Log Leisure Male × Log Net Income	-0.238		-0.981*	-0.876*	
	(0.173)		(0.412)	(0.367)	
Log Leisure Male	50.38***		59.01***	60.73***	
	(3.400)		(6.346)	(7.121)	
Log Leisure Male^2	-5.468***		-5.433***	-6.558***	
	(0.184)		(0.390)	(0.545)	
Log Leisure × German Male	-1.042*		-0.768	-1.207	
	(0.406)		(0.774)	(0.766)	
Log Leisure Male × Age Male	-0.236***		-0.311***	0.0256	
	(0.0466)		(0.0779)	(0.0791)	
Log Leisure Male × Age Male^2	0.00330***		0.00399***	0.000467	
	(0.000524)		(0.000866)	(0.000917)	
Log Leisure Male × Disability I	0.766***		0.894	0.268	
	(0.231)		(0.481)	(0.527)	
Log Leisure Male × Disability II	1.451***		3.341**	1.629*	
	(0.398)		(1.020)	(0.677)	
Log Leisure Male × East	-5.475**		1.194*	0.580	
	(1.800)		(0.544)	(0.561)	
Male Part Time	-3.162***		-2.716***	-2.817***	
	(0.112)		(0.199)	(0.193)	
Log Leisure Male × Log Leisure Female × German Male	-0.147				
	(0.105)				
Log Leisure Male × Log Leisure Female	0.327				
	(0.294)				
Log Leisure Male × Log Leisure Female quad × East	1.528***				
	(0.450)				
Observations	117395	10031	4130	3960	6854
PseudoR^2	0.29	0.27	0.35	0.41	0.28
Log − Likelihood	-9498	-2189	-871	-754	-1474
Uncompensated own-wage elasticities					
Male	0.20		0.14	0.36	
Female	0.33	0.45			0.23
Uncompensated cross-wage elasticities					
Male	-0.03		0.01		
Female	-0.06	0.02			

Source: Source: Own calculations based on the SOEP v29l (2012) and a modified version of the STSM.

Table 6: Estimation Results for Labor Supply Model 2011.

Variables	Flexible Couples	Women with Inflexible Spouse	Men with Inflexible Spouse	Single Men	Single Women
Log Net Income	5.437*	-20.63**	-6.313	-1.326	0.697
	(2.191)	(6.515)	(6.028)	(2.724)	(2.729)
Log Net Income^2	0.238***	1.101***	0.366	0.287***	0.258***
	(0.0544)	(0.269)	(0.221)	(0.0779)	(0.0704)
Log Net Income × East	-2.010	-10.53	-0.899	-1.033	-2.260
	(1.620)	(10.23)	(9.883)	(1.731)	(2.025)
Log Net Income)^2 × East	0.132	0.540	0.0591	0.0867	0.145
	(0.0937)	(0.515)	(0.506)	(0.114)	(0.125)
Log Net Income × German Female	0.350	0.662	-0.234		-1.440
	(0.472)	(1.140)	(0.375)		(1.111)
Log Leisure Female	118.8***	107.3***			121.1***
	(7.377)	(9.449)			(9.709)
Log Net Income	-1.013***	-0.0934			-0.616
× Log Leisure Female	(0.217)	(0.315)			(0.357)
Log Leisure Female ^{2}	-12.70***	-11.96***			-13.47***
	(0.776)	(1.051)			(0.992)
Log Leisure Female × German Female	-0.545	-1.041			-2.504*
	(0.407)	(0.691)			(1.021)
Age Female *x* Log Leisure Female	-0.210**	-0.593***			-0.324***
	(0.0717)	(0.0839)			(0.0719)
Age ^{2} × Log Leisure Female	0.00386***	0.00840***			0.00499***
	(0.000831)	(0.000934)			(0.000812)
Log Leisure Female × Disability I	0.153	0.968*			0.910*
	(0.347)	(0.444)			(0.409)
Log Leisure Female × Disability II	0.689	1.665*			1.363*
	(0.668)	(0.811)			(0.615)
Log Leisure Female × East	-12.45***	-1.519**			0.0807
	(2.204)	(0.464)			(0.459)
Log Leisure Female	4.765***	4.267***			5.033***
× Children Under 3 Years	(0.301)	(0.423)			(0.733)
Log Leisure Female	2.014***	1.948***			1.949***
× Children 7 to 16 Years	(0.189)	(0.283)			(0.279)
Log Leisure Female	2.210***	2.328***			2.288***
× Children 4 to 6 Years	(0.272)	(0.437)			(0.498)
Log Leisure Female	0.985***	0.702**			0.189
× Children over 17 Years	(0.191)	(0.269)			(0.299)
Female Part Time I	-1.612***	-2.070***			-2.888***
	(0.0857)	(0.123)			(0.160)
Female Part Time II	-1.605***	-1.778***			-2.279***
	(0.102)	(0.140)			(0.131)

Table continued on next page.

Variables	Flexible Couples	Women with Inflexible Spouse	Men with Inflexible Spouse	Single Men	Single Women
Log Net Income × German Male	0.566	-0.570	1.630	0.504	
	(0.686)	(0.388)	(1.932)	(0.587)	
Log Leisure Male × Log Net Income	-1.184***		-0.401	-0.735	
	(0.223)		(0.428)	(0.397)	
Log Leisure Male	81.07***		52.58***	50.15***	
	(4.327)		(6.578)	(7.163)	
Log Leisure Male^2	-7.461***		-5.675***	-5.727***	
	(0.240)		(0.393)	(0.494)	
Log Leisure × German Male	-0.117		0.403	1.612	
	(0.509)		(1.122)	(0.921)	
Log Leisure Male × Age Male	-0.334***		-0.292**	0.0394	
	(0.0616)		(0.0909)	(0.0745)	
Log Leisure Male × Age Male^2	0.00429***		0.00373***	-0.0000187	
	(0.000678)		(0.00101)	(0.000877)	
Log Leisure Male × Disability I	0.734**		1.403***	1.348**	
	(0.260)		(0.410)	(0.413)	
Log Leisure Male × Disability II	1.401**		1.976*	1.459*	
	(0.498)		(0.867)	(0.584)	
Log Leisure Male × East	-10.76***		0.352	1.067*	
	(2.345)		(0.580)	(0.492)	
Male Part Time	-3.000***		-2.546***	-2.787***	
	(0.123)		(0.215)	(0.185)	
Log Leisure Male × Log Leisure Female × German Male	-0.0537				
	(0.126)				
Log Leisure Male × Log Leisure Female	-0.962**				
	(0.364)				
Log Leisure Male × Log Leisure Female quad × East	2.821***				
	(0.576)				
Observations	87236	9690	3749	4212	8090
$Log-Likelihood$	-7180	-2349	-782	-847	-1910
$PseudoR^2$	0.27	0.19	0.35	0.38	0.21
Uncompensated own-wage elasticities					
Male	0.10		0.05	0.24	
Female	0.29	0.04			0.11
Uncompensated cross-wage elasticities					
Male	0.01		0.01		
Female	0.03	-0.01			

Source: Source: Own calculations based on the SOEP v29l (2012) and a modified version of the STSM.

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